

REFERENCES  
LUNAR SAMPLE COMPENDIUM  
(July 2012)

*Note: The abstract volumes of the annual Lunar Science and Lunar and Planetary Science Conferences were issued by the Lunar and Planetary Science Institute, Houston.. Initially, the Proceedings of these annual conferences were supplements to Geochim. Cosmochim. Acta (volumes 1-12), later J. Geophys. Res.(volumes 13-17). Proceedings 18-22 were produced and published by the Lunar Planetary Science Institute. There is an index to the first nine Lunar Science Conferences (Masterson 1979). Proceedings papers were peer-reviewed, while abstracts were not.*

Abell P.I., Cadogen P.H., Eglinton G., Maxwell J.R. and Pillinger C.T. (1971) Survey of lunar carbon compounds. *Proc. Second Lunar Sci. Conf.* 1843-1863.

Abu-Eid R.M., Vaughan D.J., Whitner M., Burns R.G. and Morawski A. (1973) Spectral data bearing on the oxidation states of Fe, Ti, and Cr in Apollo 15 and Apollo 16 samples (abs). *Lunar Sci.* **IV**, 1-3. Lunar Planetary Institute, Houston.

Adams J.B. and McCord T.B. (1970) Remote sensing of lunar surface mineralogy: Implications from visible and near-infrared reflectivity of Apollo 11 samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1937-1946.

Adams J.B. and McCord T.B. (1971) Optical properties of mineral separates, glass and anorthosite fragments from Apollo mare samples. *Proc. Second Lunar Sci. Conf.* 2183-2195.

Adams J.B. and McCord T.B. (1972) Optical evidence for average pyroxene composition of Apollo 15 samples. *In The Apollo 15 Lunar Samples*, 10-13. Lunar Planetary Institute, Houston.

Adams J.B. and McCord T.B. (1973) Vitrification darkening in the lunar highlands and identification of Descartes material at the Apollo 16 site. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 163-177.

Adams J.B., Pieters C. and McCord T.B. (1974) Orange glass: Evidence for regional deposits of pyroclastic origin on the moon. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 171-186.

Adams J.B. and Charette M.P. (1975) Spectral reflectance of highland rock types at Apollo 17: Evidence from Boulder 1, Station 2. *The Moon* **14**, 483-489.

Adler I., Walter L.S., Lowman P.D., Glass B.P., French B.M. and Philpotts J.A. (1970) Electron microprobe analysis of Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 135-158.

Aeschlimann U., Eberhardt P., Geiss J., Grogler N., Kurtz J. and Marti K. (1982) On the age of cumulate norite 78236 (abs). *Lunar Planet. Sci.* **XIII**, 1-2. Lunar Planetary Institute, Houston.

AFGIT (1973) Geologic exploration of Taurus-Littrow: Apollo 17 landing site. *Science* **182**, 672-680.

Agee C.B. and Cirone S. (1995) Crystal-liquid density inversions in high-TiO<sub>2</sub> lunar basalts (abs). *Lunar Planet. Sci.* **XXVI**, 5-6. Lunar Planetary Institute, Houston.

Agee C.B. and Duncan M.S. (2009) The effect of CO<sub>2</sub> on density of molten Apollo 14 black glass at high pressure (abs#1266). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.

Agrawal J.K., Gopalan K. and Rao M.N. (1974) Solar wind and cosmogenic rare gases in Luna 16 and Luna 20 soils and their correlations with cosmic ray produced fossil tracks in lunar samples. *Pramana* **3**, 176-185.

Agrell S.O., Scoon J.H., Muir I.D., Long J.V.P., McConnell J.D.C. and Peckett A. (1970) Observations on the chemistry, mineralogy and petrology of some Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 93-128.

- Agrell S.O., Agrell J.E., Arnold A.R. and Long J.V.P. (1973) Some observations on rock 62295 (abs). *Lunar Sci.* **IV**, 15-17. Lunar Planetary Institute, Houston.
- Agrell S.O., Agrell J.E., Arnold A.R. and Bristol C.C. (1973) Observations on glass from 15425, 15426, 15427 (abs). *Lunar Sci.* **IV**, 12-14. Lunar Planetary Institute, Houston.
- Ahrens T.J. (1993) Impact erosion of terrestrial planetary atmospheres. *Ann. Rev. Earth Planet. Sci.* **21**, 525-555. (a review)
- Ahrens T.J., O'Keefe J.D. and Gibbons R.V. (1973) Shock compression of a recrystallized anorthositic rock from Apollo 15. *Proc. 4<sup>th</sup> Lunar. Sci. Conf.* 2575-2590.
- Ahrens T.J. and Cole D.M. (1974) Shock compression and adiabatic release of lunar fines from Apollo 17. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2333-2346.
- Ahrens T.J. and Watt J.P. (1980a) Dynamic properties of mare basalts: Relations of equations of state to petrology. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 2059-2074.
- Ahrens T.J. and Watt J.P. (1980b) Dynamic properties of mare basalts: Relation of equations of state to petrology (abs). *Lunar Planet. Sci.* **XI**, 6-8. Lunar Planetary Institute, Houston.
- Ahrens T.J., Jackson I. and Jeanloz R. (1977a) Shock compression and adiabatic release of a titaniferous lunar basalt. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3437-3455.
- Ahrens T.J., Jackson I. and Jeanloz R. (1977b) Dynamic properties of ilmenite-rich mare basalt and the relative ages of lunar cratered surfaces (abs). *Lunar Sci.* **VIII**, 1-3. Lunar Planetary Institute, Houston.
- Akella J., Williams R.J. and Mullins O. (1976) Solubility of Cr, Ti and Al in coexisting olivine, spinel and liquid at 1 atmosphere. *Proc. 7<sup>th</sup> Lunar Planet. Sci. Conf.* 1179-1194.
- Akridge D.G. and 13 others (2004) Photomosaics of the cathodoluminescence of 60 sections of meteorites and lunar samples. *J. Geophys. Res.* **109**, E07S03 doi: 10.129/2003JE002198
- Albarede F. (1978) The recovery of spatial isotopic distributions from stepwise degassing data. *Earth Planet. Sci. Lett.* **39**, 387-397.
- Albee A.L. and Chodos A.A. (1970) Microprobe investigations on Apollo 11 samples. *Proc. Apollo 11 Lunar Science Conf.* 135-157.
- Albee, Burnett, Chodos, Eugster, Huneke, Papanastassiou, Podosek, Price, Sanz, Tera and Wasserburg G.J. (1970) Ages, irradiation history, and chemical composition of lunar rocks from the Sea. *Science* **167**, 463-466.
- Albee A.L., Burnett D.S., Chodos A.A., Haines E.L., Huneke J.C., Papanastassiou D.A., Podosek F.A., Russ G.P. and Wasserburg G.J. (1970) Mineralogic and isotopic investigations on lunar rock 12013. *Earth Planet. Sci. Lett.* **9**, 137-163.
- Albee A.L., Chodos A.A., Gancarz A.J., Haines E.L., Papanastassiou D.A., Ray L., Tera F., Wasserburg G.J. and Wen T. (1972) Mineralogy, petrology, and chemistry of a Luna 16 basaltic fragment, sample B-1. *Earth Planet. Sci. Lett.* **13**, 353-367.
- Albee A.L., Chodos A.A. and Gancarz A.J. (1972) Petrology of Apollo 15 sample 15486. *In The Apollo 15 Lunar Samples*, 20-25. Lunar Science Institute, Houston.

- Albee A.L., Gancarz A.J. and Chodos A.A. (1973) Metamorphism of Apollo 16 and 17 and Luna 20 metaclastic rocks at about 3.95 AE: Samples 61156, 64423,14-2, 65015, 67483,15-2, 76055, 22006, and 22007. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 569-595.
- Albee A.L., Chodos A.A., Dymek R.F., Gancarz A.J., Goldman D.S., Papanastassiou D.A. and Wasserburg G.J. (1974a) Dunite from the lunar highlands: petrography, deformational history, Rb-Sr age (abs). *Lunar Sci. V*, 3-5. Lunar Planetary Institute, Houston.
- Albee A.L., Chodos A.A., Dymek R.F., Gancarz A.J. and Goldman D.S. (1974b) Preliminary investigation of Boulders 2 and 3, Apollo 17, Station 2: Petrology and Rb-Sr model ages (abs). *Lunar Sci. V*, 6-8. Lunar Planetary Institute, Houston.
- Albee A.L., Dymek R.F. and DePaolo D.J. (1975) Spinel symplectites: High pressure solid-state reaction or late-stage magmatic crystallization? (abs) *Lunar Sci. VI*, 1-3. Lunar Planetary Institute, Houston.
- Alexander E.C. (1970) Rare gases from stepwise heating of lunar rock 12013. *Earth Planet. Sci. Lett.* **9**, 201-207.
- Alexander E.C. (1971) Spallogenic Ne, Kr, and Xe from a depth study of 12002. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1643-1650.
- Alexander E.C., Davis P.K. and Reynolds J.H. (1972) Rare-gas analysis on neutron irradiated Apollo 12 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1787-1795.
- Alexander E.C., Davis P.K., Reynolds J.H. and Srinivasan B. (1972) Age, exposure history and trace element composition of some Apollo 14 and 15 rocks as determined from rare gas analysis (abs). *Lunar Sci. IV*, 27-29.
- Alexander E.C., Davis P.K. and Lewis R.S. (1972) Rubidium-strontium and potassium-argon age of lunar sample 15555. *Science* **175**, 417-419.
- Alexander E.C. and Davis P.K. (1974)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  ages and trace element contents of Apollo 14 breccias: an interlaboratory cross-calibration of  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  standards. *Geochim. Cosmochim. Acta* **38**, 911-928.
- Alexander E.C. and Kahl S.B. (1974)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  studies of lunar breccias. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1353-1373.
- Alexander E.C., Bates A., Coscio M.R., Dragon J.C., Mutthy V.R., Pepin R.O. and Venkatesan T.R. (1977) K/Ar dating of lunar soils II. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 625-648.
- Alexander E.C., Coscio M.R., Dragon J.C., Pepin R.O. and Saito K. (1977) K/Ar dating of lunar soils III: Comparison of  $^{39}\text{Ar}$  -  $^{40}\text{Ar}$  and conventional techniques: 12032 and the age of Copernicus. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2725 - 2740.
- Alexander E.C., Coscio M.R., Dragon J.C. and Saito K. (1978)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  studies of glasses from lunar soils (abs). *Lunar Planet. Sci. IX*, 7-9. Lunar Planetary Institute, Houston.
- Alexander E.C., Coscio M.R., Dragon J.C., Pepin R.O. and Saito K. (1980) K/Ar dating of lunar soils IV: Orange glass from 74220 and agglutinates from 14259 and 14163. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1663-1677.
- Alibert C., Norman M.D. and McCulloch M.T. (1994) An ancient age for a ferroan anorthosite clast from lunar breccia 67016. *Geochim. Cosmochim. Acta* **58**, 2921-2926.
- Alibert C., Norman M.D. and McCulloch M.T. (1994) Erratum. *Geochim. Cosmochim. Acta* **58**, 5369-5370.

- Allegre, C.J., Shinizu N. and Treuil M. (1977) Comparative chemical history of the Earth, Moon and parent body of achondrite. *Phil. Trans. Roy. Soc. London* **A285**, 55-68.
- Allegre C.J., Birk J.-L., Loubet M. and Provost A. (1971) "Age"  $^{87}\text{Rb}$ - $^{87}\text{Sr}$  et teneur en K, Rb, Sr, Ba et Terres rares de sol de la Mer de la Fecondite (Lune) rapporte par la mission sovietique Luna 16. *Compt. Rend. Acad. Sci. Paris* **273**, 779.
- Allegre C.J., Manhès G. and Gopel C. (2008) The major differentiation of the Earth at  $\sim 4.45$  Ga. *Earth Planet. Sci. Lett.* **267**, 386-398.
- Allen F.M., Bence A.E. and Grove T.L. (1979) Olivine vitrophyres in Apollo 14 breccia 14321: Samples of the high-Mg component of the lunar highlands. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 695-712.
- Allen R.O., Jovanovic S. and Reed G.W. (1973) Geochemistry of primordial Pb, Bi and Zn in Apollo 15 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1169-1175.
- Allen R.O., Jovanovic S. and Reed G.W. (1974) A study of  $^{204}\text{Pb}$  partition in lunar samples using terrestrial and meteoritic analogs. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1617-1623.
- Allen R.O., Jovanovic S. and Reed G.W. (1975) Agglutinate; role in element and isotopic chemistry and inferences regarding volatile-rich 66095 and glass 74220. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2271-2279.
- Allen R.O., Jovanovic S. and Reed G.W. (1975) Heavy element affinities in Apollo 17 samples. *Earth Planet. Sci. Lett.* **27**, 163-169.
- Allen R.O., Jovanovic S. and Reed G.W. (1977) Volatile metals - mode of transport (abs). *Lunar Sci. VIII*, 22-24. Lunar Planet. Institute, Houston.
- Allton J.H. (1978) The Apollo 11 drive tubes. Curatorial facility. NASA Johnson Space Center, Houston.
- Allton J.H. (1989) Catalog of Apollo lunar surface geologic sampling tools and containers. JSC-23454 pp97 Curator's Office. JSC.
- Allton J.H. and Waltz S.R. (1980) Depth scales for Apollo 15, 16, 17 drill cores. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1463-1477.
- Allton J.H. and Beville T.J. (2003) Curatorial statistics on Apollo regolith fragments applicable to sample collection by raking. *Advances in Space Research* **31**, 2305-2313.
- Ali M.Z., Stroube W.B., James W.D. and Ehmann W.D. (1976) Compositional study of impact generated glasses and core sample 60009 (abs). *Lunar Sci. VII*, 10-12. Lunar Science Institute, Houston.
- Allison R.J. and McDonnell J.A.M. (1980) Luna 24 core spherules: Microparticle impact crater and accretia populations as indicators of the past surface environment. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1623-1634.
- Alvarez R. (1974a) Electrical properties of sample 70215. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2663-2671.
- Alvarez R. (1974b) Electrical properties of sample 70215 in the temperature range of 100 to 373°K (abs). *Lunar Sci. V*, 15-17. Lunar Planetary Institute, Houston.
- Alvarez R. (1975) Lunar and terrestrial sample photoconductivity. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3187-3197.
- Anand M., Taylor L.A., Neal C.R., Snyder G.A., Patchen A., Sano Y. and Terada K. (2003) Petrogenesis of lunar meteorite EET96008. *Geochim. Cosmochim. Acta* **67**, 3499-3518.

- Anand M., Taylor L.A., Patchen A., Cahill J. and Nazarov M.A. (2002) New minerals from a new lunar meteorite, Dhofar 280 (abs#1653). *Lunar Planet. Sci.* **XXXIII**, Lunar Planet. Institute, Houston.
- Anand M., Taylor L.A., Nazarov M.A., Shu J., Mao H.K. and Hemley R.J. (2004) Space weathering on airless planetary bodies: Clues from the lunar mineral hapkeite. *Proc. Nat. Acad.*
- Anand M. and Terada K. (2008) Timing and distribution of Mare basaltic magmatism: Constraints from lunar samples (abs#2155). *Lunar Planet. Sci.* **XXXIX**, Lunar Planetary Institute, Houston.
- Anders E. (1977) Chemical composition of the Moon, Earth and eucrite parent body. *Phil. Trans. Roy. Soc. London* **A285**, 23-40.
- Anders E. (1979) Procrustean science: Indigenous siderophiles in the Lunar Highlands, according to Delano and Ringwood. *Proc. 9<sup>th</sup> Lunar Planet. Sci.* 161-184.
- Anders E. (1979) Procrustean Science: Indigenous siderophiles in the Lunar highlands. *The Moon* **20**, 219-239.
- Anders E. and Grevesse N. (1989) Abundance of elements. *Geochim. Cosmochim. Acta* **53**, 197-214.
- Anders E., Ganapathy R., Keays R.R., Lau J.C., and Morgan J.W. (1971) Volatile and siderophile elements in lunar rocks: Comparison with terrestrial and meteoritic basalts. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1021-1036.
- Anders E., Ganapathy R., Krahenbuhl U. and Morgan J.W. (1973) Meteoritic material on the Moon. *The Moon* **8**, 3-24.
- Andersen C.A. and Hinthorne J.R. (1972) U, Th, Pb and REE abundances and  $^{207}\text{Pb}/^{206}\text{Pb}$  ages of individual minerals in returned lunar material by ion microprobe mass analysis. *Earth Planet. Sci. Lett.* **14**, 195-200.
- Andersen C.A. and Hinthorne J.R. (1973a)  $^{207}\text{Pb}/^{206}\text{Pb}$  ages of individual mineral phases in Luna 20 material by ion microprobe mass analysis. *Geochim. Cosmochim. Acta* **37**, 745-754.
- Andersen C.A. and Hinthorne J.R. (1973b)  $^{207}\text{Pb}/^{206}\text{Pb}$  ages and REE abundances in returned lunar materials by ion microprobe mass analysis (abs). *Lunar Sci.* **IV**, 37-42. Lunar Planetary Institute, Houston.
- Andersen D.J. and Lindsley D.H. (1979) The olivine-ilmenite thermometer. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 493-507.
- Andersen D.J. and Lindsley D.H. (1982) Application of a two-pyroxene thermometer (abs). *Lunar Planet. Sci.* **XIII**, 15-16. Lunar Planetary Institute, Houston.
- Anderson A.T. (1971) Exotic armalcolite and the origin of Apollo 11 ilmenite basalts. *Geochim. Cosmochim Acta* **35**, 969-973.
- Anderson A.T. (1973) The texture and mineralogy of lunar peridotite 15445,10. *J. Geol.* **81**, 219-226.
- Anderson A.T. and 10 others (1970) Armalcolite: A new mineral from the Apollo 11 samples. *Proc. Apollo 11 Lunar Sci. Conf.* 55-63.
- Anderson A.T. and Smith J.V. (1971) Nature, occurrence and exotic origin of "grey mottled" (Luny Rock) basalts in Apollo 12 soils and breccias. *Proc. Second Lunar Sci. Conf.* 431-438.

- Anderson A.T., Braziunas T.F., Jacoby J. and Smith J.V. (1972) Thermal and mechanical history of breccias 14306, 14063, 14270 and 14321. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 819-835.
- Anderson D.H. (1970) Introduction. The preliminary examination and preparation of lunar sample 12013. *Earth Planet. Sci. Lett.* **9**, 94-102.
- Anderson O.L., Scholz C., Soga N., Warren N. and Schreiber E. (1970) Elastic properties of a micro-breccia, igneous rock and lunar fines from the Apollo 11 mission. *Proc. Apollo 11 Lunar Sci. Conf.* 1959-1973.
- Annell C.S. and Helz A.W. (1970) Emission spectrographic determination of trace elements in lunar samples from Apollo 11. *Proc. Apollo 11 Lunar Sci. Conf.* 991-994.
- Apollo Soil Survey (1971) Apollo 14 – Nature and origin of rock types in soil from Fra Mauro Formation. *Earth Planet. Sci. Lett.* **12**, 49-54.
- Apollo Soil Survey (1974) Phase chemistry of Apollo Soil Sample 14259. *Modern Geology* **5**, 1-13.
- Appleman D.E., Nissen H.-U., Stewart D.B., Clark J.R., Dowty E. and Huebner J.S. (1971) Studies of lunar plagioclases, tridymite and cristobalite. *Proc. Second Lunar Sci. Conf.* 117-133.
- Arai T. and Warren P.H. (1997) "large" (1.7g) compositionally pristine diabase 14434: A lithology transitional between magnesium-gabbro and high-aluminum mare basalt (abs). *Meteor. & Planet. Sci.* **32**, A7-A8.
- Arai T. and Warren P.H. (1999) Lunar meteorite Queen Alexandra Range 94281: Glass compositions and other evidence for launch pairing with Yamato 793274. *Meteor. & Planet. Sci.* **34**, 209-234.
- Arai T., Takeda H., Miyamoto M. and Kojima H. (2006) Apollo 14 oldest mare basalt revisited: Possible petrogenetic connection between mg gabbro and VHK basalt (abs#2387). *Lunar Planet. Sci. XXXVII*, Lunar Planetary Institute, Houston.
- Arai T., Kaiden H., Misawa K. and Kojima H. (2006) Ion microprobe study of Apollo 14 oldest basalt (abs). *Antarctic Meteorites XXX*, 3-4.
- Arai T., Misawa K., Tomiyama T., Yoshitake M. and Irving A.J. (2008) Constraints on Lunar KREEP magmatism: A variety of KREEP basalt derivatives in lunar meteorite NWA 4485 (abs#2292). *Lunar Planet. Sci. XL*, Lunar Planetary Institute, Houston.
- Arai T., Hawke B.R., Gigue T.A., Misawa K., Miyamoto and Kojima H. (2010) Antarctic lunar meteorites Y-793169, A-881757, MIL 05035 and MET 01210: Launch pairing and possible cryptomare origin. *Geochim. Cosmochim. Acta* **74**, 2231-2248.
- Archnal B.A., Rosiek M.R., Kirk R.L. and Redding B.L. (2006) The unified lunar control network 2005. US Geol. Survey Open File report 1367-1380.
- Armstrong R.M.G., Georg R.B., Williams H.M. and Halliday A.N. (2012) Silicon isotopes in lunar rocks: Implications for the Moon's formation and the early history of the Earth. *Geochim. Cosmochim. Acta* **77**, 504-514.
- Arndt J., Engelhardt W. von, Gonzalez-Cabeza I. and Meier B. (1984) Formation of Apollo 15 green glass beads. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **89**, C225-C232.
- Arndt J. and Engelhardt W. von (1987) Formation of Apollo 17 orange and black glass beads. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.*, in *J. Geophys. Res.* **92**, E372-E376.

- Arnold J.R., Kohl C.P. and Nishiizumi K. (1993) Measurements of cosmogenic nuclides in lunar rock 64455 (abs). *Lunar Planet. Sci.* **XXIV**, 39-40. Lunar Planetary Institute, Houston.
- Arrhenius G., Everson J.E., Fitzgerald R.W. and Fujita H. (1971a) Zirconium fractionation in Apollo 11 and 12 rocks. *Proc. Second Lunar Sci. Conf.* 169-176.
- Arrhenius G., Liang S., Macdougall D., Wilkening L., Bhandari N., Bhat S., Lal D., Rajagopalan G., Tamhane A.S. and Venkatavaradan V.S. (1971b) The exposure history of the Apollo 12 regolith. *Proc. Second Lunar Sci. Conf.* 2583-2598.
- Arvidson R., Crozaz G., Drozd R.J., Hohenberg C.M. and Morgan C.J. (1975) Cosmic ray exposure ages of features and events at the Apollo landing sites. *The Moon* **13**, 259-276.
- Arvidson R., Drozd R., Guinness E., Hohenberg C., Morgan C., Morrison R. and Oberbeck V. (1976) Cosmic ray exposure ages of Apollo 17 samples and the age of Tycho. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2817-2832.
- Ashwal L.D. (1975) Petrologic evidence for a plutonic igneous origin of anorthositic norite clasts in 67955 and 77017. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 221-230.
- Axon H.J. and Goldstein J.I. (1972) Metallic particles of high cobalt content in Apollo 15 soil samples. *Earth Planet. Sci. Lett.* **18**, 173-180.
- Axon H.J. and Goldstein J.I. (1972) Temperature-time relationships from lunar two phase metallic particles (14310, 14163, 14003). *Earth Planet. Sci. Lett.* **16**, 439-447.
- Baedecker P.A., Cuttita F., Rose H.J., Schaudy R. and Wasson J.T. (1971) On the origin of lunar soil 12033. *Earth Planet. Sci. Lett.* **10**, 361-364.
- Baedecker P.A., Schaudy R., Elzie J.L., Kimberlin J., and Wasson J.T. (1971) Trace element studies of rocks and soils from Oceanus Procellarum and Mare Tranquillitatis. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1037-1061.
- Baedecker P.A., Chou C.-L. and Wasson J.T. (1972) The extralunar component in lunar soils and breccias. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1343-1359.
- Baedecker P.A., Chou C.-L., Sunberg L.L. and Wasson J.T. (1972) Extralunar materials in Apollo 16 soils and the decay rate of the extralunar flux 4.0 GY ago. *Earth Planet. Sci. Lett.* **17**, 79-83.
- Baedecker P.A., Chou C.-L., Grudewicz E.B. and Wasson J.T. (1974) Volatile and siderophile trace elements in Apollo 15 samples: Geochemical implications and characterization of the long-lived and short-lived extralunar materials. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1177-1195.
- Baedecker P.A., Chou C.-L., Sundberg L.L. and Wasson J.T. (1974) Volatile and siderophile trace elements in the soils and rocks of Taurus-Littrow. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1625-1643.
- Bailey J.C., Champness P.E., Dunham A.C., Esson J., Fyfe W.S., MacKenzie W.S., Stumpfl E.F. and Zussman J. (1970) Mineralogy and petrology of Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 169-194.
- Bailey N.G. and Ulrich G.E. (1975a) Apollo 14 voice transcript. USGS report # GD74-028.
- Bailey N.G. and Ulrich G.E. (1975b) Apollo 15 voice transcript. USGS report # GD74-029.
- Baker M.B. and Herzberg C.T. (1980a) Spinel cataclasites in 15445 and 72435: Petrology and criteria for equilibrium. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 535-553.

- Baker M.B. and Herzberg C.T. (1980b) Spinel cataclasites in 15445 and 72435: Petrography, mineral chemistry, and criteria for equilibrium (abs). *Lunar Planet. Sci.* **XI**, 52-54. Lunar Planetary Institute, Houston.
- Bakos L. and 11 others (1977) Investigation of the composition of the Luna 16 lunar sample, 277-280. In **Soviet-American Conf. on Cosmochemistry of the Moon and Planets**. NASA-SP370.
- Baldrige W.S., Miller F., Wang H. and Simmons G. (1972) Thermal expansion of Apollo lunar samples and Fairfax diabase. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2599-2609.
- Baldrige W.S., Beaty D.W., Hill S.M.R. and Albee A.L. (1979) The petrology of the Apollo 12 pigeonite basalt suite. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 141-179.
- Baldwin R.B. (1949) **The Face of the Moon**. Univ. of Chicago
- Baldwin R.B. (1963) **The Measure of the Moon**. Univ. of Chicago
- Baldwin R.B. (2006) Was there ever a lunar cataclysm? With lunar viscosity arguments. *Icarus* **184**, 308-318.
- Banerjee S.K., Hoffman K. and Mellema J.P. (1972) Difficulties in separating the stable component of natural remanent magnetization in lunar rocks. In **The Apollo 15 Lunar Samples**, 420-424.
- Banerjee S.K. and Mellema J.P. (1974) Lunar paleointensity from three Apollo 15 crystalline rocks using an ARM method. *Earth Planet. Sci. Lett.* **23**, 185-188.
- Banerjee S.K. and Mellema J.P. (1976a) Early lunar magnetism. *Nature* **260**, 230-231.
- Banerjee S.K. and Mellema J.P. (1976b) A solar origin for the large lunar magnetic field at  $4.0 \times 10^9$  yrs ago? *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 3259-3270.
- Banerjee S.K. and Mellema J.P. (1976c) A solar origin for the large lunar magnetic field at  $4.0 \times 10^9$  yrs ago? (abs) *Lunar Sci.* **VII**, 29-31. Lunar Planetary Institute, Houston.
- Banerjee S.K. and Swits G. (1975) Natural remanent magnetization studies of a layered breccia boulder from the lunar highland region. *The Moon* **14**, 473-481.
- Banerjee S.K., Hoffman K. and Swits G. (1974a) Remanent magnetization directions in a layered boulder from the South Massif. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2873-2881.
- Banerjee S.K., Hoffman K. and Swits G. (1974b) Reversed polarity remanent magnetization in a layered boulder near South Massif (abs). *Lunar Sci.* **V**, 32-34. Lunar Planetary Institute, Houston.
- Bansal B.M., Church S.E., Gast P.W., Hubbard N.J., Rhodes J.M. and Weismann H. (1972) The chemical composition of soil from the Apollo 16 and Luna 20 sites. *Earth Planet. Sci. Lett.* **17**, 29-35.
- Bansal B.M., Weismann H. and Nyquist L. (1975) Rb-Sr ages and initial  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios for Apollo 17 mare basalts. In Conference on **Origins of Mare Basalts** and Their Implications for Lunar Evolution (Lunar Science Institute, Houston), 1-5.
- Bakos L. and 11 others (1977) Investigation of the composition of the Luna 16 Lunar Sample, 277-280. In **Soviet-American Conf. on Cosmochemistry of the Moon and Planets**. NASA-SP370.
- Barber D.J., Cowisik R., Hutcheon I.D., Price P.B. and Rajan R.S. (1971) Solar flares, the lunar surface and gas-rich meteorites. *Proc. Second Lunar Sci. Conf.* 2705-2714.



- Barker C. (1974) Composition of the gases associated with the magmas that produced rocks 15016 and 15065. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1737-1746.
- Barker D.C. and Snow J.E. (2012) Phenocryst growth and compositional inhomogeneity of Apollo 17 glass spherules (abs). *43<sup>rd</sup> Lunar Sci. Conf. @ the Woodlands*
- Baron R.L. et al. (1977) The surface composition of lunar soil grains: A comparison of the results of Auger and X-ray photoelectron spectroscopy. *Earth Planet. Sci. Lett.* **37**, 263-272.
- Barnes I.L. and 7 others (1973) Isotopic abundance ratios and concentrations of selected elements in some Apollo 15 and Apollo 16 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1197-1207.
- Barnes J.J. and 7 other (2012) Lunar Apatite (abs). *43<sup>rd</sup> Lunar Sci. Conf. @ the Woodlands*
- Barr J.A. and Grove T.L. (2008) Was garnet in the source of Apollo 15 group A ultramafic green glass? (abs#1213) *Lunar Planet. Sci. XXXIX*, Lunar Planetary Institute, Houston.
- Barr J.A. and Grove T.L. (2009) Towards developing a garnet lherzolite saturation model for lunar low-Ti ultramafic green glass compositions (abs#2161). *Lunar Planet. Sci. XL*, Lunar Planetary Institute, Houston.
- Barra F., Swindle T.D., Korotev R.L., Jolliff B.L., Zeigler R.A. and Olson E. (2006)  $^{40}\text{Ar}/^{39}\text{Ar}$  dating of Apollo 12 regolith: Implications for the age of Copernicus and the source of nonmare materials. *Geochim. Cosmochim. Acta* **70**, 6016-6031.
- Barracough B.L. and Marti K. (1985) In search of the Moon's indigenous volatiles: Noble gasses and nitrogen in vesicular lunar glasses (abs). *Lunar Planet. Sci. XVI*, 31-32. Lunar Planetary Institute, Houston.
- Barsukov V.L. (1977) Preliminary data for the regolith core brought to earth by the automatic lunar station Luna 24. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3303-3318.
- Barsukov V.L., Tarasov L.S., Dmitriev L.V., Kolesov G.M., Shevarevsky I.D. and Garanin A.V. (1977) The geochemical and petrochemical features of regolith and rocks from Mare Crisium (preliminary data). *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3319-3332.
- Basaltic Vulcanism (1981) Pergamon Press (ed. )
- Basford J.R., Dragon J.C., Pepin R.O., Coscio M.R. and Murthy V.R. (1973) Krypton and Xenon in lunar fines. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1915-1955.
- Basford J.R. (1974) K-Ar analysis of Apollo 11 fines 10084. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1375-1388.
- Basilevsky A.T., Neukum G. and Nyquist L. (2010) Lunar meteorites: What they tell us about the spatial and temporal distribution of mare basalts (abs1214). *41<sup>st</sup> Lunar Planet. Sci. Conf. @ the Woodlands*
- Basu A. (1977) Steady state, exposure age and growth of agglutinates in lunar soils. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3617-3632.
- Basu A., Des Marais D.J., Hayes J.M. and Meinschein W.G. (1975) Integrated investigation of the mixed origin of lunar sample 72161. *The Moon* **14**, 129-138.
- Basu A. and Meinschein W.G. (1976) Agglutinates and carbon accumulation in Apollo 17 lunar soils. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 337-349.

- Basu A. and Bower J.F. (1976) Petrography of KREEP basalt fragments from Apollo 15 soils. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 659-678.
- Basu A., McKay D.S. and Fruland R.M. (1978) Clast laden nature and the origin of Luna 24 olivine-vitrophyres. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 535-546.
- Basu A., McKay D.S. and Fruland R.M. (1978) Origin and modal petrology of Luna 24 soils. In **Mare Crisium: The view from Luna 24**. *Geochem. Cosmochim. Acta suppl.* 9, 303-320. (ed. Merrill) Pergamon Press.
- Basu A., McKay D.S., Moore C.H. and Shaffer N.R. (1979) A note on the Apollo 15 green glass vitrophyres. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 301-310.
- Basu A., McKay D.S., Griffiths S.A. and Nace G-A. (1981) Regolith maturation on the earth and the moon with an example from Apollo 15. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 433-449.
- Basu A. and McKay D.S. (1984a) Petrologic comparisons of Cayley and Descartes on the basis of Apollo 16 soils from stations 4 and 11. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* 89, B535-B541.
- Basu A. and McKay D.S. (1984b) Petrologic profile of Apollo 16 regolith at station 4. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* C133-142. *J. Geophys. Res.* **89**
- Basu A. and McKay D.S. (1985) Chemical variability and origin of agglutinate glass. *Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf.* D87-94. *J. Geophys. Res.* **90**
- Basu A., McKay D.S. and Gerke T. (1988) Petrology and provenance of Apollo 15 drive tube 15007/8. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 283-298.
- Basu A., Holmberg B.B. and Molinaroli E. (1992) Origin of yellow glasses associated with Apollo 15 KREEP basalt fragments. *Proc. 22<sup>nd</sup> Lunar Planet. Sci. Conf.* 365-372. Lunar Planetary Institute, Houston.
- Basu A., Wentworth S.J. and McKay D.S. (1999) Petrology of disaggregated products of regolith breccia 10068 (abs). *Lunar Planet. Sci.* **XXX** Lunar Planetary Institute, Houston.
- Basu A., Bogard D.D., Garrison D.H., Lauer H.V., Lindstrom D., McKay D.S., Morris R.V., Pieters C.M. and Wentworth S.J. (2000) A status report on the consortium study of regolith breccia 10068 (abs#1941). *Lunar Planet. Sci.* **XXXI**, Lunar Planetary Institute, Houston.
- Basu A., Wentworth S.J. and McKay D.S. (2001) Submillimeter grain-size distribution of Apollo 11 soil 10084. *Meteorit. & Planet. Sci.* **36**, 177-181.
- Basu A., Molinaroli E., Blom M.E., Wentworth S.J. and McKay D.S. (1991) Petrology and provenance of Apollo 15 station 6 core 15009 and its bearing on site geology. *Proc. 21<sup>st</sup> Lunar Planet. Sci. Conf.* 221-228.
- Basu A., Holmberg B.B. and Molinaroli E. (1992) Origin of yellow glasses associated with Apollo 15 KREEP basalt fragments. *Proc. 22<sup>nd</sup> Lunar Planet. Sci. Conf.* 365-372.
- Basu Sarbadhikari A., Marhas K.K. and Goswami J.N. (2012) Lunar volatiles: OH, F and Cl in Apollo 15 basalt 15555 (abs#5252). 75<sup>th</sup> Meteoritical Society @ Cains
- Baur H., Frick U., Funk H., Schultz L. and Signer P. (1972) Thermal release of helium, neon, and argon from lunar fines and minerals. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1947-1966.

- Bayer G, Felsche J., Schulz H. and Ruegger P. (1972) X-ray study and Mossbauer spectroscopy on lunar ilmenites (Apollo 11). *Earth Planet. Sci. Lett.* **16**, 273-274.
- Beard B.L., Snyder G.A. and Taylor L.A. (1994) Deep melting and residual garnet in the sources of lunar basalts: Lu-Hf isotopic systematics (abs). *Lunar Planet. Sci.* **XXV**, 73-74. Lunar Planetary Institute, Houston.
- Beard B.L., Taylor L.A., Scherer E.E., Johnson C.M. and Snyder G.A. (1998) The source region and melting mineralogy of high-titanium and low-titanium lunar basalts deduced from Lu-Hf isotope data. *Geochim. Cosmochim. Acta* **62**, 525-544.
- Beatty D.W. and Albee A.L. (1978) Comparative petrology and possible genetic relations among the Apollo 11 basalts. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 359-463.
- Beatty D.W., Hill S.M.R., Albee A.L., Ma M.-S., and Schmitt R.A. (1979a) The petrology and chemistry of basaltic fragments from the Apollo 11 soil, part 1. *Proc. 10<sup>th</sup> Lunar Sci. Conf.* 41-75.
- Beatty D.W., Hill S.M.R., Albee A.L. and Baldrige W.S. (1979b) Apollo 12 feldspathic basalts 12031, 12038, and 12072: Petrology, comparison and interpretations. *Proc. 10<sup>th</sup> Lunar Sci. Conf.* 115-139.
- Beatty D.W. and Albee A.L. (1980) The geology and petrology of the Apollo 11 landing site. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 23-35.
- Becker H. and Fischer-Gudde M. (2011) Highly siderophile element abundances in lunar impact rocks and implications for the volatile budget of the silicate Earth (abs#1786). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Becker R.H. (1980) Light elements in lunar soils revisited: Carbon, nitrogen, hydrogen and helium. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1743-1761.
- Becker R.H. (2000) Nitrogen on the Moon. *Science* **290**, 1110-11.
- Becker R.H. and Clayton R.N. (1975) Nitrogen abundances and isotopic compositions in lunar samples. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2131-2149.
- Becker R.H., Clayton R.N. and Mayeda T.K. (1976) Characterization of lunar nitrogen abundances. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 441-458.
- Becker R.H. and Clayton R.N. (1977) Nitrogen isotopes in lunar soils as a measure of cosmic-ray exposure and regolith history. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3685-3704.
- Becker R.H. and Clayton R.N. (1978) Nitrogen isotope systematics of two Apollo 12 soils. *Proc. 9<sup>th</sup> Lunar Sci. Conf.* 2131-2149.
- Becker R.H. and Epstein S. (1981) Carbon isotopic ratios in some low-d<sup>15</sup>N lunar breccias. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 289-293.
- Becker R.H. and Pepin R.O. (1989) Long-term changes in solar wind elemental and isotopic ratios: A comparison of two lunar ilmenites of different antiquities. *Geochim. Cosmochim. Acta* **53**, 1135-1146.
- Beckinsale R.D. (1977) Hydrogen, oxygen and silicon isotopic systematics in lunar material. *Phil. Trans. Roy. Soc. London* **A285**, 417-426.
- Begemann F., Born W., Palme H., Vilcsek E. and Wanke H. (1972) Cosmic-ray produced radionuclides in Apollo 12 and Apollo 14 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1693-1702.

- Begemann F., Ludwig K.R., Lugmair G.W., Min K., Nyquist L.E., Patchett P.J., Renne P.R., Shih C.-Y., Villa I.M. and Walker R.J. (2001) Call for an improved set of decay constants for geochronological use. *Geochim. Cosmochim. Acta* **65**, 111-121.
- Behrmann C.J., Drozd R.J. and Hohenberg C.M. (1973a) Extinct lunar radioactivities: Xenon from  $^{244}\text{Pu}$  and  $^{129}\text{I}$  in Apollo 14 breccias. *Earth Planet. Sci. Lett.* **17**, 446-455.
- Behrmann C., Crozaz G., Drozd R., Hohenberg C.M., Ralston C., Walker R.M. and Yuhas D. (1972) Rare gas and particle track studies of Apollo 15 samples: Hadley Rille and special studies of Apollo 15 samples. *In The Apollo 15 Lunar Samples*, 26-28. Lunar Sci. Institute, Houston.
- Behrmann C.J., Crozaz G., Drozd R., Hohenberg C., Ralston C., Walker R. and Yuhas D. (1973b) Cosmic-ray exposure history of North Ray and South Ray material. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1957-1974.
- Bell P.M. and Mao H.K. (1972a) Zoned olivine crystals in an Apollo 15 lunar rock. *In The Apollo 15 Lunar Samples*, 26-28. Lunar Sci. Institute, Houston.
- Bell P.M. and Mao H.K. (1973) Optical and chemical analysis of iron in Luna 20 plagioclase. *Geochim. Cosmochim. Acta* **37**, 755-760.
- Bell P.M., and Mao H.K. (1973) An analytical study of iron in plagioclase from Apollo 16 soils 64501, 64502, 64802, rock 66095 and Apollo 15 rock 15475 (abs). *Lunar Sci.* **IV**, Lunar Sci. Institute, Houston.
- Bell P.M., El Goresy A. and Mao H.K. (1974) A study of iron-rich particles on the surfaces of orange glass spheres from 74220. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 187-191.
- Bell P.M. and Mao H.K. (1975) Cataclastic plutonites: Possible keys to the evolutionary history of the early Moon (abs). *Lunar Sci.* **VI**, 34-35. Lunar Planetary Institute, Houston.
- Bell P.M., Mao H.K., Roedder E. and Weiblen P.W. (1975) The problem of the origin of symplectites in olivine-bearing lunar rocks. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 231-248.
- Bell P.M., Mao H.K., Hazen R.M. and Mao A.L. (1978) The Luna 24 sample from Mare Crisium: New structural features in lunar glasses from the study of crystal-field spectra. *In Mare Crisium: The view from Luna 24*. *Geochem. Cosmochim. Acta suppl.* 9, 265-280. (ed. Merrill) Pergamon Press.
- Bence A.E., Papike J.J. and Prewitt C.T. (1970) Apollo 12 clinopyroxene chemical trends. *Earth Planet. Sci. Lett.* **8**, 393-399.
- Bence A.E., Papike J.J. and Lindsley D.H. (1971a) Crystallization histories of clinopyroxenes in two porphyritic rocks from Oceanus Procellarum. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 559-574.
- Bence A.E., Holzwarth W. and Papike J.J. (1971b) Petrology of basaltic and monomineralic soil fragments from the Sea of Fertility. *Earth Planet. Sci. Lett.* **13**, 299-311.
- Bence A.E. and Papike J.J. (1972) Pyroxenes as recorders of lunar basalt petrogenesis: Chemical trends due to crystal-liquid interaction. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 431-469.
- Bence A.E. and Autier B. (1972) Secondary ion analysis of pyroxenes from two porphyritic lunar basalts. *In The Apollo 15 Lunar Samples*, 191-194. The Lunar Science Institute, Houston.
- Bence A.E., Papike J.J., Sueno S. and Delano J.W. (1973) Pyroxene poikiloblastic rocks from the lunar highlands. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 597-611.
- Bence A.E., Delano J.W., Papike J.J. and Cameron K.L. (1974) Petrology of the highlands massifs at Taurus-Littrow: An analysis of the 2-4 mm soil fraction. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 785-827.

- Bence A.E., Taylor S.R., Muir P.M., Nance W.B., Rudowski R. and Ware N. (1975) Chemical and petrologic relations among highland rock types (abs). *Lunar Sci.* **VI**, 36-38. Lunar Planetary Institute, Houston.
- Bence A.E., Grove T.L. and Seambos T. (1977) Gabbros from Mare Crisium: An analysis of the Luna 24 soil. *Geophys. Res. Lett.* **4**, 493-496.
- Bence A.E. and Grove T.L. (1978) The Luna 24 highland component. In **Mare Crisium: The View from Luna 24**. 429-444
- Benkert J.P., Baur H., Pedroni A., Wieler R. and Signer P. (1988) Solar He, Ne and Ar in regolith minerals: All are mixtures of two components (abs). *Lunar Planet. Sci.* **XIX**, 59-60. Lunar Planetary Institute, Houston.
- Benkert J.P., Kerridge J.F., Kim J.S., Kim Y., Marti K., Signer P. and Wieler R. (1991) Evolution of isotopic signatures in lunar regolith nitrogen: Noble gases and N in ilmenite grain-size fractions from regolith breccia 79035 (abs). *Lunar Planet. Sci.* **XXII**, 85-86. Lunar Planetary Institute, Houston.
- Benkert J.P., Baur H., Signer P. and Wieler R. (1993) He, Ne, and Ar from the solar wind and solar energetic particles in lunar ilmenites and pyroxenes. *J. Geophys. Res.* **98**, 13147-13162.
- Benoit et al. (2001) The induced thermoluminescence and thermal history of plagioclase feldspars. *Amer. Mineral.* **86**, 78-789.
- Berdot J.L., Chetrit G.C., Lorin J.C., Pellas P. and Poupeau G. (1972) Track studies of Apollo 14 rocks and Apollo 14, Apollo 15 and Luna 16 soils. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2867-2881.
- Berdot J.L., Chetrit G.C., Lorin J.C., Pellas P. and Poupeau G. (1972) Irradiation studies of lunar soils: 15100, Luna 20 and compacted soil from breccia 14307. In **The Apollo15 Lunar Samples**, 333-335. Lunar Planetary Institute, Houston.
- Berking B., Jagodzinski H. and Schmid R. (1972) Crystallography of lunar feldspars and pyroxenes from 15076,55. In **The Apollo 15 Lunar Samples**, 29-33.
- Bernatowitz T., Drozd R.J., Hohenberg C.M., Lugmair G., Morgan C.J. and Podosek F.A. (1977) The regolith history of 14307. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2763-2783.
- Bernatowicz T.J., Hohenberg C.M., Hudson B., Kennedy B.M. and Podosek F. (1978a) Argon ages for lunar breccias 14064 and 15405. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 905-919.
- Bernatowicz T.J., Hohenberg C.M., Hudson B., Kennedy B.M. and Podosek F. (1978b) Excess fission xenon at Apollo 16. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 1571-1597.
- Bernatowicz T.J., Hohenberg C.M. and Podosek F.A. (1979) Xenon component organization in 14301. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1587-1616.
- Bernatowicz T.J., Hohenberg C.M., Hudson B., Kennedy B.M., Laul J.C. and Podosek F.A. (1980) Noble gas component organization in 14301. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 629-668.
- Bernatowicz T.J., Nichols R.H., Hohenberg C.M. and Maurette M. (1994) Vapor deposits in the lunar regolith: Technical comment. *Science* **265**, 1779-1780.
- Bersch M.G., Taylor G.J. and Keil K. (1988) Ferroan anorthosites and the magma ocean: Searching for trends in the Sea of Confusion (abs). *Lunar Planet. Sci.* **XIX**, 67-68. Lunar Planetary Institute, Houston.

- Bersch M.G., Taylor G.J., Keil K. and Norman M.D. (1991) Mineral compositions in pristine lunar highland rocks and the diversity of highland magmatism. *Geophys. Res. Lett.* **18**, 2085-2088.
- Bernstein M.L. (1983) 15445 and 15455: Origin and preliminary age data (abs). *Lunar Planet. Sci.* **XIV**, 33-34.
- Best J.B. and Minkin J.A. (1972) Apollo 15 glasses of impact origin. *In The Apollo 15 Lunar Samples*, 34-39. Lunar Planetary Institute, Houston.
- Bhai N.B. et al. (1978) Solar cosmic ray produced neon in 14148 and 24087. *Proc. 9<sup>th</sup> Lunar Planet. Sci.* 1629-1645.
- Bhandari N. (1977a) Solar flare exposure ages of lunar rocks and boulders based on <sup>26</sup>A1. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3607-3615.
- Bhandari N. (1977b) Solar flare induced Al-26 in short exposure age rocks (abs). *Lunar Sci.* **VIII**, 100-102. Lunar Planetary Institute, Houston.
- Bhandari N., Bhat S., Lal D., Rajagopalan G., Tamhane A.S. and Venkatavaradan V.S. (1971) High resolution time averaged (millions of years) energy spectrum and chemical composition of iron-group cosmic-ray nuclei at 1 A.U. based on fossil tracks in Apollo samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 2611-2619.
- Bhandari N., Goswami J.N., Gupta S.K., Lal D., Tamhane A.S. and Venkatavaradan V.S. (1972) Collision controlled radiation history of the lunar regolith. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2811-2829.
- Bhandari N., Goswami J. and Lal D. (1973) Surface irradiation and evolution of the lunar regolith. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2275-2290.
- Bhandari N., Bhattacharya S.K. and Padia J.T. (1975) The surface radioactivity of lunar rocks: Implications to solar activity in the past. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1913-1925.
- Bhandari N., Bhattacharya S.K. and Padia J.T. (1976a) Solar proton fluxes during the last million years. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 513-523.
- Bhandari N., Bhattacharya S.K. and Padia J.T. (1976b) Solar flare records in lunar rocks (abs). *Lunar Sci.* **VII**, 49-51. Lunar Planetary Institute, Houston.
- Bhattacharya S.K., Goswami J.N., Lal D., Patel P.P. and Rao M.N. (1975) Lunar regolith and gas-rich meteorites: Characterization based on particle tracks and grain-size distributions. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3509-3526.
- Bibring J.P., Burlingame A.L., Langevin Y., Maurette M. and Wszolek P.C. (1974) Simulation of lunar carbon chemistry: II. Solar winds contribution. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1763-1784.
- Bickel C.E. (1977) Petrology of 78155: An early, thermally metamorphosed polymict breccia. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2007-2027.
- Bickel C.E. and Warner J.L. (1977) Petrology of 78155: An early, thermally metamorphosed polymict breccia (abs). *Lunar Sci.* **VIII**, 109-111. Lunar Planetary Institute, Houston.
- Bickel C.E. and Warner J.L. (1978a) Survey of lunar plutonic and granulitic lithic fragments. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 629-652.
- Bickel C.E. and Warner J.L. (1978b) Textural-mineralogical relationships in a population of ANT samples (abs). *Lunar Planet. Sci.* **IX**, 82-84. Lunar Planetary Institute, Houston.

Bickel C.E., Warner J.L. and Phinney W.C. (1976a) Petrology of 79215: Brecciation of a lunar cumulate. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1793-1819.

Bickel C.E., Warner J.L. and Phinney W.C. (1976b) 79215: A unique, early lunar breccia (abs). *Lunar Sci. VII*, 55-57. Lunar Planetary Institute, Houston.

Biemann K. (1972) In situ synthesis during organic analysis of lunar samples. *Space Life Sci.* **3**, 469-473.

Biggar G.M., O'Hara M.J., Peckett A. and Humphries D.J. (1971) Lunar lavas and the achondrites: Petrogenesis of protohypersthene basalts in the maria lava lakes. *Proc. Second Lunar Sci. Conf.* 617-643.

Binder A.B. (1976) On the compositions and characteristics of the mare basalt magmas and their source regions. *The Moon* **16**, 115-150.

Binder A.B., Lange M.A., Brandt H.-J. and Kahler S. (1980) Mare basalt units and the compositions of their magmas. *The Moon and Planets* **23**, 445-481.

Binder A.B. (1985) Mare basalt genesis: Modeling trace elements and isotopic ratios. *Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **90**, C396-C404.

Birck J.L., Fourcade S. and Allegre C.J. (1975) <sup>87</sup>Rb/<sup>86</sup>Sr age of rocks from the Apollo 15 landing site and significance of internal isochron. *Earth Planet. Sci. Lett.* **26**, 29-35.

Birck J.L., Manhès G., Richard P., Joron J.L., Treuil M. and Allegre C.J. (1977) <sup>87</sup>Rb/<sup>87</sup>Sr age of Luna 24 micrograbbers and isotopic and trace element study of soil 24096 (abs). **Conf. on Luna 24**. 34-36. Lunar Planetary Institute, Houston.

Birck J.L. and Allegre C.J. (1994) Contrasting Re/Os magmatic fractionation in planetary basalts. *Earth Planet. Sci. Lett.* **124**, 139-148.

Birkebak R.C. and Abdulkadir A. (1972) Total emittance of lunar fines. *J. Geophys. Res.* **77**, 1340-1341.

Bischoff A., Stoffler D., Borchardt R. and Rehfeldt A. (1983) Clast population statistics of fragmental breccias, North Ray Crater, Apollo 16: Implications for the Descartes Formation (abs). *Lunar Planet. Sci. XIV*, 49-50. Lunar Planetary Institute, Houston.

Bischoff A., Borchardt R., Jessberger E.K., Ostertag R., Palme H., Reimold W.U., Stoffler D., Wacker K. and Wanke H. (1984a) The lunar crust in the Descartes Highland area, Apollo 16: I. Photogeology and composition of rocks. *Terra Cognita* **4**, 76.

Bischoff A., Borchardt R., Jessberger E.K., Ostertag R., Palme H., Reimold W.U., Stoffler D., Wacker K. and Wanke H. (1984b) The lunar crust in the Descartes Highland area, Apollo 16: II Chronology and selenological interpretations. *Terra Cognita* **4**, 76.

Bishop K.M., Jolliff B.L., Korotev R.L. and Haskin L.A. (1993) North Massif lithologies and chemical compositions viewed from 2-4 mm particles of soil sample 76503 (abs). **In Workshop on Geology of the Apollo 17 Landing Site**. LPI Tech. Rpt. 92-09. 2-3.

Black D. (1972) On the origins of trapped helium, neon, and argon isotopic variations in meteorites: I, Gas-rich meteorites, lunar soil and breccia. *Geochim. Cosmochim. Acta* **36**, 347-376.

Blair I.M., Edginton J.A. and Jahn R.A. (1971) The luminescent and thermoluminescent properties of Apollo 12 lunar samples. *Earth Planet. Sci. Lett.* **13**, 116-120.

Blanchard D.P. (1973) The analysis of Apollo 15 rake sample walnuts and lunar breccias 15465 and 15565 for major and trace elements by atomic absorption spectrometry and neutron activation analysis. PhD thesis, Univ. of Wisconsin, Madison. 97 pp

Blanchard D.P., Haskin L.A., Jacobs J.W., and Brannon J.C. and Korotev R.L. (1975a) Major and trace element chemistry of boulder 1 at station 2, Apollo 17. *The Moon* **14**, 359-371.

Blanchard D.P., Korotev R.L., Brannon J.C., Jacobs J.W., Haskin L.A. Reid A.M., Donaldson C. and Brown R.W. (1975b) A geochemical and petrographic study of 1-2 mm fines from Apollo 17. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2321-2342.

Blanchard D.P., Jacobs J.W., Brannon J.C. and Haskin L.A. (1976) Major and trace element compositions of matrix and aphanitic clasts from consortium breccia 73215. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2179-2187.

Blanchard D.P., Jacobs J.W. and Brannon J.C. (1977a) Chemistry of ANT-suite and feldspar clasts from consortium breccia 73215 and of gabbroic anorthosite 79215. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2507-2524.

Blanchard D.P., Brannon J.C., Jacobs J.W. and Haskin L.A. (1977b) Major and trace element abundances in anorthositic gabbro clasts and a clast of K-rich feldspar from consortium breccia 73215 (abs). *Lunar Sci. VIII*, 124-126. Lunar Planetary Institute, Houston.

Blanchard D.P., Haskin L.A., Brannon J.C. and Aaboe E. (1977) Chemistry of soils and particles from Luna 24. *In Papers Presented to the Conference on Luna 24*, 37-40 Lunar Science Institute, Houston.

Blanchard D.P., Brannon J.C., Aaboe E. and Budahn J.R. (1978) Major and trace element chemistry of Luna 24 samples from Mare Crisium. *In Mare Crisium: The View from Luna 24* (Merrill R.B. and Papike J.J., eds.) 613-630. Pergamon.

Blanchard D.P. and Budahn J.R. (1978) Chemistry of orange/black soils from core 74001/2. *Proc. Lunar 9<sup>th</sup> Planet. Sci. Conf.* 1969-1980.

Blanchard D.P., Budahn J.R., Kerridge J.F. and Compston W. (1978) Consortium breccia 73255: Rare-earth-element, light-element, and Rb-Sr chemistry of aphanitic lithologies (abs). *Lunar Planet. Sci. IX*, 103-105. Lunar Planetary Institute, Houston.

Blanchard D.P. and Budahn J.R. (1979a) Remnants from the ancient lunar crust: Clasts from consortium breccia 73255. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 803-816.

Blanchard D.P. and Budahn J.R. (1979b) Clasts from consortium breccia 73255: Remnants from the early lunar crust? (abs) *Lunar Planet. Sci. X*, 134-136. Lunar Planetary Institute, Houston.

Blanchard D.P. and McKay G.A. (1980) Remnants from the ancient lunar crust II: Norite 15455 (abs). *Lunar Planet. Sci. XI*, 82-84.

Blanchard D.P. and McKay G.A. (1981) Remnants from the ancient lunar crust: Norite 78236 (abs). *Lunar Planet. Sci. XII*, 83-85. Lunar Planetary Institute, Houston.

Blanford G.E., Fruland R.M., McKay D.S. and Morrison D.A. (1974a) Lunar surface phenomena: Solar flare track gradients, microcraters, and accretionary particles. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2501-2526.

Blanford G.E., McKay D. and Morrison D. (1974b) Accretionary particles and microcraters (abs). *Lunar Sci. V*, 67-69. Lunar Planetary Institute, Houston.

Blanford G.E., Fruland R.M. and Morrison D.A. (1975) Long term differential energy spectrum for solar-flare iron-group particles. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3557-3576.



- Blanford G.E. and Wood G.C. (1978) Particle track densities in the Luna 24 core. *In Mare Crisium: The view from Luna 24*. *Geochem. Cosmochim. Acta* suppl. 9, 157-164. (ed. Merrill) Pergamon Press.
- Blank H., Nobiling R., Traxel K. and El Goresy A. (1981) Partitioning of trace elements among coexisting opaque oxides in Apollo 17 basalts using a proton probe microanalyzer (abs). *Lunar Planet. Sci.* **XII**, 89-91. Lunar Planetary Institute, Houston.
- Blank H., ElGoresy A., Janicke J., Nobiling R. and Traxel K. (1984) Partitioning of Zr and Nb between coexisting opaque phases in lunar rocks - determined by quantitative proton microprobe analysis. *Earth Planet. Sci. Lett.* **68**, 19-33.
- Bloch M.R., Fechtig H., Genter W., Neukum G. and Schneider E. (1971) Meteorite impact craters, crater simulations, and the meteoroid flux in the early solar system. *Proc. Second Lunar Sci. Conf.* 2639-2652.
- Bobardieri D., Norman M., Kamenetsky V. and Danyushevsky L. (2005) Major element and primary sulfur concentrations in Apollo 12 mare basalts: The view from melt inclusions. *Meteor. & Planet. Sci.* **40**, 679-693.
- Bochsler P., Eberhardt P., Geiss J., Loosli H., Oeschger H. and Wahlen M. (1971) Tritium in lunar material. *Proc. Second Lunar Sci. Conf.* 1803-1812.
- Boeckl R.S. (1972) A depth profile of  $^{14}\text{C}$  in the lunar rock 12002. *Earth Planet. Sci. Lett.* **16**, 269-272.
- Bogard D.D. (1983) A meteorite from the Moon. *Geophys. Res. Lett.* **10**, 773. (an editorial)
- Bogard D.D. (2008) Chronology of impact bombardment in the early solar system: An overview (abs). *In Workshop on Early Solar System Bombardment*. Lunar Planetary Institute, Houston.
- Bogard D.D. and Nyquist L.E. (1972) Noble gas studies on regolith materials from Apollo 14 and 15. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1797-1819.
- Bogard D.D. and Nyquist L.E. (1973)  $^{40}\text{Ar}/^{36}\text{Ar}$  variations in Apollo 15 and 16 regolith. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1975-1986.
- Bogard D.D., Funkhouser J.G., Schaeffer O.A. and Zahringer J. (1971) Noble gas abundances in lunar material-cosmic ray spallation products and radiation ages from the Sea of Tranquillity and the Ocean of Storms. *J. Geophys. Res.* **76**, 2757-2779.
- Bogard D.D., Nyquist L.E., Hirsch W.C. and Moore D.R. (1973b) Trapped solar and cosmogenic noble gas abundances in Apollo 15 and 16 deep drill samples. *Earth Planet. Sci. Lett.* **21**, 52-69.
- Bogard D.D., Nyquist L.E. and Hirsch W.C. (1974a) Noble gases in Apollo 17 boulders and soils (abs). *Lunar Sci.* **V**, 73-75. (unpublished data is available in Phinney 1981)
- Bogard D.D., Hirsch W.C. and Nyquist L.E. (1974b) Noble gases in Apollo 17 fines: Mass fractionation effects in trapped Xe and Kr. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1975-2003.
- Bogard D.D. and Nyquist L.E. (1974) 76535: An old lunar rock? (abs) *Lunar Sci.* **V**, 70-72. Lunar Planetary Institute, Houston.
- Bogard D.D. and Gibson E.K. (1975) Volatile gases in breccia 68115 (abs). *Lunar Sci.* **VI**, 63-65. Lunar Planetary Institute, Houston.
- Bogard D.D., Nyquist L.E., Bansal B.M., Wiesmann H. and Shih C.-Y. (1975) 76535: An old lunar rock. *Earth Planet. Sci. Lett.* **26**, 69-80.

- Bogard D.D. and Hirsch W.C. (1978) Depositional and irradiational history and noble gas contents of orange-black droplets in the 74002/1 core from Shorty Crater. *Proc. 9<sup>th</sup> Lunar Sci. Conf.* 1981-2000.
- Bogard D.D. and Hirsch W.C. (1978) Noble gases in Luna 24 core soils. In **Mare Crisium: The view from Luna 24**. *Geochem. Cosmochim. Acta suppl.* 9, 105-116. (ed. Merrill) Lunar Planetary Institute, Houston.
- Bogard D.D., Morris R.V., Hirsch W.C. and Lauer H.V. (1980) Depositional and irradiational history of the Hadley Rille core 15010/11. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1511-1529.
- Bogard D.D., Morris R.V., Johnson P. and Lauer H.V. (1982) The Apennine Front core 15007/8: Irradiation and depositional history. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **87**, A221-231.
- Bogard D.D., McKay D.S. and Morris R.V. (1985) Regolith breccias from Apollo 15 and 16: Petrology, rare gases and FMR maturity (abs). *Lunar Planet. Sci.* **XVI**, 73-74. Lunar Planetary Institute, Houston.
- Bogard D.D., Garrison D.H., Shih C.-Y. and Nyquist L.E. (1994) <sup>39</sup>Ar-<sup>40</sup>Ar dating of two lunar granites: The age of Copernicus. *Geochim. Cosmochim. Acta* **58**, 3093-3100.
- Bombardier D.J., Norman M.D., Kamenetsky V.S. and Danyushevsky L.V. (2005) Major element and primary sulfur concentrations in Apollo 12 mare basalts: The view from melt inclusions. *Meteoritics & Planet. Sci.* **40**, 679-693.
- Borchardt R., Stoffler D., Bischoff A. and Rehfeldt A. (1983a) Characterization of Descartes and Cayley Formations by different impact melt lithologies. *Terra Cognita* **3**, 81.
- Borchardt R., Stoffler D., Bischoff A. and Rehfeldt A. (1983b) Are the Descartes and Cayley Formations at Apollo 16 characterized by different impact melt lithologies? (abs). *Lunar Planet. Sci.* **XIV**, 59-60. Lunar Planetary Institute, Houston.
- Borchardt R., Knoll H.-D., Bischoff A., Ostertag R. and Stoffler D. (1985) Microprobe analyses of Apollo 14 and 16 lunar minerals and rocks. Monograph. U. Munster.
- Borchardt R., Stoffler D., Spettel B., Palme H., Wanke H., Wacker K. and Jessberger E.K. (1986) Composition, structure and age of the Apollo 16 subregolith basement as deduced from the chemistry of post-Imbrium melt bombs. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **90**, E43-E54.
- Borg J., Dran J.C., Durrieu L., Jouret C. and Maurette M. (1970) High voltage electron microscope studies of fossil nuclear particle tracks in extraterrestrial matter. *Earth Planet. Sci. Lett.* **8**, 379-386.
- Borg Lars., Norman M., Nyquist L., Bogard D., Snyder G., Taylor L. and Lindstrom M. (1999) Isotopic studies of ferroan anorthosite 62236: A younger lunar crustal rock from a light rare-earth-element-depleted source. *Geochim. Cosmochim. Acta* **63**, 2679-2691.
- Borg L.E., Schearer C.K., Asmerom Y. and Papike J.J. (2004) Prolonged KREEP magmatism on the Moon indicated by the youngest dated lunar igneous rock. *Nature* **432**, 209-211.
- Borg L.E. and Wadhwa M. (2006) <sup>142</sup>Nd-<sup>143</sup>Nd isotopic evidence for protracted lunar differentiation (abs#1154). *Lunar Planet. Sci.* **XXXVII**, Lunar Planetary Institute, Houston.
- Borg L.E., Gaffney A.M., Shearer Chip, DePaolo D.J., Hutcheon I.D., Owens T.L., Ramon E. and Brennecka G. (2009) Mechanisms for incompatible-element enrichment on the Moon deduced from the lunar basaltic meteorite Northwest Africa 032. *Geochim. Cosmochim. Acta* **73**, 3963-3980.
- Borg L.E., Connelly J.N., Boyet M. and Carlson R.W. (2011) Chronological evidence that the Moon is either young or did not have a global magma ocean. *Nature* **477**, 70 – 72.

Borg L.E., Connelly J., Boyet M. and Carlson R. (2011) The age of lunar ferroan anorthosite 60025 with implications for the interpretation of lunar chronology and the magma ocean model (abs#1171). *Lunar Planet. Sci. 42<sup>nd</sup> Conf.* The Woodlands.

Bottino M.L., Fullagar P.D., Schnetzler C.C. and Philippotts J.A. (1971) Sr isotopic measurements in Apollo 12 samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1487-1491.

Bottke W.F., Levison H.F., Nesvorny D. and Dones Luke (2007) Can planetesimals left over from the terrestrial planet formation produce the lunar late heavy bombardment? *Icarus* **190**, 203-223.

Bottke W.F., Vokrouhlicky D., Minton D., Nesvorny D., Morbidelli A., Brasser R. and Simonson B. (2012) The great Archean Bombardment (abs#4036). **Early Solar System Bombardment II**, Lunar Planet. Sci. Institute, Houston.

Bottke W.F., Walker R.J., Day J.M.D., Nesvorny D. and Elkins-Tanton L. (2010) Stochastic late accretion to Earth, the Moon and Mars. *Science* **330**, 1527-1530.

Bottke W.F., Vokrouhlicky D., Minton D., Nesvorny D., Morbidelli A., Brasser R., Simonson B. and Levison H.F. (2012) An Archaean heavy bombardment from a destabilized extension of the asteroid belt. *Nature* doi:10.1038

Bouchet M., Kaplan G., Voudon A. and Bertolotti M.-J. (1971) Spark source spectrometric analysis of major and minor elements in six lunar samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1247-1252.

Bouvier A., Wadhwa M., Korotev R.L. and Hartmann W.K. (2011) U-Pb chronology of two lunar impact melt breccias (abs). *Met. Soc. London*

Boyce Jeremy, Liu Y., Rossman G.r., Guan Y., Eiler J.M., Stöpler E.M. and Taylor L.A. (2010) Lunar apatite with terrestrial volatile abundances. *Nature* 466, 469

Boyce et al. (2012) Lunar apatite (abs). *43<sup>rd</sup> Lunar Sci. Conf.* @ the Woodlands

Boyd F.R. and Smith D. (1971) Compositional zoning in pyroxenes from lunar rock 12021, Oceanus Procellarum. *J. Petrol.* **12**, 439-464.

Boyet Maud and Carlson R.W. (2007) A highly depleted Moon or a non-magma ocean origin for the lunar crust? *Earth Planet. Sci. Lett.* **262**, 505-516.

Boyet M., Carlson R.W., Horan M. and Borg L. (2009)  $^{146,147}\text{Sm}$ - $^{142,143}\text{Nd}$  systematic of lunar ferroan anorthosites (abs). *Meteorit. & Planet. Sci.*, FRANCE

Boynton W.V., Baedeker P.A., Chou C.-L., Robinson K.L. and Wasson J.T. (1975a) Mixing and transport of lunar surface materials: Evidence obtained by the determination of lithophile, siderophile, and volatile elements. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2241-2259.

Boynton W.V., Chou C.-L., Bild R.W. and Wasson J.T. (1975b) Surface correlation of volatile elements in Apollo-16 soils (abs). *Lunar Sci.* **VI**, 74-76. Lunar Planetary Institute, Houston.

Boynton W.V., Chou C.-L., Robinson Karen Lee, Warren Pablo H. and Wasson J.T. (1976) Lithophiles, siderophiles and volatiles in Apollo 16 soils and rocks. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 727-742.

Braddy D., Hutcheon I.D. and Price P.B. (1975a) Crystal chemistry of Pu and U and concordant fission track ages of lunar zircons and whitlockites. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3581-3600.

- Braddy D., Hutcheon I.D. and Price P.B. (1975b) Crystal chemistry of Pu and U and concordant fission track ages of lunar zircons and whitlockites (abs). *Lunar Sci.* **VI**, 77-79. Lunar Planetary Institute, Houston.
- Brandon A. (2007) A younger moon. *Nature* **450**, 1169-1170. *an editorial*
- Brandon A.D., Lapen T.V., Debaille V., Beard B.L., Rankenburg K., and Neal C. (2009) Re-evaluating the  $^{142}\text{Nd}/^{144}\text{Nd}$  in lunar mare basalts with implications for the early evolution and bulk Sm/Nd of the Moon. *Geochim. Cosmochim. Acta* **73**, 6425–6445.
- Brecher A. (1974) Inferences from comparative magnetic studies of some Apollo 17 basalts, breccias and soils (abs). *Lunar Sci.* **V**, 83-85. Lunar Planetary Institute, Houston.
- Brecher A. (1975) Textural remanence: A new model of lunar rock magnetism (abs). *Lunar Sci.* **VI**, 83-85. Lunar Planetary Institute, Houston.
- Brecher A. (1976a) Textural remanence: A new model of lunar rock magnetism. *Earth Planet. Sci. Lett.* **29**, 131-145.
- Brecher A. (1976b) The magnetic characteristics of highland breccia 73215: Evidence for textural control of magnetization. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2217-2231.
- Brecher A. (1976c) Textural control of magnetization in lunar, meteoritic and terrestrial rocks (abs). *Lunar Sci.* **VII**, 91-93. Lunar Planetary Institute, Houston.
- Brecher A. (1977a) Interrelationships between magnetization directions, magnetic fabric and oriented petrographic features in lunar rocks. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 703-723.
- Brecher A. (1977b) New evidence for textural magnetization (TXM) in lunar rocks synthetic analogs and meteorites (abs). *Lunar Sci.* **VIII**, 142-144. Lunar Planetary Institute, Houston.
- Brecher A. and Morash K.R. (1973) Magnetic characteristics of Apollo 17 orange and grey soils (abs). *EOS Trans. AGU* **54**, 581-582.
- Brecher A., Vaughan D.J., Burns R.G. and Morash K.R. (1974) Magnetic and Mossbauer studies of Apollo 16 rocks chips 60315 and 62295. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2991-3001.
- Brecher A., Menke W.H. and Morash K.R. (1974) Comparative magnetic studies of some Apollo 17 rocks and soils and their implications. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2795-2814.
- Brecher A., Menke W.H., Adams J.B. and Gaffey M.J. (1975) The effects of heating and subsolidus reduction on lunar materials: An analysis by magnetic methods, optical, Mossbauer, and X-ray diffraction spectroscopy. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3091-3109.
- Brett R. (1975) Thickness of some lunar basalt flows and ejecta blankets based on chemical kinetic data. *Geochim. Cosmochem. Acta* **39**, 1135-1141.
- Brett R. (1976) Reduction of mare basalts by sulfur loss. *Geochim. Cosmochim. Acta* **40**, 997-1004.
- Brett R. (1993) The lunar crust: A product of heterogeneous accretion or differentiation of a homogeneous Moon? *Geochim. Cosmochim. Acta* **37**, 2697-2703.
- Brett R., Butler P., Meyer C., Reid A.M., Takeda H. and Williams R. (1971) Apollo 12 igneous rocks 12004, 12008, 12009 and 12022: A mineralogical and petrological study. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 301-317.

- Brett R., Gooley R.C., Dowty E., Prinz M. and Keil K. (1973) Oxide minerals in lithic fragments from Luna 20 fines. *Geochim. Cosmochim. Acta* **37**, 761-773.
- Brown G.E. and Wechsler B.A. (1973) Crystallography of pigeonites from basaltic vitrophyre 15597. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 887-900.
- Brown G.M. (1970) Petrology, mineralogy and genesis of lunar crystalline igneous rocks. *J. Geophys. Res.* **75**, 6480-6496.
- Brown G.M. (1977) Two-stage generation of lunar mare basalts. *Phil. Trans. Roy. Soc. London* **A285**, 169-176.
- Brown G.M., Emeleus C.H., Holland J.G. and Phillips R. (1970) Mineralogical, chemical, and petrological features of Apollo 11 rocks and their relationship to igneous processes. *Proc. Apollo 11 Lunar Sci. Conf.* 195-219.
- Brown G.M., Emeleus C.H., Holland J.G., Peckett A. and Phillips R. (1971) Picrite basalts, ferrobasalts, feldspathic norites, and rhyolites in a strongly fractionated lunar crust. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 583-600.
- Brown G.M. and Peckett A. (1971) Selective volatilization on the lunar surface: Evidence from Apollo 14 feldspar-phyric basalts. *Nature* **234**, 262-266.
- Brown G.M. and Gay P. (1971) Lunar antiperthites. *Earth Planet. Sci. Lett.* **11**, 23-27.
- Brown G.M., Emeleus C.H., Holland G.J., Peckett A. and Phillips R. (1972) Mineral-chemical variations in Apollo 14 and Apollo 15 basalts and granitic fractions. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 141-157.
- Brown G.M., Peckett A., Phillips R. and Emeleus C.H. (1973) Mineral-chemical variations in the Apollo 16 magnesian-feldspathic highland rocks. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 505-518.
- Brown G.M., Holland J.G. and Peckett A. (1973) Orange soil from the moon. *Nature* **242**, 515.
- Brown G.M., Peckett A., Emeleus C.H. and Phillips R. (1974) Mineral-chemical properties of Apollo 17 mare basalts and terra fragments (abs). *Lunar Sci.* **V**, 89-91. Lunar Planetary Institute, Houston.
- Brown G.M., Peckett A., Emeleus C.H., Phillips R. and Pinsent R.H. (1975a) Petrology and mineralogy of Apollo 17 mare basalts. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1-13.
- Brown G.M., Peckett A., Phillips R. and Emeleus C.H. (1975b) Mineralogy and petrology of Apollo 17 basalts (abs). *Lunar Sci.* **VI**, 95-97. Lunar Planetary Institute, Houston.
- Brownlee D.E., Horz F., Hartung J.B. and Gault D.E. (1972) Micrometeoroid craters smaller than 100 microns. In **The Apollo 15 Lunar Samples**, 407-409.
- Brownlee D.E., Horz F., Vedder J.F., Gault D.E. and Hartung J.B. (1973) Some physical parameters of micrometeoroids. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 3197-3212.
- Brownlee D.E., Horz F., Hartung J.B. and Gault D.E. (1975) Density, chemistry and size distribution of interplanetary dust. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3409-3416.
- Brunfelt A.O., Heier K.S. and Steienns E. (1971a) Determination of 40 elements in Apollo 12 materials by neutron activation analysis. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1281-1290.

- Brunfelt A.O., Heier K.S., Steinnes E. and Sundvoll B. (1971b) Determination of 36 elements in Apollo 14 bulk fines by activation analysis. *Earth Planet. Sci. Lett.* **11**, 351-353.
- Brunfeldt A.O., Heier K.S., Nilssen B., Sundvoll B. and Steinnes E. (1972) Distribution of elements between different phases of Apollo 14 rocks and soils. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1133-1147.
- Brunfelt A.O., Heier K.S., Nilssen B., Steinnes E. and Sundvoll B. (1972) Elemental composition of Apollo 15 samples. In **The Apollo 15 Lunar Samples** (Chamberlain and Watkins, eds.), 195-197. Lunar Science Institute, Houston.
- Brunfelt A.O., Heier K.S., Nilssen B., Steinnes E. and Sundvoll B. (1973) Elemental composition of Apollo 15 and 16 rocks, fines and minerals (abs). *Lunar Sci.* **IV** 100-102.
- Brunfelt A.O., Heier K.S., Nilssen B., Sundvoll B. and Steinnes E. (1973) Geochemistry Apollo 15 and 16 materials. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1209-1218.
- Brunfelt A.O., Heier K.S., Nilssen B., Steinnes E. and Sundvoll B. (1974) Elemental composition of Apollo 17 fines and rocks. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 981-990.
- Bull R.K. and Durrani S.A. (1975) Annealing and etching studies of fossil and fresh tracks in lunar and analogous crystals. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3619-3637.
- Bunch T.E., Keil K. and Prinz M. (1970) Electron microprobe analyses of pyroxenes, plagioclases, and ilmenites from Apollo 11 lunar samples. Special. Pub. #1, UNM Institute of Meteoritics, ABQ.
- Bunch T.E., Prinz M., Keil K. and Dowty E. (1972a) Composition and origin of glasses and chondrules in Apollo 15 rake samples from Spur Crater (abs). *Meteoritics* **8**, 21-22.
- Bunch T.E., Quaide W., Prinz M., Keil K. and Dowty E. (1972b) Lunar ultramafic glasses, chondrules and rocks. *Nature* **239**, 57-59.
- Bunch T.E., Keil K. and Prinz M. (1972c) Mineralogy, petology and chemistry of lunar rock 12039. *Meteoritics* **7**, 245-255.
- Bunch T.E., Prinz M. and Keil K. (1972d) Electron microprobe analyses of lithic fragments and glasses from Apollo 12 lunar samples. Special. Pub. #4, UNM Institute of Meteoritics, ABQ.
- Burger P.V., Shearer C.K. and Papike J.J. (2009) The multi-stage cooling history of lunar meteorite NWA 032 as recorded by phenocrystic olivine and pyroxene (abs#2043). *Lunar Planet Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Burlingame A.L., Hauser J.S., Simonett B.R., Smith D.H., Biemann K., Mancuso N., Murphy R., Flory D.A. and Reynolds M.A. (1971) Preliminary organic analysis of the Apollo 12 cores. *Proc. Second Lunar Sci. Conf.* 1891-1899.
- Burlingame A.L., Holland P., McFadden W.H., Simoneit B.R., Wilder J.T. and Wszolek P.C. (1971) UCB Space Sciences Laboratory Simulation 3 sand transfer and transfer of Apollo 14 SESC Lunar Material. June 17, 1971
- Burnett D.S. (1975) Lunar Science: The Apollo Legacy. *Rev. Geophys. Space Phys.* **13**, 13-
- Burnett D.S. and Woolum D.S. (1977) Exposure ages and erosion rates for lunar rocks. *Phys. Chem. Earth* **10**, 63-101.
- Burnett D.S., Monnin M., Seitz M., Walker R., Woolum D. and Yuhas D. (1970) Charged particle track studies in lunar rock 12013. *Earth Planet. Sci. Lett.* **9**, 127-136.

- Burnett D.S., Monnin M., Seitz M., Walker R. and Yuhas D. (1971) Lunar astrology – U-Th distributions and fission-track dating of lunar samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1503-1519.
- Burnett D.S., Huneke J.C., Podosek F.A., Russ G.P., Turner G. and Wasserburg G.J. (1972) The irradiation history of lunar samples (abs). *Lunar Sci.* **III**, 105-107. Lunar Planetary Institute, Houston.
- Burns R.G., Vaughan D.J., Abu-Eid R.M. and Witner M. (1973) Spectral evidence for Cr<sup>+3</sup>, Ti<sup>+3</sup> and Fe<sup>+2</sup> rather than Cr<sup>+2</sup> and Fe<sup>+3</sup> in lunar ferromagnesian silicates. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 983-994.
- Burns R.G. and Dyar M.D. (1983) Spectral chemistry of green-glass-bearing 15426 regolith. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **88**, B221-B228.
- Busche F.D., Conrad G.H., Keil K., Prinz M., Bunch T.E., Erlichman J. and Quaide W.L. (1971) Electron microprobe analysis of minerals from Apollo 12 lunar samples. Special Pub. #3, UNM Institute of Meteoritics. ABQ
- Busche F.D., Prinz M., Keil K. and Kurat G. (1972) Lunar zirkelite: A uranium-bearing phase. *Earth Planet Sci. Lett.* **14**, 313-321.
- Busche F.D., Prinz M., Keil K. and Bunch T.E. (1972) Spinels and the petrogenesis of some Apollo 12 igneous rocks. *Am. Mineral.* **57**, 1729-1747.
- Butler J.C., King E.A. and Carman M.F. (1972) Size frequency distributions and petrographic observations of Apollo 15 samples. In **The Apollo 15 Lunar Samples**, 45-48.
- Butler J.C., Greene G.M. and King E.A. (1973) Grain size frequency distribution and modal analysis of Apollo 16 fines. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 267-278.
- Butler J.C. and King E.A. (1974) Analysis of the grain size-frequency distributions of lunar fines. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 829-841.
- Butler P. (1971) Lunar Sample Catalog, Apollo 15. Curators' Office, MSC 03209
- Butler P. (1972a) Lunar Sample Information Catalog Apollo 16. Lunar Receiving Laboratory. MSC 03210 Curator's Catalog. pp. 370.
- Butler P. (1972b) Compositional characteristics of olivines from Apollo 12 samples. *Geochim. Cosmochim. Acta* **36**, 773-785.
- Butler P. (1973) Lunar Sample Information Catalog Apollo 17. Lunar Receiving Laboratory. MSC 03211 Curator's Catalog. pp. 447.
- Butler P. (1978) Recognition of lunar glass droplets produced directly from endogenous liquids: The evidence from S-Zn coatings. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 1459-1471.
- Butler P. and Dealing T.E. (1974) The dissection and consortium allocation of Apollo 17 lunar rocks from the boulder at Station 7. *Earth Planet. Sci. Lett.* **23**, 429-434.
- Butler P. and Meyer C. (1976) Sulfur prevails in coatings on glass droplets: Apollo 15 green and brown glasses and Apollo 17 orange and black (devitrified) glasses. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1561-1581.
- Butler P. and Morrison D.A. (1977) Geology of the Luna 24 landing site. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3281-3301.
- BVSP (1981) **Basaltic Volcanism on the Terrestrial Planets**. Pergamon Press, Inc. New York. 1286 pp.

- Cadenhead D.A., Wagner N.J., Jones B.R. and Stetter J.R. (1972) Some surface characteristics and gas interactions of Apollo 14 fines and rock fragments. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2243-2257.
- Cadenhead D.A., Jones B.R., Buergel W.C. and Stetter J.R. (1973) Solar wind and terrestrial atmosphere effects on lunar sample surface composition. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2391-2401.
- Cadenhead D.A. and Stetter J.R. (1974) The interaction of water vapor with a lunar soil, a compacted soil and a cinder-like rock fragment. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2301-2316.
- Cadenhead D.A. and Buergel W.G. (1974) The interaction of hydrogen with Taurus-Littrow orange soil. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2287-2300.
- Cadenhead D.A. and Brown M.G. (1976) The surface and composition of 60017,43. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 927-936.
- Cadenhead D.A., Brown M.G., Rice D.K. and Stetter J.R. (1977) Some surface area and porosity characterizations of lunar soils. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1291-1303.
- Cadogan P.H. (1974) The oldest and largest lunar basin? *Nature* **250**, 315-316.
- Cadogan P.H. (1981) **The Moon-Our Sister Planet**. Cambridge Univ. Press, pp. 391.
- Cadogan P.H., Eglinton G., Maxwell J.R. and Pillinger C.T. (1971) Carbon chemistry of the lunar surface. *Nature* **231**, 29-31.
- Cadogan P.H., Eglinton G., Firth J.N.M., Maxwell J.R., Mays B.J. and Pillinger C.T. (1972) Survey of lunar carbon compounds: II. The carbon chemistry of Apollo 11, 12, 14 and 15 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2069-2090.
- Cadogan P.H., Eglinton G., Gowar A.P., Jull A.J.T., Maxwell J.R. and Pillinger C.T. (1973a) Location of methane and carbide in Apollo 11 and 16 lunar fines. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1493-1508.
- Cadogan P.H., Eglinton G., Maxwell J.R. and Pillinger C.T. (1973b) Distribution of methane and carbide in Apollo 12 fines. *Nature* **241**, 81-83.
- Cadogan P.H. and Turner G. (1976) The chronology of the Apollo 17 Station 6 boulder. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2267-2285.
- Cadogan P.H. and Turner G. (1977) <sup>40</sup>Ar-<sup>39</sup>Ar dating of Luna 16 and Luna 20 samples. *Philos. Trans. Roy. Soc. London* **A284**, 167-177.
- Caffee M., Hohenberg C. and Hudson B. (1981a) Troctolite 76535: A study in the preservation of early isotopic records (abs). *Lunar Planet. Sci.* **XII**, 120-122. Lunar Planetary Institute, Houston.
- Caffee M., Hohenberg C.M. and Hudson B. (1981b) Troctolite 76535: A study in the preservation of early isotopic records. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 99-115.
- Cahill J.T.S., Lucey P.G. and Wieczorek M.A. (2009) The composition of lunar central peaks relative to lunar samples (abs#1222). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Cameron A.G.W. (1997) The origin of the moon and the single impact hypothesis. *Icarus* 126-137.
- Cameron E.N. (1970) Opaque minerals in certain lunar rocks from Apollo 11. *Proc. Apollo 11 Lunar Sci. Conf.* 221-245.



- Cameron K.L., Delano J.W., Bence A.E. and Papike J.J. (1972) Petrology of the 2-4 mm sized soil fragments from Apollo 15. In **The Apollo 15 Lunar Samples**. 1-4. Lunar Planetary Institute, Houston
- Cameron K.L. and Delano J.W. (1973) Petrology of Apollo 15 consortium breccias 15465. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 461-466.
- Cameron K.L., Delano J.W., Bence A.E. and Papike J.J. (1973) Petrology of the 2-4 mm soil fraction from the Hadley-Apennine region of the moon. *Earth Planet. Sci. Lett.* **19**, 9-21.
- Cameron K.L., Papike J.J., Bence A.E. and Sueno S. (1973) Petrology of fine-grained rock fragments and petrologic implications of single crystals from the Luna 20 soil. *Geochim. Cosmochim. Acta* **37**, 775-793.
- Cameron K.L. and Fischer G.W. (1975) Olivine-matrix reactions in thermally metamorphosed Apollo 14 breccias. *Earth Planet. Sci. Lett.* **25**, 197-207.
- Canup R.M. and Righter K. (2000) **Origin of the Earth and Moon**. Univ. of Arizona Press pp. 391.
- Canup R.M. and Asphaug E. (2001) Origin of the Moon in a giant impact near the end of the Earth's formation. *Nature* **412**, 708-712.
- Carlson I.C. and Walton W.J.A. (1978) **Apollo 14 Rock Samples**. Curators Office. JSC 14240
- Carlson R.W. and Lugmair G.W. (1979a) Early history recorded by norite 78236. In Papers Presented to the **Conference on the Lunar Highlands Crust**. LP1 Contr. 394, 9-11. Lunar Planetary Institute, Houston
- Carlson R.W. and Lugmair G.W. (1979b) Sm-Nd constraints on early lunar differentiation and the evolution of KREEP. *Earth Planet. Sci. Lett.* **45**, 123-132.
- Carlson R.W. and Lugmair G.W. (1980) 78236, a primary, but partially senile, lunar norite (abs). *Lunar Planet. Sci.* **XI**, 125-128. Lunar Planetary Institute, Houston
- Carlson R.W. and Lugmair G.W. (1981a) Time and duration of lunar highlands crust formation. *Earth Planet. Sci. Lett.* **52**, 227- 238.
- Carlson R.W. and Lugmair G.W. (1981b) Sm-Nd age of ilmenite 67667: Implications for the processes involved in lunar crustal formation. *Earth Planet. Sci. Lett.* **56**, 1-8.
- Carlson R.W. and Lugmair G.W. (1988) The age of ferroan anorthosite 60025: oldest crust on a young Moon? *Earth Planet. Sci. Lett.* **90**, 119-130.
- Caro G., Bourdon B., Halliday A.N. and Quitte G. (2008) Super-chondritic Sm/Nd ratios in Mars, the Earth and the Moon. *Nature* **452**, 336-339.
- Carpenter P., Edmunsen J., Cohen B.A., Zeigler R.A. and Jolliff B.L. (2011) First lunar occurrence of Keivite-(Y) in troctolitic anorthosite 76335 (abs#2767). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Carr L.P., Wright I.P., and Pillinger C.T. (1985) Nitrogen abundance and isotopes in lunar breccias - a progress report (abs). *Lunar Planet. Sci.* **XVI**, 115-116. Lunar Planetary Institute, Houston.
- Carr M.H. and Meyer C.E. (1972) Chemical and petrographic characterization of Fra Mauro soils. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1015-1027.
- Carr M.H. and Meyer C.E. (1974) The regolith at the Apollo 15 site and its stratigraphic implications. *Geochim. Cosmochim. Acta* **38**, 1183-1197.
- Carrier W.D. (1973) Lunar grain size distribution. *The Moon* **6**, 250-263.

Carrier W.D., Johnson S.W., Werner R.A. and Schmidt R. (1971) Disturbance in samples recovered with the Apollo core tubes. *Proc. 2<sup>nd</sup> Lunar Science Conf.* 1959-1972.

Carrier W.D., Johnson S.W., Carrasco L.H. and Schmidt R. (1972) Core sample depth relationships: Apollo 14 and 15. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 3213-3221.

Carrier W.D., Mitchell J.K. and Mahmood A. (1973) The relative density of lunar soil. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2403-2411.

Carrier W.D., Bromwell L.G., and Martin R.T. (1973) Behavior of returned lunar soil in vacuum. *J. of the Soil Mechanics and Foundations Division ASCE* **99**, 979-996.

Carrier W.D., Olhoeft G.R. and Mendell W. (1991) Physical properties of the Lunar Surface. In **Lunar Sourcebook: a users guide to the moon**. (eds. Heiken et al. ) Cambridge Univ. Press

Carron M.K., Annell C.S., Christian R.P., Cuttitta F., Dwornik E.J., Ligon D.T. and Rose H.J. (1972) Elemental analysis of lunar soil samples from Apollo 15 mission. In **The Apollo 15 Samples** 198-201.

Carter J.L. (1971) Chemistry and surface morphology of fragments from Apollo 12 soil. *Proc. Second Lunar Sci. Conf.* 873-892.

Carter J.L. (1972) Morphology and chemistry of galss surface of breccias 15015,36. In **The Apollo 15 Lunar Samples**, 51-53.

Carter J.L. (1973) Chemistry and surface morphology of soil particles from Luna 20 sample 22003. *Geochim. Cosmochim. Acta* **37**, 795-804.

Carter J.L. and MacGregor I.D. (1970) Mineralogy, petrology and surface features of some Apollo 11 samples. *Proc. Apollo 11 Lunar Sci. Conf.* 247-265.

Carter J.L., Taylor H.C. and Padovani E. (1973) Morphology and chemistry of particles from Apollo 17 soils 74220, 74241 and 75081 (abs). *EOS Trans. AGU* **54**, 582.

Carter J.L. and Padovani E. (1973) Genetic implications of some unusual partociles in Apollo 16 less than 1 mm fines 68841, 69941. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 323-332.

Carter J.L., Clanton U.S., Fuhrman R., Laughton R.B., McKay D.S. and Usselman T.M. (1975) Morphology and composition of chalcopyrite, chromite, Cu, Ni-Fe, pentandite, and troilite in vugs of 76015 and 76215. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 719-728.

Carpender P.K., Zeigler R.A., Jolliff B.L., Vicenzi E.P., Davis J.M. and Donovan J.J. (2009) Advances in electron-probe microanalysis and compositional mapping: Applications to Lunar Samples (abs#2531). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.

Carusi, A., Cavaretta G., Cinotti F., Civitelli G., Coradini A., Funicello R., Fulchignoni M. and Taddevcci A. (1972) Lunar Glasses as an index of the impacted sites lithology: The source area of Apollo 15 "green glasses." *Geol. Romana* **11**, 137-151.

Carusi A. and various authors (1972) The source of the Apollo 15 green glass (abs). In **The Apollo 15 Lunar Samples**. 5-9. Lunar Planetary Institute, Houston.

Cavaretta G., Funicello R., Giles H., Nicholls G.D., Taddeucci A. and Zussman J. (1972) Geochemistry of green glass spheres from Apollo 15 samples (abs). In **The Apollo 15 Lunar Samples**. 202-205 Lunar Planetary Institute, Houston

- Chabot N.L. and Agee C.B. (2003) Core formation in the Earth and Moon: New experimental constraints from V, Cr and Mn. *Geochim. Cosmochim. Acta* **67**, 2077-2091.
- Chaillou D., Pellas P. Michel-Levy M.C. and Storzer D. (1978) Cosmic ray track and maturity of the Luna 24 regolith. In **Mare Crisium: The view from Luna 24**. *Geochem. Cosmochim. Acta suppl.* 9, 171-178. (ed. Merrill) Pergamon Press.
- Chakrabarti R. and Jacobsen S.B. (2011) The isotopic composition of magnesium in bulk lunar soils (abs#2006). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Chaklader J., Schearer C.K. and Borg L.E. (2006) The behavior (bad) of Li and B in lunar mare basalts. *Amer. Mineral.* Chak, 1553-1564.
- Champness P.E., Dunham A.C., Gibb F.G.F., Giles H.N., MacKenzie W.S., Stumpel E.F. and Zussman J. (1971) Mineralogy and petrology of some Apollo 12 lunar samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 359-376.
- Chang S., Kvendolden K., Lawless J., Ponnampereuma C. and Kaplan I.R. (1971) Carbon, carbides and methane in an Apollo 12 sample. *Science* **171**, 474-477.
- Chang S. and Young R.S. (1972) The organic analysis and carbon chemistry of lunar samples: Their significance for exobiology. *Space Life Sci.* **3**, 315-319
- Chang S., Lawless J., Romiez M., Kaplan I.R., Petroweski C., Sakai H. and Smith J.W. (1974) Carbon, nitrogen and sulfur in lunar fines 15012 and 15013: abundances, distributions and isotopic compositions. *Geochim. Cosmochim. Acta* **38**, 853-872.
- Chang S., Lennon K. and Gibson E.K. (1974) Abundances of C, N, H, He and S in Apollo 17 soils. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1785-1800.
- Chang S. and Lennon K. (1975) Implantation of carbon and nitrogen ions into lunar fines: Trapping efficiencies and saturation concentrations. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2171-2188.
- Chao E.C.T. (1973a) The petrology of 76055,10, a thermally metamorphosed fragment-laden olivine microronite hornfels. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 719-732.
- Chao E.C.T. (1973b) 76055, a fragment-laden contact-metamorphosed: magnesian hornfels (abs). *EOS Trans. AGU* **54**, 584.
- Chao E.C.T. (1973c) Geologic implications of the Apollo 14 Fra Mauro breccias and comparison with ejecta from the Ries Crater, Germany. *J. Res. U.S. Geol. Survey* **1**, 1-18.
- Chao E.C.T. (1977) Basis for interpretation regarding the ages of the Serenitatis, Imbrium and Orientale events. *Phil. Trans. Roy. Soc. London* **A285**, 115-126.
- Chao E.C.T. and Minkin J.A. (1972) Apollo 14 breccias: General characteristics and classification. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 645-659.
- Chao E.C.T. and Minkin J.A. (1974a) Preliminary description of Apollo 17 station 7 boulder consortium rocks (abs). *Lunar Sci.* **V**, 109-111. Lunar Planetary Institute, Houston.
- Chao E.C.T. and Minkin J.A. (1974b) The petrogenesis of 77135, a fragment-laden pigeonite feldspathic basalt - a major highland rock type (abs). *Lunar Sci.* **V**, 112-114. Lunar Planetary Institute, Houston.
- Chao E.C.T., James O.B., Minkin J.A., Boreman J.A., Jackson E.D. and Raleigh C.B. (1970) Petrology of unshocked crystalline rocks and evidence of impact metamorphism in Apollo 11 returned lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 287-314.

- Chao E.C.T., Boreman J.A., Minkin J.A. and James O.B. (1970) Lunar glasses of impact origin: Physical and chemical characteristics and geologic implications. *J. Geophys. Res.* **75**, 7445-7479.
- Chao E.C.T., Boreman J.A. and Desborough G.A. (1971) The petrology of unshocked and shocked Apollo 11 and Apollo 12 microbreccias. *Proc. Second Lunar Sci. Conf.* 791-816.
- Chao E.C.T., Minkin J.A. and Best J.B. (1972a) Apollo 14 breccias: General characteristics and classification. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 645-659.
- Chao E.C.T., Best J.B. and Minkin J.A. (1972b) Apollo 14 glasses of impact origin and their parent rock types. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 907-925.
- Chao E.C.T., Minkin J.A. and Thompson C.L. (1974) Preliminary petrographic description and geologic implications of the Apollo 17 Station 7 Boulder Consortium samples. *Earth Planet. Sci. Lett.* **23**, 413-428.
- Chao E.C.T., Minkin J.A., Thompson C.L. and Heubner J.S. (1975a) The petrogenesis of 77115 and its xenocrysts: Description and preliminary interpretation. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 493-515.
- Chao E.C.T., Minkin J.A. and Thompson C.L. (1975b) The petrogenesis of 77115 and its xenocrysts: Description and preliminary interpretation (abs). *Lunar Sci.* **VI**, 134-136. Lunar Planetary Institute, Houston.
- Chao E.C.T., Minkin J.A. and Thompson C.L. (1976a) The petrology of 77215, a noritic impact breccia. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2287-2308.
- Chao E.C.T., Minkin J.A. and Thompson C.L. (1976b) The petrology of 77215, a noritic impact ejecta breccia (abs). *Lunar Sci.* **VII**, 129-131. Lunar Planetary Institute, Houston.
- Chapman C.R., Cohen B.A. and Grinspoon D.H. (2007) What are the real constraints on the existence and magnitude of the late-heavy-bombardment ? *Icarus* **189**, 233-245.
- Chappell B.W., Compston W., Green D.H. and Ware N.G. (1972) Chemistry, geochronology and petrogenesis of lunar sample 15555. *Science* **175**, 415-416
- Chappell B.W. and Green D.H. (1973) Chemical compositions and petrogenetic relationships in Apollo 15 mare basalts. *Earth Planet. Sci. Lett.* **18**, 237-246.
- Charette M.P. and Adams J.B. (1975a) Mare basalts: Characterization of compositional parameters by spectral reflectance. In *Papers presented to the Conference on Origins of Mare Basalts and their Implications for Lunar Evolution*, 25-28. Lunar Planetary Institute, Houston.
- Charette M.P. and Adams J.B. (1975) Agglutinates as indicators of lunar soil maturity: The rare gas evidence at Apollo 16. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2281-2290.
- Charette M.P., Soderblom L.A., Adams J.B., Gaffey M.J. and McCord T.B. (1976) Age-color relationships in the lunar highlands. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2579-2592.
- Charette M.P. and Adams J.B. (1977) Spectral reflectance of lunar highland rocks (abs). *Lunar Sci.* **VIII**, 172-174. Lunar Planetary Institute, Houston.
- Chaussidon M. (2008) The Early Moon was rich in water. *Nature* **454**, 170-172. *an editorial*
- Chen H.-K., Delano J.W. and Lindsley D.H. (1982) Chemistry and phase relations of VLT volcanic glasses from Apollo 14 and Apollo 17. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **87**, A171-A181.

- Chen J.H., Tilton G.R., Mattinson J.M. and Vidal P. (1978a) Lead isotope systematics of mare basalt 75075. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 509-521.
- Chen J.H., Tilton G.R. and Mattinson J.M. (1979) Lead isotope systematics of three Taurus-Littrow mare basalts (abs). *Lunar Planet. Sci. X*, 195-197. Lunar Planetary Institute, Houston.
- Chen J.H. and Wasserburg G.J. (1980) The isotopic composition of U in meteorites and lunar samples (abs). *Lunar Planet. Sci. XI*, 131-133. Lunar Planetary Institute, Houston.
- Chen J.H., Mattinson J.M., Tilton G.R. and Vidal P. (1978b) Lead isotope systematics of mare basalt 75075 (abs). *Lunar Planet. Sci. IX*, 160-162. Lunar Planetary Institute, Houston.
- Chen Y. and Zang Y. (2012) Initial water concentration and degassing of lunar basalts inferred from melt inclusions in olivine (abs). *43<sup>rd</sup> Lunar Sci. Conf. @ the Woodlands*
- Chou C.-L., Baedeker P.A., Bild R.W. and Wasson J.T. (1974) Volatile-element systematics and green glass in Apollo 15 lunar soils. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1645-1657.
- Chou C.-L., Boynton W.V., Sundberg L.L. and Wasson J.T. (1975) Volatiles on the surface of Apollo 15 green glass and trace-element distributions among Apollo 15 soils. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1701-1727.
- Chou C.-L. and Pearce G.W. (1976) Relationship between nickel and metallic iron contents of Apollo 16 and 17 soils. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 779-789.
- Christian R.P., Ansell C.S., Carron M.K., Cuttitta F., Dwornik E.J., Ligon D.T. and Rose H.J. (1972) Chemical composition of some Apollo 15 igneous rocks. In **The Apollo 15 Lunar Samples** (Chamberlain and Watkins, eds.), 206-209. The Lunar Science Institute, Houston.
- Christian R.P., Berman S., Dwornik E.J., Rose H.J. and Schnepfe M.M. (1976) Composition of some Apollo 14, 15 and 16 lunar breccias and two Apollo 15 fines (abs). *Lunar Sci. VII*, 138-140. Lunar Planetary Institute, Houston.
- Christie J.M., Lally J.S., Heuer A.H., Fischer R.M., Griggs D.T. and Radcliffe S.V. (1971) Comparative electron petrography of Apollo 11, Apollo 12 and terrestrial rocks. *Proc. Second Lunar Sci. Conf.* 69-89.
- Christie J.M., Griggs D.T., Heuer A.H., Nord G.L., Radcliffe S.V., Lally J.S. and Fischer R.M. (1973) Electron petrography of Apollo 14 and 15 breccias and shock-produced analogs. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 365-382.
- Christophe-Michel-Levy M. and Levy C. (1972) The magnesian spinel-bearing rocks from the Fra Mauro formation. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 887-894.
- Chung Dae H. (1973) Elastic wave velocities in anorthosite and anorthositic gabbros from Apollo 15 and 16 landing sites. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2591-2600.
- Chung D.H., Westphal W.B. and Simmons G. (1971) Dielectric behavior of lunar samples: Electromagnetic probing of the lunar interior. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 2381-2390.
- Chung D.H., Westphal W.B. and Olhoeft G.R. (1972) Dielectric properties of Apollo 14 lunar samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 3161-3172.
- Chung D.H. and Westphal W.B. (1973) Dielectric spectra of Apollo 15 and 16 lunar solid samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 3077-3091.

Church S.E., Bansal B.M. and Wiesmann H. (1972) The distribution of K, Ti, Zr, U, and Hf in Apollo 14 and 15 materials. In **The Apollo 15 Lunar Samples** (Chamberlain and Watkins, eds.), 210-213. The Lunar Science Institute, Houston.

Church S.E. and Tilton G.R. (1974) Lead isotope systematics of some Apollo 17 soils and some separated components from 76501. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1389-1400.

Church S.E. and Tilton G.R. (1975) Lead isotope systematics of soils and soil breccias from Taurus-Littrow (abs). *Lunar Sci.* **VI**, 143-145. Lunar Planetary Institute, Houston.

Chyi L.L. and Ehmann W.D. (1973) Zirconium and hafnium in some lunar materials and implications of their ratios. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1219-1226.

Chyi L.L. and Ehmann W.D. (1974) Implications of Zr and Hf abundances and their ratios in lunar materials (abs). *Lunar Sci.* **V**, 118-120. Lunar Planetary Institute, Houston.

Cimbalnikova A., Palivova M., Frana J. and Mastalka A. (1977) Chemical composition of crystalline rock fragments from Luna 16 and Luna 20 fines. In **The Soviet-American conference on cosmochemistry of the moon and planets.** 263-275.

Cintala M.J. and Grieve R.A.F. (1994) The effects of differential scaling of impact melt and crater dimensions on lunar and terrestrial craters: Some brief examples. In *Large Meteorite Impacts and Planetary Evolution*, GSA paper **293**, 51-59.

Cintala M.J. and Grieve R.A.F. (1998) Scaling impact-melt and crater dimensions: Implications for the lunar cratering record. *Meteorit. Planet. Sci.* **33**, 889-912.

Cirlin E.H. and Housley R.M. (1977a) A flameless atomic absorption study of the volatile trace metal lead in lunar samples. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3931-3940.

Cirlin E.H. and Housley R.M. (1977b) An atomic absorption study of volatile trace metals in lunar samples (abs). *Lunar Sci.* **VIII**, 184-186. Lunar Planetary Institute, Houston.

Cirlin E.H., Housley R.M. and Grant R.W. (1978) Studies of volatiles in Apollo 17 samples and their implications to vapor transport processes. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2049-2063.

Cirlin E.H. and Housley R.M. (1979) Scanning Auger microprobe and atomic absorption studies of lunar volcanic volatiles. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 341-354.

Cirlin E.H. and Housley R.M. (1980) Redistribution of volatiles during lunar metamorphism. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 349-364.

Cirlin E.H. and Housley R.M. (1981) Distribution and evolution of Zn, Cd, and Pb in Apollo 16 regolith samples and the average U-Pb ages of the parent rocks. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 529-540.

Circone S. and Agee C.B. (1996) Compressibility of molten high-Ti mare glass: Evidence for crystal-liquid inversions in the lunar mantle. *Geochim. Cosmochim. Acta* **60**, 2709-2720.

Cisowski S.M. and Fuller M. (1983) Lunar sample magnetic stratigraphy (abs). *Lunar Planet. Sci.* **XIV**, 115-116. Lunar Planetary Institute, Houston.

Cisowski C.S., Dunn J.R., Fuller M., Rose M.F. and Wasilewski P.J. (1974) Impact processes and lunar magnetism. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2841-2858.

Cisowski S.M., Hale C. and Fuller M. (1977) On the intensity of ancient lunar fields. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 725-750.

- Cisowski S.M., Collinson D.W., Runcom S.K., Stephenson A. and Fuller M. (1983) A review of lunar paleointensity data and implications for the origin of lunar magnetism. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* A691-A704.
- Clanton U.S. and Fletcher C.R. (1976) Sample size and sampling errors as the source of dispersion in chemical analyses. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1413-1428.
- Clanton U.S., McKay D.S., Watts G. and Fuhrman R. (1978) Sublimate morphology on 74001 and 74002 orange and black glassy droplets. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 1945-1957.
- Clanton U.S. and Morrison D.A. (1979) Hypervelocity impact craters less than 1000A diameter (abs). *Lunar Planet. Sci. X*, 212-214. Lunar Planetary Institute, Houston.
- Clanton U.S., Carter J.L. and McKay D.S. (1975) Vapor-phase crystallization of sulfides? (abs) *Lunar Sci. VI*, 152-154. Lunar Planetary Institute, Houston.
- Clark R.S. and Keith J.E. (1973) Determination of natural and cosmic ray induced radionuclides in Apollo 16 lunar samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2105-2113.
- Clayton R.N. (1972) Oxygen isotope composition of Luna 16 soil. *Earth Planet. Sci. Lett.* **13**, 455-456.
- Clayton R.N. (1973) Oxygen isotopic composition of the Luna 20 soil. *Geochim. Cosmochim. Acta* **37**, 811-814.
- Clayton R.N., Onuma N. and Mayeda T.K. (1971) Oxygen isotope fractionation in Apollo 12 rocks and soils. *Proc. Second Lunar Sci. Conf.* 1417-1420.
- Clayton R.N., Hurd Julie and Mayeda Toshiko K. (1972) Oxygen isotopic compositions and oxygen concentrations of Apollo 14 and Apollo 15 rocks and soils. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1455-1463.
- Clayton R.N. and Mayeda T.K. (1973) Oxygen isotopic fractionation within ultrabasic clasts of lunar breccia 15445. *J. Geol.* **81**, 227-228.
- Clayton R.N., Hurd J.M. and Mayeda T.K. (1973) Oxygen isotope compositions of Apollo 15, 16 and 17 samples, and their bearing on lunar origin and petrogenesis. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1535-1542.
- Clayton R.N., Mayeda T.K. and Hurd J.M. (1974) Loss of oxygen, silicon, sulfur, and potassium from the lunar regolith. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1801-1809.
- Clayton R.N. and Mayeda T.K. (1975a) Genetic relations between the moon and meteorites. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1761-1769.
- Clayton R.N. and Mayeda T.K. (1975b) Genetic relations between the Moon and meteorites (abs). *Lunar Sci. VI*, 155-157. Lunar Planetary Institute, Houston.
- Clayton R.N. and Thiemens M.H. (1980) Lunar nitrogen: Evidence for secular change in the solar wind. *In The Ancient Sun* 463-473. (eds Pepin, Eddy, Merrill)
- Cliff R.A., Lee-Hu C. and Wetherill G.W. (1971) Rb-Sr and U, Th-Pb measurements on Apollo 12 material. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1493-1502.
- Cliff R.A., Lee-Hu C. and Wetherill G.W. (1972) K, Rb and Sr measurements in Apollo 14 and 15 material (abs). *Lunar Science III*, 146-147.

- Cloud P., Margolis S.V., Moorman M., Barker J.M., Licari G. Kringsley D. and Barnes V.E. (1970) Micromorphology and Surface Characteristics of Lunar Dust and Breccia. *Proc. Apollo 11 Lunar Science Conf.* 1793- 1798.
- Coch N.K. (1976) Radiographic enhancement analysis of sedimentary structures and depositional history in Apollo 15 core 15011. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 113-122.
- Cohen B.A. (2001) Lunar meteorites and the lunar cataclysm. Planetary Science Research Discoveries. <http://www.psrdr.hawaii.edu/Jan01/lunarCataclysm.html>
- Cohen B.A. (2004) Can granulitic metamorphic conditions reset  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  ages in lunar rocks? (abs#1009) *Lunar Planet. Sci. XXXV*, Lunar Planetary Institute, Houston.
- Cohen B.A. (2008) A review of lunar meteorite impact-melt clast compositions and ages (abs). *In* Workshop on **Early Solar System Bombardment**. Lunar Planetary Institute, Houston.
- Cohen B.A., Swindle T.D. and Kring D.A. (2000) Support for the lunar cataclysm hypothesis from lunar meteorite impact melt ages. *Science* **290**, 1754-1756.
- Cohen B.A., Snyder G.A., Hall C.M., Taylor L.A. and Nazarov M.A. (2001)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  chronology and petrogenesis along the eastern limb of the moon from Luna 16, 20 and 24 samples. *Meteor. & Planet. Sci.* **36**, 1345-1366.
- Cohen B.A., James O.B., Taylor L.A., Nazarov M. and Barsukova L.D. (2005) Lunar highland meteorite Dhofar 026 and Apollo sample 15418: Two strongly shocked, partially melted, granulitic breccias. *Meteoritics & Planet. Sci.* **40**, 755-777.
- Cohen B.A., Swindle T.D., Kring D.A. and Olson E.K. (2005) Geochemistry and  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  geochronology of impact-melt clasts in lunar meteorites Dar al Gani 262 and Calalong creek (abs# 1481). *Lunar Planet. Sci. XXXV*, Lunar Planetary Institute, Houston.
- Cohen B.A., Swindle T.D. and Kring D.A. (2005) Geochemistry and  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  geochronology of impact-melt clasts in feldspathic lunar meteorites: Implications for lunar bombardment history. *Meteor. & Planet. Sci.* **40**, 755-777.
- Cohen B.A., Symes S.J. and Swindle T.D. (2006) Petrography and chemistry of impact-melt clasts in Apollo 16 breccias (abs#1379 ). *Lunar Planet. Sci. XXXVII*, Lunar Planetary Institute, Houston.
- Cohen B.A., Symes S.J., Swindle T.D., Weirich J. and Isachsen C. (2007) Ages of Impact-melt clasts in Apollo 16 breccias (abs#1006 ). *Lunar Planet. Sci. XXXVIII*, Lunar Planetary Institute, Houston.
- Coish R.A. and Taylor L.A. (1978) Mineralogy and petrology of basaltic fragments from the Luna 24 drill core. *In Mare Crisium: The View from Luna 24.* (ed. Merrill and Papike) Pergamon 403-417.
- Collinson D.W., Runcorn S.K., Stephenson A. and Manson A.J. (1972a) Magnetic properties of Apollo 14 rocks and fines. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2343-2361.
- Collinson D.W., Runcom S.K. and Stephenson A. (1972b) Magnetic properties of Apollo 15 rocks and fines. *In The Apollo 15 Lunar Samples* 425-427.
- Collinson D.W., Stephenson A. and Runcom S.K. (1973) Magnetic properties of Apollo 15 and 16 rocks. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2963-2976.
- Collinson D.W., Runcom S.K. and Stephenson A. (1975) On changes in the ancient lunar magnetic field intensity (abs). *Lunar Sci.* **VI**, 158-160. Lunar Planetary Institute, Houston.



- Collinson D.W., Stephenson A. and Runcorn S.K. (1977) Intensity and origin of the ancient magmatic field. *Phil. Trans. Roy. Soc. London* **A285**, 241-248.
- Colson R.O. (1992) Mineralization on the Moon ? Theoretical consideration of Apollo 16 “rusty rocks”, sulfide replacement in 67016 and surface-correlated volatiles on lunar volcanic glass. *Proc. 22<sup>nd</sup> Lunar Planet. Sci. Conf.*, 427-436.
- Compston W., Arriens P.A., Vernon M.J. and Chappell B.W. (1970a) Rubidium-strontium chronology and chemistry of lunar material. *Science* **167**, 474-476.
- Compston W., Chappell B.W., Arriens P.A. and Vernon M.J. (1970b) The chemistry and age of Apollo 11 lunar material. *Proc. Apollo 11 Lunar Sci. Conf.* 1007-1027.
- Compston W., Berry H., Vernon M.J., Chappell B.W. and Kay M.J. (1971) Rubidium-strontium chronology and chemistry of lunar material from the Ocean of Storms. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1471-1485.
- Compston W., Vernon M.J., Berry H. and Rudowski R. (1971) The age of the Fra Mauro Formation: A radiometric older limit. *Earth Planet. Sci. Lett.* **12**, 55-58.
- Compston W., Vernon M.J., Berry H., Rudowski R., Gray C.M. and Ware N. (1972) Age and petrogenesis of Apollo 14 basalts (abs). *Lunar Planet. Sci.* **III**, 151-153. Lunar Science Institute, Houston.
- Compston W., Vernon M.J., Berry H., Rudowski R., Gray C.M., Ware N., Chappell B.W. and Kaye M. (1972) Apollo 14 mineral ages and the thermal history of the Fra Mauro formation. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1487-1501.
- Compston W., de Laeter J.R. and Vernon M.J. (1972) Strontium isotope geochemistry of Apollo 15 basalts. In **The Apollo 15 Lunar Samples** (Chamberlain and Watkins, eds.), 347-351. Lunar Science Institute, Houston.
- Compston W., Vernon M.J., Chappell B.W. and Freeman R. (1973) Rb-Sr model ages and chemical composition of nine Apollo 16 soils (abs). *Lunar Sci.* **IV**, 158. Lunar Science Institute, Houston.
- Compston W., Foster J.J. and Gray C.M. (1975) Rb-Sr ages of clasts from within Boulder 1, Station 2, Apollo 17. *The Moon* **14**, 445-462.
- Compston W., Foster J.J. and Gray C.M. (1977a) Rb-Sr systematics in clasts and aphanites from consortium breccia 73215. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2525-2549.
- Compston W., Foster J.J. and Gray C.M. (1977b) Rb-Sr systematics in clasts and aphanites from consortium breccia 73215 (abs). *Lunar Sci.* **VIII**, 199-201. Lunar Planetary Institute, Houston.
- Compston W., Williams I.S. and Meyer C. (1983) U-Pb geochronology of zircons from breccia 73217 using a Sensitive High Mass-Resolution Ion Microprobe (SHRIMP) (abs). *Lunar Planet. Sci.* **XIV**, 130-131. Lunar Planetary Institute, Houston.
- Compston W., Williams I.S. and Meyer C. (1984a) U-Pb geochronology of zircons from lunar breccia 73217 using a sensitive high mass-resolution ion microprobe. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* B525-B534. In *J. Geophys. Res.* **89**
- Compston W., Williams I.S. and Meyer C. (1984b) Age and chemistry of zircons from late stage differentiates (abs). *Lunar Planet. Sci.* **XV**, 182-184. Lunar Planetary Institute, Houston.
- Compston W., Williams I.S. and Meyer C. (1991) Initial Pb isotopic compositions of lunar granites as determined by ion microprobe. In **Stable Isotope Geochemistry**, Spec. Pub. 3 (eds. Taylor et al.) 473-486.

Comstock G.M., Evwaraye A.O., Fleischer R.L. and Hart H.R. (1971) The particle track record of lunar soil. *Proc. Second lunar Sci. Conf.* 2569-2582.

Cook D.L., Berger E., Faestermann T., Herzog G.F., Knie K., Korschinek G., Rugel G. and Serefiddin F. (2009)  $^{60}\text{Fe}$ ,  $^{10}\text{Be}$  and  $^{26}\text{Al}$  in lunar cores 12025/8 and 60006/7: Search for a nearby supernova (abs#1129). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.

Costes N.C. and Mitchell J.K. (1970) Apollo 11 soil mechanics investigation. *Proc. Apollo 11 Lunar Science Conf.* 2025-2044.

Cournede C., Gattacceca J. and Rochette P. (2012) Magnetic study of large Apollo samples: Possible evidence for an ancient centered dipolar field on the Moon. *Earth Planet. Sci. Lett.* **331**, 31-41.

Crawford I.A., Fagents S.A. and Joy K.H. (2007) The survival of ancient solar wind, galactic cosmic ray particles and samples of the early Earth in lunar paleoregolith deposits (abs#1323). *Lunar Planet. Sci.* **XXXVIII**, Lunar Science Institute, Houston.

Crawford I.A., Baldwin E.C., Taylor E.A., Bailey J.A. and Tsembelis K. (2008) On the survivability and detectability of terrestrial meteorites on the Moon. *Astrobiology* 8, 242-252.

Crawford M.L. (1973) Crystallization of plagioclase in mare basalts. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 705-717.

Crawford M.L. (1975a) Magma genesis by in situ melting within the lunar crust. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 249-261.

Crawford M.L. (1975b) Closed system partial melting of a K-rich highlands rock (abs). *Lunar Sci.* **VI**, 164-166. Lunar Planetary Institute, Houston.

Crawford M.L. and Hollister L.S. (1974) KREEP basalt: a possible partial melt from the lunar interior. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 399-419.

Crawford M.L. and Weigand P.W. (1973) Petrology of Luna 20 regolith from the lunar highlands. *Geochim. Cosmochim. Acta* **37**, 815-824.

Cripe J.D. and Moore C.B. (1974) Total sulfur contents of Apollo 15 and 16 lunar samples (abs). *Lunar Sci.* **V**, 523-525. Lunar Planetary Institute, Houston.

Cripe J.D. and Moore C.B. (1975) Total sulfur contents of Apollo 15, 16, and 17 samples (abs). *Lunar Sci.* **VI**, 167-169. Lunar Planetary Institute, Houston.

Cronberger K. and Neal C.R. (2012) The textural pristinity of KREEP basalts: the role of impact melting and volcanic eruptions (abs). *43<sup>rd</sup> Lunar Sci. Conf.* @ the Woodlands

Crow C.A., McKeegan K.D. and Taylor D.J. (2011) Pb-Pb ages of Apollo 15 zircons (abs#5354). Meteoritical Society, London

Crow C.A., McKeegan K.D., Gilmour J.D., Crowther S.A. and Taylor D.J. (2012a) Are Apollo zircons witness to a lunar cataclysm? (abs#4024) **Early Solar System Impact Bombardment II**, Lunar Planet. Sci. Institute, Houston.

Crow C.A., McKeegan K.D., Gilmour J.D., Crowther S.A. and Taylor D.J. (2012b) Are Apollo zircons witness to a lunar cataclysm? (abs#1639) *Lunar Planet. Sci. Conf.* **XLIII** Lunar Planetary Institute, The Woodlands.

Crozaz G. (1977) The irradiation history of the lunar soil. *Phys. Chem. Earth* **X**, 197-214.

- Crozaz G. (1978) Regolith depositional history at Shorty Crater. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2001-2009.
- Crozaz G. (1978) Nuclear particle tracks and the regolith at the Luna 24 site. *In Mare Crisium: The view from Luna 24*. *Geochem. Cosmochim. Acta suppl.* 9, 165-170. (ed. Merrill) Pergamon Press.
- Crozaz G. (1979) Regolith reworking at Shorty Crater. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1381-1384.
- Crozaz G. (1980) Irradiation history of the lunar regolith at the Apollo 14, 15 and 17 sites: Additional insights. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1453-1462.
- Crozaz G., Haack U., Hair M., Maurette M., Walker R. and Woolum D. (1970) Nuclear track studies of ancient solar radiations and dynamic lunar surface processes. *Proc. Apollo 11 Lunar Science Conf.* 2051-2080.
- Crozaz G., Walker R. and Woolum D. (1971) Nuclear track studies of dynamic surface processes on the moon and the constancy of solar activity. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 2543-2558.
- Crozaz G., Drozd R., Graf H., Hohenberg C.M., Monnin M., Ragan D., Ralston C., Seitz M., Shirck J., Walker R.M. and Zimmerman J. (1972a) Uranium and extinct Pu<sup>244</sup> effects in Apollo 14 materials. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1623-1636.
- Crozaz G., Drozd R., Hohenberg C.M., Hoyt H.P., Rajan D., Walker R.M. and Yuhas D. (1972b) Solar flare and galactic cosmic ray studies of Apollo 14 and 15 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2917-2931.
- Crozaz G., Walker R. and Zimmerman D. (1973) Fossil track and thermoluminescence studies of Luna 20 material. *Geochim. Cosmochim. Acta* **37**, 825-830.
- Crozaz G., Drozd R., Hohenberg C., Morgan C., Ralston C., Walker R. and Yuhas D. (1974a) Lunar surface dynamics: Some general conclusions and new results from Apollo 16 and 17. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2475-2499.
- Crozaz G., Drozd R., Hohenberg C., Morgan C., Walker R. and Yuhas D. (1974b) Lunar surface dynamics: Some general conclusions and new results from Apollo 16 and 17 (abs). *Lunar Sci.* **V**, 157-159. Lunar Planetary Institute, Houston.
- Crozaz G. and Plachy A.L. (1976) Origin of the Apollo 17 deep drill coarse-grained layer. *Proc. 7<sup>th</sup> Lunar Planet. Sci. Conf.* 123-131.
- Crozaz G. and Ross L.M. (1979) Deposition and irradiation of the Apollo 17 deep drill core. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1229-1241.
- Crozaz G., Poupeau G., Walker R.M., Zinner E. and Morrison D.A. (1977) The record of solar and galactic radiations in the ancient lunar regolith and their implications for the early history of Sun and Moon. *Phil. Trans. Roy. Soc. London* **A285**, 587-592.
- Cuk M., Gladman B.J. and Stewart S.T. (2010) Constraint on the source of lunar cataclysm impactors. *Icarus* **207**, 590-594.
- Cuk M. and Stewart S.T. (2012) Resonances and the angular momentum of the Earth-Moon system (abs#4006). **Early Solar System Impact Bombardment II**, Lunar Planet. Sci. Institute, Houston.
- Cukierman M. and Uhlmann D.A. (1972) Viscous flow of lunar compositions. *In The Apollo 15 Lunar Samples*, 57-59. Lunar Planetary Institute, Houston.

- Cukierman M., Klein L., Scherer G., Hopper R.W. and Uhlmann D.R. (1973) Viscous flow and crystallization behavior of selected lunar compositions. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2685-2696.
- Culler T.S., Becker T.A., Muller R.A. and Renne P.R. (2000) Lunar impact history from  $^{40}\text{Ar}/^{39}\text{Ar}$  dating of glass spherules. *Science* **287**, 1785 – 1788.
- Curtis D.B. and Wasserburg G.J. (1975) Apollo 17 neutron stratigraphy – sedimentation and mixing in the lunar regolith. *The Moon* **13**, 185-227.
- Curtis D.B. and Wasserburg G.J. (1977) Transport and erosional processes in the Taurus-Littrow Valley – Inferences from neutron fluences in lunar soils. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3045-3057.
- Cushing J.A., Taylor G.J., Norman M.D. and Keil K. (1993a) The granulite suite: Impact melts and metamorphic breccias of the early lunar crust (abs). *Lunar Planet. Sci. XXIV*, 369-370. Lunar Planetary Institute, Houston.
- Cushing J.A., Taylor G.J., Norman M.D. and Keil K. (1993b) Refining the granulite suite. *In Workshop on Geology of the Apollo 17 Landing Site*. LPI Tech. Rpt. 92-09.4-5. Lunar Planetary Institute, Houston.
- Cushing J.A., Taylor G.J., Norman M.D. and Keil K. (1999) The granulitic impactite suite: Impact melts and metamorphic breccias of the early lunar crust. *Meteorit. Planet. Sci.* **34**, 185-195.
- Cuttitta F., Rose H.J., Annell C.S., Carron M.K., Christian R.P., Dwornik E.J., Greenland L.P., Helz A.P. and Ligon D.T. (1971) Elemental composition of some Apollo 12 lunar rocks and soils. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1217-1229.
- Cuttitta R., Rose H.J., Annell C.S., Carron M.K., Christian R.P., Ligon D.T., Dwornik E.J., Wright T.L. and Greenland L.P. (1973) Chemistry of twenty-one igneous rocks and soils returned by the Apollo 15 mission. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1081-1096.
- Czank M., Grigis K., Harnik A.B., Laves F., Schmit R., Schultz H. and Weber L. (1972) Crystallographic studies of lunar plagioclases from samples 14053, 14163, 14301 and 14310. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 603-613.
- Czank M., Grigis K., Gubser R.A., Harnik A.B., Laves F., Schmit R., Schultz H. and Weber L. (1973) Temperature dependence of the diffuseness of c-reflections in Apollo 15 plagioclases (abs). *Lunar Sci. IV*, 169-171. Lunar Sci. Institute, Houston.
- Dabrowski A., Robens E., Mendyk E., Bischoff A., Schreiber A., Gac W., Dumanski-Slowik M., Skrzypic K. and Goworek J. (2009) Determination of surface area, porosity and surface properties of lunar regolith. Characterization of Porous Solids VIII. *Royal Society of Chemistry Special Publications* **318**, 362-369.
- Dalrymple G.B. and Doell R.R. (1970) Thermoluminescence of lunar samples from Apollo 11. *Proc. Apollo 11 Lunar Science Conf.* 2081-2092.
- Dalrymple G.B. and Ryder G. (1991)  $^{40}\text{Ar}/^{39}\text{Ar}$  ages of six Apollo 15 impact melt rocks by laser step heating. *Geophys. Res. Lett.* **18**, 1163-1166.
- Dalrymple G.B. and Ryder G. (1993)  $^{40}\text{Ar}/^{39}\text{Ar}$  age spectra of Apollo 15 impact melt rocks by laser step-heating and their bearing on the history of lunar basin formation. *J. Geophys. Res.* **98**, 13,085-13,095.
- Dalrymple G.B. and Ryder G. (1996a)  $^{40}\text{Ar}/^{39}\text{Ar}$  laser step heating ages of some Apollo 17 melt rocks and the age of the Serenitatis impact (abs). *Lunar Planet. Sci. XXVII*, 285-286. Lunar Planetary Institute, Houston.

- Dalrymple G.B. and Ryder G. (1996b) Argon-40/argon-39 age spectra of Apollo 17 highlands breccia samples by laser step heating and the age of the Serenitatis basin. *J. Geophys. Res.* **101**, 26069-26084.
- Dankwerth P.A., Hess P.C. and Rutherford M.J. (1979) The solubility of sulfur in high-TiO<sub>2</sub> mare basalts. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 517-530.
- Dash E.J., Shih C.-Y., Bansal B.M., Wiesmann H. and Nyquist L.E. (1987) Isotopic analysis of basaltic fragments from lunar breccia 14321: Chronology and petrogenesis of pre-Imbrium mare volcanism. *Geochim. Cosmochim. Acta* **51**, 3241-3254.
- D'Amico J., DeFelice J. and Fireman E.L. (1970) The cosmic-ray and solar-flare bombardment of the moon. *Proc. Apollo 11 Lunar Sci. Conf.* 1029-1036.
- D'Amico J., DeFelice J., Fireman E.L., Jones C. and Spannagel G. (1971) Tritium and argon radioactivities and their depth variations in Apollo 12 samples. *Proc. 2<sup>nd</sup> Lunar Sci/ Conf.* 1825-1839.
- Dash E.J., Ryder G. and Nyquist L.E. (1989) Chronology and complexity of the lunar crust. *Tectonophysics* **161**, 157-164.
- Davenport J. and Neal C.R. (2012) revisiting the lunar magma ocean crystallization: Creating a unified hybrid model (abs). *43<sup>rd</sup> Lunar Sci. Conf.* @ the Woodlands
- Davis P.K., Lewis R.S. and Reynolds J.H. (1971) Stepwise heating analysis of rare gases from pile-irradiated rocks 10044 and 10057. *Proc. Second Lunar Sci. Conf.* 1693-1703.
- Day J.M.D., Pearson D.G. and Taylor L.A. (2007) Highly siderophile element constraints on accretion and differentiation of the Earth-Moon system. *Science* **315**, 217-219.
- Day J.M.D., Pearson D.G. and Taylor L.A. (2008) Accretion, differentiation and late bombardment history of the Moon deduced from Re-Os isotopic systematics of Mare basalts (abs#2253). *Lunar Planet. Sci. XXXIX*, Lunar Planetary Institute, Houston.
- Day J.M.D., Walker R.J., James O.B. and Puchel Igor (2010) Os isotope and high siderophile element systematic of the lunar crust. *Earth Planet. Sci. Lett.* **289**, 595-605.
- Day J.M.D. and Walker R.J. (2011) The highly siderophile element composition of the lunar mantle (abs#1288). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Dauber I.J., Kring D.A., Swindle T.D. and Jull A.J.T. (2002) Northwest Africa 482: A crystalline impact-melt breccia from the lunar highlands. *Meteor. & Planet. Sci.* **37**, 1797-1814.
- Delaney J.S. (1989) Lunar basalt breccia identified among Antarctic meteorites. *Nature* **342**, 889-890.
- Delaney J.S. and Sutton S.R. (1991) Fe-Mn-Mg in plagioclase from lunar basalt and highland samples (abs). *Lunar Planet. Sci.* **XXII**, 299-300. Lunar Planetary Institute, Houston.
- Delaney J.S., Sutton S.R., Bait S. and Smith J.V. (1992) In situ microXANES determination of ferrous/ferric ratio in terrestrial and extraterrestrial plagioclase: First reconnaissance (abs). *Lunar Planet. Sci.* **XXIII**, 299-300. Lunar Planetary Institute, Houston.
- Delano J.W. (1972) Petrologic examination of breccia 15465 and its implications as to the nature of the Apennine front. In **The Apollo 15 Lunar Samples**, 60-62. Lunar Planetary Institute, Houston.
- Delano J.W. (1975) Petrology of the Apollo 16 mare component: Mare Nectaris. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 15-47.

- Delano J.W. (1977) Experimental melting relations of 63545, 76015 and 76055. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2097-2123.
- Delano J.W. (1979) Apollo 15 green glass: Chemistry and possible origin. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 275-300.
- Delano J.W. (1980) Chemistry and liquidus relations of Apollo 15 red glass: Implications for the deep lunar interior. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 251-288.
- Delano J.W. (1980) Constraints on the chemical nature of magmas parental to pristine highland cumulates (abs). *Lunar Planet. Sci.* **XI**, 216-218. Lunar Planetary Institute, Houston.
- Delano J.W. (1986) Pristine lunar glasses: Criteria, data and implications. *Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **91**, D201-D213.
- Delano J.W. (1987) Apollo 14 regolith breccias: Different glass populations and their potential for charting space/time variations. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 59-65. Lunar Planetary Institute, Houston.
- Delano J.W. (1991) Geochemical comparison of impact glasses from lunar meteorites ALHA81005 and MAC88105 and Apollo 16 regolith 64001. *Geochim. Cosmochim. Acta* **55**, 3019-3029.
- Delano J.W. (1993) Mare volcanism in the Taurus-Littrow region. *In Workshop on **Geology of the Apollo 17 Landing Site***. LPI Tech. Rpt. 92-09.5-6. Lunar Planetary Institute, Houston.
- Delano J.W. (2009) Scientific exploration of the Moon. *Elements* **5**, 11-16.
- Delano J.W., Bence A.E., Papike J.J. and Cameron K.L. (1973) Petrology of the 2 -4 mm soil fractions from the Descartes region of the moon and stratigraphic implications. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 537-551.
- Delano J.W. and Ringwood A.E. (1979) Indigenous abundances of siderophile elements in the lunar highlands: Implications for the origin of the Moon. *The Moon* **18**, 385-425.
- Delano J.W. and Ringwood A.E. (1978) Siderophile elements in the lunar highlands: Nature of the indigenous component and implications for origin of the Moon. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 111-159.
- Delano J.W. and Livi K. (1981) Lunar volcanic glasses and their constraints on mare petrogenesis. *Geochim. Cosmochim. Acta* **45**, 2137-2149.
- Delano J.W., Lindsley D.H. and Rudowski R. (1981) Glasses of impact origin from Apollo 11, 12, 15 and 16: Evidence for fractional vaporization and mare/highland mixing. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 339-370.
- Delano J.W. and Lindsley D.H. (1982) Chromium, nickel, and titanium abundances in 74275 olivines: More evidence for a high-pressure origin of high-titanium mare basalts (abs). *Lunar Planet. Sci.* **XIII**, 160-161. Lunar Planetary Institute, Houston
- Delano J.W., Lindsley D.H., Ma M-S. and Schmitt R.A. (1982) The Apollo 15 yellow impact glasses: Chemistry, petrology, and exotic origin. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* A159-170.
- Delano J.W. and Lindsley D.H. (1983a) Mare volcanic glasses from Apollo 17 (abs). *Lunar Planet. Sci.* **XIV**, 156-157. Lunar Planetary Institute, Houston
- Delano J.W. and Lindsley D.H. (1983) Mare glasses from Apollo 17: Constraints on the moon's bulk composition. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **88**, B3-B16.

- Delano J.W., Hughes S.S. and Schmitt R.A. (1989) Apollo 14 pristine mare glasses. *In Moon in Transition: Apollo 14, KREEP, and Evolved Lunar Rocks*. LPI Tech Rpt. 89-03, 34-37. Lunar Planetary Institute, Houston.
- Delano J.W. and McGuire J. (1993) Abundances of sodium, sulfur, and potassium in lunar volcanic glasses: Evidence for volatile loss during eruption. *In Workshop on Geology of the Apollo 17 Landing Site*. LPI Tech. Rpt. 92-09. 7-8. Lunar Planetary Institute, Houston.
- Delano J.W., Zellner N.E.B., Barra F., Olson E., Swindle T.D., Tibbetts N.J. and Whittet D.C.B. (2007) An integrated approach to understanding Apollo 16 impact glasses: Chemistry, isotopes and shape. *Meteorit. & Planet. Sci.* **42**, 993-1004.
- de Laeter J.R., Vernon M.J. and Compston W. (1973) Revision of lunar Rb-Sr ages. *Geochem. Cosmochim. Acta* **37**, 700-702.
- Demidova S.I., Nazarov M.A., Anosova M.O., Kostitsyn Y.A., Brandstatter F. and Ntaflos Th. (2012) U-Pb dating of zircons from the Dhofar 1442 lunar meteorite (abs#1090). *Lunar Planet. Sci. Conf. XLIII* Lunar Planetary Institute @ The Woodlands.
- Dence M.R. (1977) The contribution of major impact processes to lunar crustal evolution. *Phil. Trans. Roy. Soc. London* **A285**, 259-266.
- Dence M.R., Douglas J.A.V., Plant A.G. and Traill R.J. (1970) Petrology, mineralogy and deformation of Apollo 11 samples. *Proc. Apollo 11 Lunar Science Conf.* 315-340.
- Dence M.R., Douglas J.A.V., Plant A.G. and Traill R.J. (1971) Mineralogy and petrology of some Apollo 12 samples. *Proc. Second Lunar Sci. Conf.* 285-299.
- Dence M.R. and Plant A.G. (1972) Analysis of Fra Mauro samples and the origin of the Imbrium Basin. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 379-399.
- Dence M.R. and Grieve R.A.F. (1976) Secondary impact mixing in the formation of Apollo 17 grey breccias (abs). *Lunar Sci.* VII, 196-198. Lunar Planetary Institute, Houston.
- Dence M.R., Grieve R.A.F. and Plant A.G. (1976) Apollo 17 grey breccias and crustal composition in the Serenitatis Basin region. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1821-1832.
- Des Marais David J. (1978a) Carbon, nitrogen and sulfur in Apollo 15, 16 and 17 rocks. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2451-2467.
- Des Marais D.J. (1978b) Carbon isotopes, nitrogen and sulfur in lunar rocks (abs). *Lunar Planet. Sci.* **IX**, 247-249. Lunar Planetary Institute, Houston.
- Des Marais D.J. (1980) Six lunar rocks have little carbon and nitrogen and some rocks have detectable spallogenic <sup>13</sup>C (abs). *Lunar Planet. Sci.* **XI**, 228-230. Lunar Planetary Institute, Houston.
- Des Marais D.J., Hayes J.M. and Meinschein W.G. (1972) The distribution in lunar soils of carbon released by pyrolysis. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1543-1558.
- Des Marais D.J., Hayes J.M. and Meinschein W.G. (1973a) Pyrolysis study of carbon in lunar fines and rocks. *In The Apollo 15 Lunar Samples*, 294-298. Lunar Sci. Institute, Houston.
- Des Marais D.J., Hayes J.M. and Meinschein W.G. (1973b) Accumulation of carbon in lunar soils. *Nature* **246**, 65-68.

- Des Marais D.J., Hayes J.M. and Meinschein W.G. (1974) The distribution in lunar soils of hydrogen released by pyrolysis. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1811-1822.
- Des Marais D.J., Basu A., Hayes J.M. and Meinschein W.G. (1975) Evolution of carbon isotopes, agglutinates, and the lunar regolith. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2353-2373.
- Deutsch A. and Stoffler D. (1987) Rb-Sr-analyses of Apollo 16 melt rocks and a new age estimate for the Imbrium basin: Lunar basin chronology and the early heavy bombardment of the moon. *Geochim. Cosmochim. Acta* **51**, 1951-1964.
- Devine J.M., McKay D.S. and Papike J.J. (1982) Lunar regolith: Petrology of the <10 micron fraction. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **87**, A260-A268.
- Dickey J.S. (1970) Nickel-iron in lunar anorthosites. *Earth Planet. Sci. Lett.* **8**, 387-392.
- Dickinson J.E. and Hess P.C. (1982) Zircon saturation in lunar basalts and granites. *Earth Planet. Sci. Lett.* **57**, 336-344.
- Dickinson T., Taylor G.J., Keil K., Schmitt R.A., Hughes S.S. and Smith M.R. (1985) Apollo 14 aluminous mare basalts and their possible relationship to KREEP. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **90**, C365-C374.
- Dickinson T., Bild R.W., Taylor G.J. and Keil K. (1988) Late-stage enrichment of Ge in the magma ocean: Evidence from lunar basalts (abs). *Lunar Planet. Sci.* **XIX**, 277-278. Lunar Planetary Institute, Houston.
- Dickinson T., Taylor G.J., Keil K. and Bild R.W. (1989) Germanium abundances in lunar basalts: Evidence of mantle metasomatism. *Proc. 19<sup>th</sup> Lunar Planet. Sci.* 189-198. Lunar Planetary Institute, Houston.
- Dikov Yu.P., Bogatkov O.A., Barsukov V.L., Florensky K.P., Ivanov A.V., Nemoshkalenko V.V. and Alyoshin V.G. (1978) Some features of surface layers. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2111-2124.
- Dikov Yu.P., Bogatkov O.A., Barsukov V.L., Florensky K.P., Ivanov A.V., Nemoshkalenko V.V. and Alyoshin V.G. (1979) Chemical peculiarities of particle surface layers of some Apollo 17 regolith samples. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1491-1505.
- Dixon J.R. and Papike J.J. (1975) Petrology of anorthosites from the Descartes region of the moon: Apollo 16. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 263-291.
- Dixon J.R. and Papike J.J. (1978) Petrologic history of Apollo 16 breccia 68815 (abs). *Lunar Planet. Sci.* **IX**, 253-255. Lunar Planetary Institute, Houston.
- Doe B.R. and Tatsumoto M. (1971) Volatilized lead from Apollo 12 and 14 soils. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1981-1988.
- Doell R.R. and Dalrymple G.B. (1971) Thermoluminescence of Apollo 12 lunar samples. *Earth Planet. Sci. Lett.* **10**, 357-360.
- Doell R.R. and Gromme C.S. (1970) Survey of magnetic properties of Apollo 11 samples at the Lunar Receiving Laboratory. *Proc. Apollo 11 Lunar Sci. Conf.* 2093-2096.
- Dollase W.A., Cliff R.A. and Wetherill G.W. (1971) Note on trymite in rock 12021. *Proc. Second Lunar Sci. Conf.* 141-142.
- Dollfus A. and Geake J.E. (1975) Polarimetric properties of the lunar surface and its interpretation: Part 7 – Other solar system objects. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2749-2768.



Dollfus A. and Geake J.E. (1977) Polarimetric and photometric studies of lunar samples. *Phil. Trans. Roy. Soc. London* **A285**, 397-402.

Domeneghetti M.C., McCallum I.S., Schwartz J.M., Camara F., Zema M., McCammon C. and Ganguly J. (2001) Complex cooling histories of lunar troctolite 76535 and Stillwater orthopyroxenite SC-936 (abs#1151). *Lunar Planet. Sci.* **XXX**, Lunar Planetary Institute, Houston.

Dominik B. and Jessberger E.K. (1978) Early lunar differentiates: 4.42-AE-old plagioclase clasts in Apollo 16 breccia 67435. *Earth Planet. Sci. Lett.* **38**, 407-415.

Donaldson C.H., Drever H.I. and Johnston R. (1977) Supercooling on the lunar surface: a review of analogue information. *Phil. Trans. Roy. Soc. London* **A285**, 207-218.

Donohue P. and Neal C.R. (2009) Apollo 17 high-titanium basalt petrogenesis revealed by crystal size distributions and mineral geochemistry (abs#1805). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.

Donohue P. and Neal C.R. (2012) Apollo 17 high-Ti basalt evolution: Whole rock vrs. mineral crystallization trends (abs). *43<sup>rd</sup> Lunar Sci. Conf.* @ the Woodlands

Dowty E., Keil K. and Prinz M. (1972) Anorthosite in the Apollo 15 rake samples from Spur Crater. *In The Apollo 15 Lunar Samples*, 62-65.

Dowty E., Conrad G.H., Green J.A., Hlava P.F., Keil K., Moore R.B., Nehru C.E. and Prinz M. (1973a) Catalog of Apollo 15 rake samples from stations 2 (St. George), 7 (Spur Crater) and 9a (Hadley Rille). *Inst. Meteoritics Spec. Publ. No 11*, 51-73. Univ. New Mex. ABQ.

Dowty E., Prinz M. and Keil K. (1973b) Composition, mineralogy, and petrology of 28 mare basalts from Apollo 15 rake samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 423-444.

Dowty E., Keil K. and Prinz M. (1973c) Major-element vapor fractionation on the lunar surface: An unusual lithic fragment from the Luna 20 fines. *Earth Planet. Sci. Lett.* **21**, 91-96.

Dowty E., Keil K. and Prinz M. (1974) Plagioclase twin laws in lunar highland rocks; possible petrogenetic significance. *Meteoritics* **9**, 183-197.

Dowty E., Keil K. and Prinz M. (1974a) Igneous rocks from Apollo 16 rake samples. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 431-445.

Dowty E., Prinz M. and Keil K. (1974b) Ferroan anorthosite: a widespread and distinctive lunar rock type. *Earth Planet. Sci. Lett.* **24**, 15-25.

Dowty E., Keil K. and Prinz M. (1974c) Lunar pyroxene-phyric basalts: Crystallization under supercooled conditions. *J. Petrology* **15**, 419-453.

Dowty E., Prinz M. and Keil K. (1974d) Very high alumina basalt: A mixture and not a magma type. *Science* **183**, 1214-1215.

Dowty E., Green J.A., Hlava P.F., Keil K., Moore R.B., Nehru C.E., Prinz M. and Warner R.D. (1976) Electron microprobe analyses of minerals from Apollo 16 rake samples. *Inst. Meteoritics Spec. Publ. No 14*, 141 pp.. Univ. New Mex. ABQ

Dowty E., Keil K., Prinz M., Gros J. and Takahashi H. (1976) Meteorite-free Apollo 15 crystalline KREEP. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1833-1844.

- Drake J.C. and Klein C. (1972) Mineralogical and chemical studies of breccia 15086. In **The Apollo 15 Lunar Samples**, 67-69.
- Drake J.C. and Klein C. (1973) Lithic fragments and glasses in microbreccia 15086: Their chemistry and occurrence. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 467-479.
- Drake M.J. (1974) Apollo 15 deep-drill-core: Classification, description and inventory of separated particles. Curator's Catalog. JSC.
- Drake M.J. (1975) Lunar anorthosite paradox. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 293-299.
- Drake M.J. (1983) Geochemical constraints on the origin of the Moon. *Geochim. Cosmochim. Acta* **47**, 1759-1767.
- Drake M.J., McCallum I.S., McKay G.A. and Weill D.F. (1970) Mineralogy and petrology of Apollo 12 sample no. 12013: a progress report. *Earth Planet. Sci. Lett.* **9**, 103-123.
- Drake M.J. and Weill D.F. (1971) Petrology of Apollo 11 sample 10071. A differentiated mini-igneous complex. *Earth Planet. Sci. Lett.* **13**, 61-70.
- Drake M.J. and Consolmagno G.J. (1976) Critical review of models for the evolution of high-Ti mare basalts. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1633-1657.
- Drake M.J., Newsom H.E. and Capobianco C.J. (1989) V, Cr and Mn in the Earth, Moon, EPB and SPB and the origin of the moon: Experimental studies. *Geochim. Cosmochim. Acta* **53**, 2101-2111.
- Dran J.C., Durrieu L., Jouret C. and Maurette M. (1970) Habit and texture studies of lunar and meteoritic material with the 1 MeV electron microscope. *Earth Planet. Sci. Lett.* **9**, 391-400.
- Dran J.C., Duraud J.P., Maurette M., Durrieu L., Jouret C. and Legressus C. (1972) Track metamorphism in extraterrestrial breccias. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2883-2903.
- Dran J.C., Duraud J.P., Klossa J., Langevin Y. and Maurette M. (1977) Microprobe studies of space weathering effects in extraterrestrial dust grains. *Phil. Trans. Roy. Soc. London* **A285**, 433-440.
- Dreibus G., Palme H., Rammensee W., Spettel B. and Wanke H. (1981) On mobilization and redistribution of Au and other siderophiles in lunar highland materials (abs). *Lunar Planet. Sci.* **XII**, 240-242. Lunar Planetary Institute, Houston.
- Dreibus G., Spettel B. and Wanke H. (1977) Lithium and halogens in lunar samples. *Phil. Trans. Roy. Soc. London* **A285**, 49-54.
- Drever H.I. and Johnston R. (1972) Metastable growth patterns in some terrestrial and lunar rocks. *Meteoritics* **7**, 327-340.
- Drever H.I., Johnston R., Butler P. and Gibb F.G.F. (1972) Some textures in Apollo 12 lunar igneous rocks and in terrestrial analogs. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 171-184.
- Drever H.I., Johnston R. and Brebner G. (1973) Radiate texture in lunar igneous rocks and terrestrial analogs (abs). *Lunar Sci.* **IV**, 187-189.
- Drozd R.J. (1974) Krypton and xenon in lunar and terrestrial samples. Ph.D. dissertation, Washington Univ. St. Louis.
- Drozd R.J., Hohenberg C.M. and Ragan D. (1973) Fission xenon from extinct <sup>244</sup>Pu in 14301. *Earth Planet. Sci. Lett.* **15**, 383-346.

- Drozd R.J., Hohenberg C.M., Morgan C.J. and Ralston C.E. (1974) Cosmic-ray exposure history at the Apollo 16 and other lunar sites: lunar surface dynamics. *Geochim. Cosmochim. Acta* **38**, 1625-1642.
- Drozd R., Hohenberg C. and Morgan C. (1975) Krypton and xenon in Apollo 14 samples: Fission and neutron capture effects in gas-rich samples. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1857-1877.
- Drozd R.J., Kennedy B.M., Morgan C.J., Podosek F.A. and Taylor G.J. (1976) The excess fission Xenon problem in lunar samples. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 599-623.
- Drozd R.J., Hohenberg C.M., Morgan C.J., Podosek F.A. and Wroge M.L. (1977) Cosmic-ray exposure history at Taurus-Littrow. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3027-3043.
- Duke M.B. (2003) Sample return from the lunar South Pole-Aitken basin. *Advances in Space Research* **31**, 2347-2352.
- Duke M.B. and Nagle J.S. (1974) **Lunar Core Catalog**. JSC09252. Curators' Office
- Duke M.B. and Nagle J.S. (1976) Lunar Core Catalog. JSC09252 rev. Curators' Office
- Duke M.B., Woo C.C., Sellers G.A., Bird M.L. and Finkelman R.B. (1970) Genesis of lunar soil at Tranquillity base. *Proc. Apollo 11 Lunar Sci. Conf.* 347-362.
- Duncan A.R., Erlank A.J., Willis J.P. and Ahrens L.H. (1973) Composition and inter-relationships of some Apollo 16 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1097-1113.
- Duncan A.R., Erlank A.J., Willis J.P., Sher M.K. and Ahrens L.H. (1974a) Trace element evidence for a two-stage origin of some titaniferous mare basalts. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1147-1157.
- Duncan A.R., Erlank A.J., Willis J.P., Sher M.K. and Ahrens L.H. (1974b) Trace element evidence for a two-stage origin of high-titanium mare basalts (abs). *Lunar Sci.* **V**, 187-189. Lunar Planetary Institute, Houston.
- Duncan A.R., Erlank A.J., Willis J.P. and Sher M.K. (1974c) Compositional characteristics of the Apollo 17 regolith (abs). *Lunar Sci.* **V**, 184-186. Lunar Planetary Institute, Houston
- Duncan A.R., McKay S.M., Stoesser J.W., Lindstrom M.M., Lindstrom D.J., Fruchter J.S. and Goles G.C. (1975a) Lunar polymict breccia 14321: A compositional study of its principal components. *Geochim. Cosmochim. Acta* **39**, 247-260.
- Duncan A.R., Sher M.K., Abraham Y.C., Erlank A.J., Willis J.P. and Ahrens L.H. (1975c) Interpretation of the compositional variability of Apollo 15 soils. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2309-2320.
- Duncan A.R., Grieve R.A.F. and Weill D.F. (1975b) The life and times of Big Bertha: Lunar breccia 14321. *Geochim. Cosmochim. Acta* **39**, 265-273.
- Duncan A.R., Erlank A.J., Sher M.K., Abraham Y.C., Willis J.P. and Ahrens L.H. (1976a) Some trace element constraints on lunar basalt genesis. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1659-1671.
- Duncan A.R., Sher M.K., Abraham Y.C., Erlank A.J., Willis J.P. and Ahrens L.H. (1976b) Source region constraints for lunar basalt types inferred from trace element chemistry (abs). *Lunar Sci.* **VII**, 218-220. Lunar Planetary Institute, Houston.
- Duncan R.A., Norman M.D., Ryder G., Dalrymple G.B. and Huard J.J. (2004) Identifying impact events within the lunar cataclysm from the  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  ages of Apollo 16 impact melt rocks (abs#1328). *Lunar Planet. Sci.* **XXXV**, Lunar Planetary Institute, Houston.

- Duncan R.A. and Norman Marc (2005) Assembly of the Descartes terrance: argon ages of lunar breccias 67016 and 67455 (abs). *Meteorit. Planet. Sci.* **40**, A41
- Dungan M.A. and Brown R.W. (1977) The petrology of the Apollo 12 basalt suite. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1339-1381.
- Dunlap D.J., Gose W.A., Pearce G.W. and Strangway D.W. (1973) Magnetic properties and granulometry of metallic iron in lunar breccia 14313. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2977-2990.
- Dunn J.R. and Fuller M. (1972) On the remanent magnetization of lunar samples with special reference to 10048,55 and 14053,48. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2363-2386.
- Dunn J.R., Fuller M. and Clauter D.A. (1981) On the estimation of lunar paleointensities: Studies of synthetic analogues of stably magnetized samples. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 1747-1758.
- Durrani S.A. (1972) Refrigeration of lunar samples destined for thermoluminescence studies. *Nature* **240**, 96-97.
- Durrani S.A. (1977) Charged-particle track analysis, thermoluminescence and microcratering studies of lunar samples. *Phil. Trans. Roy. Soc. London* **A285**, 309-318.
- Durrani S.A. and Hwang F.S.W. (1975) Thermoluminescence and thermal environment of some Apollo 17 fines. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2689-2702.
- Durrani S.A., Khazal K.A.R. and Ali A. (1976) Temperature and duration of some Apollo 17 boulder shadows. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1157-1177.
- Durrani S.A., Bull R.K. and McKeever S.W.S. (1978) Radiation and thermal histories of Luna 24 drill-core samples. In **Mare Crisium: The view from Luna 24**. *Geochim. Cosmochim. Acta* suppl. 9, 179-194. (ed. Merrill) Pergamon Press.
- Dust S. and Crozaz G. (1977) 68815 revisited. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2315-2319.
- Dwornik E.J., Annel C.S., Christian R.P., Cuttitta F., Finkelman R.B., Ligon D.T. and Rose H.J. (1974) Chemical and mineralogical composition of Surveyor 3 scoop sample 12039,9. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1009-1014.
- Dyal P., Parkin C.W., Sonett C.P., Dubois R.L. and Simmons G. (1972) Lunar Portable Magnetometer Experiment. In Apollo 16 Preliminary Science Report. NASA SP-315, 12-1
- Dyar Darby (1984) Experimental methods for quenching structures in lunar-analog silicate melts. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf. J. Geophys. Res.* **89**, C233-C239.
- Dyar M.D., Hibbitts K.A., King P.L., Breves E.A., Orlando T.M., Poston M.J., Grieves G.A., Tucker J.M. and Seaman S.J. (2012) Remote sensing of H in lunar surface materials: the effects of composition on hydrogen solubility and quantification (abs). *43<sup>rd</sup> Lunar Sci. Conf. @ the Woodlands*
- Dymek R.F., Albee A.L. and Chodos A.A. (1974) Glass-coated soil breccia 15205: Selenologic history and petrologic constraints on the nature of its source region. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 235-260.
- Dymek R.F., Albee A.L. and Chodos A.A. (1975a) Comparative mineralogy and petrology of Apollo 17 mare basalts: Samples 70215, 71055, 74255, and 75055. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 49-77.

- Dymek R.F., Albee A.L. and Chodos A.A. (1975b) Comparative petrology of lunar cumulate rocks of possible primary origin: Dunite 72415, troctolite 76535, norite 78235, and anorthosite 62237. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 301-341.
- Dymek R.F., Albee A.L. and Chodos A.A. (1976a) Petrology and origin of Boulders #2 and #3, Apollo 17 Station 2. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2335-2378.
- Dymek R.F., Albee A.L. and Chodos A.A. (1976b) Petrographic investigation of lunar sample 72435 with emphasis on the nature of its clasts (abs). *Lunar Sci.* **VII**, 227-229. Lunar Planetary Institute, Houston.
- Dymek R.F., Albee A.L. and Chodos A.A. (1976c) Chemical and mineralogical homogeneity of Boulder #2, Apollo 17 Station #2 (abs). *Lunar Sci.* **VII**, 230-232. Lunar Planetary Institute, Houston.
- Eberhardt P., Geiss J., Graf H., Grogler N., Krahenbuhl U., Schwaller H., Schwarzmuller J. and Stettler A. (1970) Correlation between rock type and irradiation history of Apollo 11 igneous rocks. *Earth Planet. Sci. Lett.* **10**, 67-72.
- Eberhardt P., Geiss J., Grogler N., Krahenbuhl U., Morgeli M., and Stettler A. (1971a) Potassium-Argon age of Apollo 11 rock 10003. *Earth Planet. Sci. Lett.* **11**, 245-246.
- Eberhardt P., Geiss J., Graf H. and Schwaller H. (1971b) On the origin of excess <sup>131</sup>Xe in lunar rocks. *Earth Planet. Sci. Lett.* **12**, 260-262.
- Eberhardt P., Geiss J., Graf H., Grogler N., Mendina M.D., Morgeli M., Schwaller H., Stettler A., Krahenbuhl U. and von Gunten H.R. (1972) Trapped solar wind noble gases in Apollo 12 lunar fines 12001 and Apollo 11 breccia 10046. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1821-1856.
- Eberhardt P., Geiss J., Grögler N. and Stettler A. (1973) How old is the crater Copernicus? *The Moon* **8**, 104-114.
- Eberhardt P., Eugster O., Geiss J., Graf H., Grögler N., Guggisberg S., Jungk M., Maurer P., Morgeli M. and Stettler A. (1974a) Solar wind and cosmic radiation history of Taurus-Littrow regolith (abs). *Lunar Sci.* **V**, 197-199. Lunar Planetary Institute, Houston.
- Eberhardt P., Geiss J., Graf H., Grogler N., Krahenbuhl U., Schwaller H. and Stettler A. (1974b) Noble gas investigations of lunar rocks 10017 and 10071. *Geochim. Cosmochim. Acta* **38**, 97-120.
- Eberhardt P., Eugster O., Geiss J., Graf H., Grögler N., Morgeli M. and Stettler A. (1975a) <sup>81</sup>Kr-Kr exposure ages of some Apollo 14, Apollo 16 and Apollo 17 rocks (abs). *Lunar Sci.* **VI**, 233-235. Lunar Planetary Institute, Houston.
- Eberhardt P., Eugster O., Geiss J., Grögler N., Jungck M., Mauer P., Mörgeli M. and Stettler A. (1975b) Shorty Crater, noble gasses, and chronology (abs). *Meteoritics* **10**, 93-94.
- Eberhardt P., Eugster O., Geiss J., Grogler N., Guggisberg S. and Morgeli M. (1976) Noble gases in the Apollo 16 special soils from the east west split and the permanently shadowed area. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 563-585.
- Ebihara M., Wolf R., Warren P.H. and Anders E. (1992) Trace elements in 59 mostly highland moon rocks. *Proc. 22<sup>nd</sup> Lunar Planet. Sci. Conf.* 417-426. Lunar Planetary Institute, Houston
- Eckert J.O., Taylor L.A. and Neal C.R. (1991a) Spinel troctolite from Apollo 17 breccia 73215: Evidence for petrogenesis as deep-seated lunar crust (abs). *Lunar Planet. Sci.* **XXII**, 329-330. Lunar Planetary Institute, Houston.

Eckert J.O., Taylor L.A., Neal C.R. and Schmitt R.A. (1991b) Cumulate lithologies and melt rocks from Apollo 17 breccias: Correlations of whole-rock and mineral chemistry (abs). *Lunar Planet. Sci.* **XXII**, 333-334. Lunar Planetary Institute, Houston.

Eckert J.O., Taylor L.A., Neal C.R. and Patchen A.D. (1991c) Anorthosites with negative Eu anomalies in Apollo 17 breccias: Further evidence for "REEP" metasomatism (abs). *Lunar Planet. Sci.* **XXII**, 331-332. Lunar Planetary Institute, Houston.

Edmunson Janet, Borg L.E., Nyquist L.E. and Asmerom Y. (2005) Three-system isotopic study of lunar norite 78238: Rb-Sr results (abs#1473). *Lunar Planet. Sci.* **XXXVI**, Lunar Planetary Institute, Houston.

Edmunson J., Gaffney A.M. and Borg L.E. (2006) Disturbance of U-Pb isotopic systematics in lunar samples: Mare basalt 10017 and norite 78235 (abs#1506). *Lunar Planet. Sci.* **XXXVII**, Lunar Planetary Institute, Houston.

Edmunson J., Nyquist L.E. and Borg L.E. (2007) Sm-Nd isotopic systematics of troctolite 76335 (abs#1962). *Lunar Planet. Sci.* **XXXVIII**, Lunar Planetary Institute, Houston.

Edmunson J., Borg L.E., Nyquist L.E. and Asmerom Y. (2009) A combined Sm-Nd, Rb-Sr, and U-Pb isotopic study of Mg-suite norite 78238: Further evidence for early differentiation of the Moon. *Geochim. Cosmochim. Acta* **73**, 514-527.

Edmunson J., Cohen B.A. and Spilde M.N. (2009) Characterizing the effect of shock on isotopic ages I: Ferroan anorthosite major elements (abs#2094). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.

Edmunson J. and Cohen B.A. (2009) Characterizing the effect of shock on isotopic ages II: Mg-suite troctolite major elements (abs). M&PS FRANCE

Edmunson J., Cohen B.A. Carpenter P., Zeigler R.A. and Jolliff B.L. (2010) Yttrium silicate in lunar troctolitic anorthosite 76335 (abs#2627). *Lunar Planet. Sci.* **IVL**, Lunar Planetary Institute, The Woodlands.

Egan W.G. and Hilgemann T. (1973) Optical constants for terrestrial analogs of lunar materials. *Astro. J.* **78**, 799-804.

Eglinton G., Maxwell J.R. and Pillinger C.T. (1972) Lunar carbon chemistry: Relations to and implications for terrestrial organic geochemistry. *Space Life Sci.* **3**, 497-506.

Eglinton G., Mays B.J., Pillinger C.T., Agrell S.O., Scoon J.H., Dran J.C., Maurette M., Bowell E., Dollfus A., Geake J.E., Schultz L. and Signer P. (1974) The history of lunar breccia 14267. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1159-1180.

Eglinton G. et al. (1977) The history of lunar breccia 15015. see European Consortium

Eglinton G. and 22 other (1977) The analysis of various size, visually selected and density and magnetically separated fractions of Luna 16 and 20 samples. *In Soviet-American Conf. on Cosmochemistry of the Moon and Planets*, 703-727. NASA-SP370.

Ehmann W.D. (1972) Elemental abundance studies of Apollo 15 and some Fra Mauro formation lunar samples. *In The Apollo 15 Lunar Samples* (Chamberlain J.W. and Watkins C., eds.), 214-216. Lunar Science Institute, Houston.

Ehmann W.D. and Morgan J.W. (1970) Oxygen, silicon and aluminium in Apollo 11 rocks and fines by 14 MeV Neutron Activation. *Proc. Apollo 11 Lunar Science Conf.* 1071-1079.

- Ehmann W.D. and Morgan J.W. (1971) Major element abundances in Apollo 12 rocks and fines by 14 MeV neutron activation. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1237-1245.
- Ehmann W.D., Gillum D.E. and Morgan J.W. (1972) Oxygen and bulk element composition studies of Apollo 14 and other lunar rocks and soil. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1149-1160.
- Ehmann W.D. and Chyi L.L. (1974) Abundances of the group IVB elements, Ti, Zr, and Hf and implications of their ratios in lunar materials. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1015-1024.
- Ehmann W.D., Miller M.D., Ma M.-S. and Pacer R.A. (1974) Compositional studies of the lunar regolith at the Apollo 17 site (abs). *Lunar Sci.* **V**, 203-205. Lunar Planetary Institute, Houston.
- Ehmann W.D., Chyi L.L., Garg A.N., Hawke B.R., Ma M.-S., Miller M.D., James W.D. and Pacer R.A. (1975a) Chemical studies of the lunar regolith with emphasis on zirconium and hafnium. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1351-1361.
- Ehmann W.D., Chyi L.L., Hawke B.R., Ma M.-S., Miller M.D. and Pacer R.A. (1975b) Chemical studies of the lunar regolith with emphasis on zirconium and hafnium (abs). *Lunar Sci.* **VI**, 236-238. Lunar Planetary Institute, Houston.
- Eichhorn G., James O.B., Schaeffer O.A. and Muller H.W. (1978a) Laser <sup>39</sup>Ar-<sup>40</sup>Ar dating of two clasts from consortium breccia 73215. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 855-876.
- Eichhorn G., James O.B., Schaeffer O.A. and Muller H.W. (1978b) Laser-probe <sup>39</sup>Ar-<sup>40</sup>Ar dating of two clasts from consortium breccia 73215 (abs). *Lunar Planet. Sci.* **IX**, 279-281. Lunar Planetary Institute, Houston.
- Eichhorn G., McGee J.J., James O.B. and Schaeffer O.A. (1979a) Consortium breccia 73255: Laser <sup>39</sup>Ar-<sup>40</sup>Ar dating of aphanite samples. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 763-788.
- Eichhorn G., James O.B., McGee J.J. and Schaeffer O.A. (1979b) Consortium breccia 73255: Preliminary <sup>39</sup>Ar-<sup>40</sup>Ar laser dating of aphanite samples (abs). *Lunar Planet. Sci.* **X**, 346-348. Lunar Planetary Institute, Houston.
- Eisentraut K.J., Black M.S., Hilman F.D., Sievers R.F. and Ross W.D. (1972) Beryllium and chromium abundances in Fra Mauro and Hadley-Apennine lunar samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1327-1333.
- Elardo S.M. and Draper D.S. (2000) Crystallization of a lunar magma ocean: Preliminary experimental results (abs#1181). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Elardo S.M., McCubbin F.M., Shearer C.K. and Draper D.S. (2011) Mechanisms for the depletion of chromium in Mg-suite parental magmas (abs#2309). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Elardo S.M., Draper D.S. and Shearer C.K. (2011) Lunar Magma Ocean crystallization revisited: Bulk composition, early cumulate mineralogy, and the source regions of the highlands Mg-suite. *Geochim. et Cosmochim. Acta* **75**, 3024-3045.
- Elardo S.M., McCubbin F.M. and Shearer C.K. (2012a) The origin of chromite symplectites in lunar troctolite 76535: A new look at an old rock (abs). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Elardo S.M., McCubbin F.M. and Shearer C.K. (2012b) Chromite symplectites in Mg-suite troctolite 76535 as evidence for infiltration metasomatism of a lunar layered intrusion. *Geochim. Cosmochim. Acta* **87**, 154-177.
- Eldridge J.S., O'Kelley G.D. and Northcutt K.J. (1972) Abundances of primordial and cosmogenic radionuclides in Apollo 14 rocks and fines. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1651-1658.

- Eldridge J.S., O'Kelley G.D. and Northcutt K.J. (1972) Concentrations of cosmogenic radionuclides in Apollo 15 rocks and soils. In **The Apollo 15 Lunar Samples** 357-359. Lunar Sci. Institute, Houston.
- Eldridge J.S., O'Kelley G.D. and Northcutt K.J. (1973) Radionuclide concentrations in Apollo 16 lunar samples determined by nondestructive gamma-ray spectrometry. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2115-2122.
- Eldridge J.S., O'Kelley G.D. and Northcutt K.J. (1974a) Primordial radioelement concentrations in rocks and soils from Taurus-Littrow. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1025-1033.
- Eldridge J.S., O'Kelley G.D. and Northcutt K.J. (1974b) Primordial radioelement concentrations in rocks and soils from Taurus-Littrow (abs). *Lunar Sci.* **V**, 206-208. Lunar Planetary Institute, Houston.
- Eldridge J.S., O'Kelley G.D. and Northcutt K.J. (1975a) Primordial and cosmogenic radionuclides in Descartes and Taurus-Littrow materials: extension of studies by nondestructive x-ray spectrometry. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1407-1418.
- Eldridge J.S., O'Kelley G.D. and Northcutt K.J. (1975b) Primordial radioelements and cosmogenic nuclides in rocks and soils from Descartes and Taurus-Littrow (abs). *Lunar Sci.* **VI**, 242-244. Lunar Planetary Institute, Houston.
- El Goresy A., Ramdohr P. and Taylor L.A. (1971a) The opaque minerals in the lunar rocks from Oceanus Procellarum. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 219-235.
- El Goresy A., Ramdohr P. and Taylor L.A. (1971b) The geochemistry of the opaque minerals in Apollo 14 crystalline rocks. *Earth Planet. Sci. Lett.* **13**, 121-129.
- El Goresy A., Taylor L.A. and Ramdohr P. (1972) Fra Mauro crystalline rocks: Mineralogy, geochemistry and subsolidus reduction of the opaque minerals. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 333-349.
- El Goresy A., Ramdohr P. and Medenbach O. (1973b) Lunar samples from Descartes site: Opaque mineralogy and geochemistry. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 733-750.
- El Goresy A., Ramdohr P., Pavicevic M., Medenbach O., Miller O. and Genter W. (1973c) Zinc, lead, chlorine and FeO(OH)-bearing assemblages in the Apollo 16 sample 66095: origin by impact of a comet or a carbonaceous chondrite? *Earth Planet. Sci. Lett.* **18**, 411-419.
- El Goresy A., Ramdohr P., Medenbach O. and Bernhardt H.-J. (1974a) Taurus-Littrow TiO<sub>2</sub>-rich basalts: Opaque mineralogy and geochemistry. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 627-652.
- El Goresy A., Ramdohr P., Medenbach O. and Bernhardt H.-J. (1974b) Taurus-Littrow crystalline rocks: Opaque mineralogy and geochemistry (abs). *Lunar Sci.* **V**, 209-211. Lunar Planetary Institute, Houston.
- El Goresy A. and Ramdohr P. (1975a) Subsidius reduction of lunar opaque oxides: Textures, assemblages, geochemistry, and evidence for a late-stage endogenic gaseous mixture. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 729-745.
- El Goresy A. and Ramdohr P. (1975b) Subsidius reduction of lunar opaque oxides: Evidence, assemblages, geochemical relevance, and evidence for a late-stage reducing gaseous mixture (abs). *Lunar Sci.* **VI**, 245-247. Lunar Planetary Institute, Houston.
- El Goresy A. and Ramdohr P. (1975c) Taurus-Littrow TiO<sub>2</sub>-rich basalts: Opaque mineralogy and geochemistry (abs). *Lunar Sci.* **VI**, 248-250. Lunar Planetary Institute, Houston.
- El Goresy A., Prinz M. and Ramdohr P. (1976a) Zoning in spinels as an indicator of the crystallization histories of mare basalts. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1261-1279.



- El Goresy A., von Engelhardt W., Arndt J. and Mangliers D. (1976b) Shocked norite 78235: Primary textures and shock features (abs). *Lunar Sci.* **VII**, 239-241. Lunar Planetary Institute, Houston.
- El Goresy A. and Ramdohr P. (1977a) Apollo 17 TiO<sub>2</sub>-rich basalts: Reverse spinel zoning as evidence for the subsolidus equilibration of the spinel-ilmenite assemblage. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1611-1624.
- El Goresy A. and Ramdohr P. (1977b) Apollo 17 TiO<sub>2</sub>-rich basalts: Spinel chemical bimodality in the two major basalt types and genetic significance of inverted zoning in chromian ulvospinel (abs). *Lunar Sci.* **VIII**, 281-283. Lunar Planetary Institute, Houston.
- Elkins L.T., Fernandes Vera A., Delano J.W. and Grove T.L. (2000) Origin of lunar ultramafic green glasses: Constraints from phase equilibrium studies. *Geochim. Cosmochim. Acta* **64**, 2339-2350.
- Elkins-Tanton L.T., Orman J.A.V., Hager B.H. and Grove T.L. (2002) Reexamination of the lunar magma ocean cumulate overturn hypothesis: melting or mixing is required. *Earth Planet. Sci. Lett.* **196**, 239-249.
- Elkins-Tanton Linda T., Hager B.H. and Grove T.L. (2004) Magmatic effects of the lunar late heavy bombardment. *Earth Planet. Sci. Lett.* **222**, 17-27.
- Elkins-Tanton L.T., Burgess Seth and Yin Q-Z. (2011) The lunar magma ocean: Reconciling the solidification process with lunar petrology and geochronology. *Earth Planet. Sci. Lett.* **304**, 326-336.
- Elkins-Tanton L.T. and Grove T.L. (2011) Water (hydrogen) in the lunar mantle: Results from petrology and magma ocean modeling. *Earth Planet. Sci. Lett.* **307**, 173-179.
- Engel A.E.J. and Engel Celeste G. (1970) Lunar rock compositions and some interpretations. *Proc. Apollo 11 Lunar Sci. Conf.* 1081-1084.
- Engel A.E.J., Engel C.G., Sutton A.L. and Myers A.T. (1971) Composition of five Apollo 11 and Apollo 12 rocks and one Apollo 11 soil and some petrogenetic considerations. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 439-448.
- von Engelhardt W. (1979) Ilmenite in the crystallization sequence of lunar rocks. *Proc. 10<sup>th</sup> Lunar Sci. Conf.* 677-694.
- von Engelhardt W., Arndt J., Muller W.F. and Stoffler D. (1970) Shock metamorphism of lunar rocks and origin of the regolith at the Apollo 11 landing site. *Proc. Apollo 11 Lunar Sci. Conf.* 363-384.
- von Engelhardt W., Arndt J., Muller W.F. and Stoffler D. (1971) Shock metamorphism and origin of regolith and breccias at the Apollo 11 and Apollo 12 landing sites. *Proc. Second Lunar Sci. Conf.* 833-854.
- von Engelhardt W., Arndt J., Stoffler D. and Schneider H. (1972) Apollo 14 regolith and fragmental rocks, their compositions and origins by impacts. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 753-770.
- von Engelhardt W., Arndt J. and Schneider H. (1972) Apollo 15 regolith and breccias. *In The Apollo 15 Lunar Samples*, 174-176. Lunar Sci. Institute, Houston.
- von Engelhardt W., Arndt J. and Schneider H. (1973) Apollo 15: Evolution of the regolith and origin of glasses. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 239-249.
- von Engelhardt W. and Stengelin R. (1977) Chemical changes at impact-induced phase transitions on the lunar surface. *Phil. Trans. Roy. Soc. London* **A285**, 285-292.
- von Engelhardt W. and Stengelin R. (1981) Normative composition and classification of lunar igneous rocks and glasses. II Lunar glasses. *Earth Planet. Sci. Lett.* **52**, 55-66.

- von Engelhardt W., Hurre H. and Luft E. (1976) Microimpact-induced changes of textural parameters and modal composition of the lunar regolith. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 373-392.
- Epstein S. and Taylor H.P. (1970) The concentration and isotopic composition of hydrogen, carbon and silicon in Apollo 11 lunar rocks and minerals. *Proc. Apollo 11 Lunar Sci. Conf.* 1085-1096.
- Epstein S. and Taylor H.P. (1971)  $O^{18}/O^{16}$ ,  $Si^{30}/Si^{28}$ , D/H, and  $C^{13}/C^{12}$  ratios in lunar samples. *Proc. Second Lunar Sci. Conf.* 1421-1441.
- Epstein S. and Taylor H.P. (1972)  $O^{18}/O^{16}$ ,  $Si^{30}/Si^{28}$ ,  $C^{13}/C^{12}$  and D/H studies of Apollo 14 and 15 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1429-1454.
- Epstein S. and Taylor H.P. (1973a)  $O^{18}/O^{16}$ ,  $Si^{30}/Si^{28}$ ,  $C^{13}/C^{12}$ , D/H and hydrogen and carbon concentration data on Apollo 17 soils (abs). *EOS Trans. AGU* **54**, 585-586.
- Epstein S. and Taylor H.P. (1973b) The isotopic composition and concentration of water, hydrogen, and carbon in some Apollo 15 and 16 soils and in the Apollo 17 orange soil. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1559-1575.
- Epstein S. and Taylor H.P. (1974) D/H,  $O^{18}/O^{16}$  of  $H_2O$  in the “rusty” breccias 66095 and the origin of “lunar water”. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1839-1854.
- Epstein S. and Taylor H.P. (1975) Investigation of carbon, hydrogen, oxygen and silicon isotope and concentration relationships on the grain surfaces of a variety of lunar soils and in some Apollo 15 and 16 core samples. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1771-1798.
- Esat T.M. and Taylor S.R. (1992) Magnesium isotope fractionation in lunar soils. *Geochim. Cosmochim. Acta* **56**, 1025-1031.
- Essene E.J., Ringwood A.E. and Ware N.G. (1970) Petrology of the lunar rocks from Apollo 11 landing site. *Proc. Apollo 11 Lunar Sci. Conf.* 385-397.
- Etique P., Derksen U., Funk H., Horn P., Signer P. and Wieler R. (1978) He, Ne, Ar in 61501 agglutinates: Implications to gas studies on complex samples. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2233-2267.
- Eugster O. (1971) Li, Be and B abundances in fines from the Apollo 11, Apollo 12, Apollo 14 and Luna 16 missions. *Earth Planet. Sci. Lett.* **12**, 273-281.
- Eugster O. (1985) Multistage exposure history of the 74261 soil constituents. *Proc. 16<sup>th</sup> Lunar Planet Sci. Conf.* D95-D102. JGR and Lunar Planet. Institute.
- Eugster Otto (1989) History of meteorites from the Moon collected in Antarctica. *Science* **245**, 1197-1202.
- Eugster O. (1999) Chronology of dimict breccias and the age of South Ray crater at the Apollo 16 site. *Meteor. & Planet. Sci.* **34**, 385-391.
- Eugster O. (2003) Cosmic-ray exposure ages of meteorites and lunar rocks and their significance. *Chemie der Erde* **63**, 3-30.
- Eugster O., Tera F., Burnett D.S. and Wasserburg G.J. (1970) The isotopic composition of Gd and the neutron capture effects in samples from Apollo 11. *Earth Planet. Sci. Lett.* **8**, 20-30.
- Eugster O., Eberhardt P., Geiss J., Grögler N., Jungck M. and Mörgeli M. (1975) Solar-wind-trapped and cosmic-ray-produced noble gases in Luna 20 soil. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1989-2007.

Eugster O., Eberhardt P., Geiss J., Grögler N., Jungck M. and Mörgeli M. (1977) The cosmic-ray exposure history of Shorty Crater samples; the age of Shorty Crater. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3059-3082.

Eugster O., Grögler N., Eberhardt P. and Geiss J. (1979) Double drive tube 74001/2: History of the black and orange glass; Determination of a pre-exposure 3.7 AE ago by  $^{136}\text{Xe}/^{235}\text{U}$  dating. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1351-1379.

Eugster O., Grogler N., Eberhardt P. and Geiss J. (1980) Noble gases trapped 3.7 AE ago in orange and black glasses from drive tubes 74001/2 (abs). *Lunar Planet. Sci. XI*, 268-270. Lunar Planetary Institute, Houston.

Eugster O., Grögler N., Eberhardt P. and Geiss J. (1980) Double drive tube 74001/2: Composition of noble gases trapped 3.7 AE ago. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1565-1592.

Eugster O., Grögler N., Eberhardt P., Geiss J. and Kiesel W. (1981) Double drive tube 74001/2: A two-stage exposure model based on noble gases, chemical abundances and predicted production rates. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 541-558.

Eugster O., Eberhardt P., Geiss J. and Grögler N. (1983) Neutron induced fission of uranium: a dating method for lunar surface material. *Science* **219**, 170-172.

Eugster O., Eberhardt P., Geiss J., Grogler N., Jungck M., Meier F., Morgell M. and Niederer F. (1984a) Cosmic ray exposure histories of Apollo 14, Apollo 15 and Apollo 16 rocks. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **89**, B498-B512.

Eugster O., Eberhardt P., Geiss J., Grögler N. and Schwaller H. (1984b) Cosmic ray exposure histories and  $^{235}\text{U}$ - $^{136}\text{Xe}$  dating of Apollo 11, Apollo 12, and Apollo 17 mare basalts. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **89**, C171-C181.

Eugster O. and Niedermann S. (1986) Single-stage exposure history of lunar highlands breccias 60018, 67435 and 67455. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **91**, E55-E63.

Eugster O., Terribilini Dario, Polnau E. and Kramers J. (2001) The antiquity indicator argon-40/argon-36 for lunar surface samples calibrated by uranium-235-xenon-136 dating. *Meteor. & Planet. Sci.* **36**, 1097-1115.

European Consortium (1974) The history of lunar breccia 15015 (abs). *Lunar Sci.* **V**, 217-219.

European Consortium (1977) The history of lunar breccia 15015. In **Lunar Sample Studies**, NASA SP-418. (ed. Phinney)

Evans H.T. (1970) The crystallography of lunar troilite. *Proc. Apollo 11 Lunar Sci. Conf.* 399-408.

Evans H.T., Huebner J.S. and Konnert J.A. (1978) The crystal structure and thermal history of orthopyroxene from lunar anorthosite 15415. *Earth Planet. Sci. Lett.* **37**, 476-484.

Evensen N.M., Murthy V.R. and Coscio M.R. (1973) Rb-Sr ages of some mare basalts and the isotopic and trace element systematics in lunar fines. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1707-1724.

Evensen N.M., Murthy V.R. and Coscio M.R. (1973b) Taurus-Littrow: Age of mare volcanism; chemical and Rb-Sr isotopic systematics of the dark mantle soil (abs). *EOS* **54**, 587-588. AGU

Evensen N.M., Murthy V.R. and Coscio M.R. (1974) Provenance of KREEP and the exotic component: Elemental and isotopic studies of grain size fractions in lunar soils. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1401-1418.

Fabel G.W., White W.B., White E.W. and Roy R. (1972) Structure of lunar glasses by Raman and soft x-ray spectroscopy. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 939-951.

Fagan T.J. and 16 coauthors (2002) Northwest Africa 032: Product of volcanism. *Meteor. & Planet. Sci.* 371-394.

Fagan A.L., Neal C.R. and Simonetti A. (2010) Apollo 14 olivine vitrophyres: Geochemical evidence for heterogeneous target materials (abs#2226). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands

Fagan A.L. and Neal C.R. (2011) Crystallization conditions of Apollo 16 impact melts (abs#2137). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands

Fagan A.L. and Neal C.R. (2012) Apollo 11-type basalts from Apollo 16: A new type of high-Ti basalt? (abs) *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands

Fagents Sara, Rumpf Elise, Crawford Ian, and Joy Katie (2010) Preservation potential of implanted solar wind volitites in lunar paleoregolith deposits buried by lava flows. *Icarus* **207**, 595-604.

Fallick A.E., Pillinger C.T. and Stephenson A. (1981a) Very fine iron in Apollo 16 soils: Observations and some theoretical aspects of magnetic response (abs). *Lunar Planet. Sci.* **XII**, 274-276.

Fallick A.E., Pillinger C.T. and Stephenson A. (1981b) Hydrolysable carbon, magnetic susceptibility and isothermal remanent magnetization measurements of highland sample 68501: Comments on carbon content and size distribution of finely divided lunar iron. *Proc. 10<sup>th</sup> Lunar Sci. Conf.* 1469-1481.

Fanale F.P., Nash D.B. and Cannon W.A. (1971) Lunar fines and terrestrial rock powders: relative surface areas and heats of adsorption. *J. Geophys. Res.* **76**, 6459-6461.

Fang C.Y., Yinnon H. and Uhlmann D.R. (1983) Cooling rates for glass containing lunar compositions. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* A907-911.

Fechtig H., Hartung J.B., Nagel K., Neukum G. and Storzer D. (1974a) Lunar microcrater studies, derived meteoroid fluxes, and comparison with satellite-borne experiments. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2463-2474.

Fechtig H., Hartung J.B., Nagel K., Neukum G. and Storzer D. (1974b) Microcrater studies, derived meteoroid fluxes and comparison with satellite experiments (abs). *Lunar Sci.* **V**, 22-224. Lunar Planetary Institute, Houston.

Fechtig H., Nagel K., Stahle V., Grogler N., Schneider E. and Neukum G. (1977) Impact phenomena on an Apollo 12 sample. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 889-899.

Fernandes Vera and Burgess Ray (2005) Volcanism in Mare Fecunditatis and Mare Crisium: Ar-Ar age studies. *Geochm. Cosmochim. Acta* **69**, 4919-4934.

Fernandes V.A., Burgess R., Bischoff A., Sokol A.K. and Haloda J. (2008) Kalahari 009 and NorthEast Africa 003: Young (<2.5 Ga) lunar mare basalts (abs#1511). *Lunar Planet. Sci.* **XXXIX**, Lunar Planetary Institute, Houston.

Fernandes V.A., Garrick-Bethell I., Shuster D.L. and Weiss B. (2008) Common 4.2 Ga impact age in samples from Apollo 16 and 17 (abs). *In Workshop on Early Solar System Bombardment.* Lunar Planetary Institute, Houston.

Fernandes V.A., Korotev R.L. and Renne P.R. (2009) <sup>40</sup>Ar-<sup>39</sup>Ar ages and chemical composition for lunar mare basalts: NWA 4734 and NWA 4898 (abs#1045). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.

- Fernandes V.A. and Fritz J.P. (2011)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  vrs. shock features in Apollo 16 and 17 samples (abs#1189). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Fernandez-Moran H., Ohtsuki M., Hafner S.S. and Virgo D. (1970) High voltage electron microscopy and electron diffraction of lunar pyroxenes. *Proc. Apollo 11 Lunar Sci. Conf.* 409-417.
- Fernandez-Moran H., Virgo D. and Ohtsuki M. (1973) High-resolution electron microscopy and electron diffraction of Apollo 15 lunar pyroxenes (abs). *Lunar Sci.* **IV**, 236-238.
- Fields P.R., Diamond H., Metta D.N., Rokop D.J. and Stevens C.M. (1972a)  $^{237}\text{Np}$ ,  $^{236}\text{U}$  and other actinides on the moon. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1637-1644.
- Fields P.R., Diamond H., Metta D.N. and Rokop D.J. (1972b) Lunar actinides. In **The Apollo 15 Lunar Samples**, 360-362.
- Finger L.W., Hafner S.S., Schurmann K., Virgo D. and Warburton D. (1972) Distinct cooling histories and reheating of Apollo 14 rocks (abs). *Lunar Sci.* **III**, 259-261. Lunar Planetary Institute, Houston.
- Filleux C., Tombrello T.A. and Burnett D.S. (1977) Direct measurement of surface carbon concentrations. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3755-3772.
- Filleux C., Spear R.H., Tombrello T.A. and Burnett D.S. (1978a) Direct measurement of surface carbon concentrations for lunar soil breccias. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 1599-1617.
- Filleux C., Spear R.H., Tombrello T.A. and Burnett D.S. (1978b) Carbon depth distributions for soil breccias (abs). *Lunar Planet. Sci.* **IX**, 317-319. Lunar Planetary Institute, Houston.
- Fillberto Justin, Jackson C., Le L. and Treiman A.H. (2009) Partitioning of Ni between olivine and in iron-rich basalt: Experiments and what not. *Amer. Mineral.* **94**, 256-261.
- Fimiani L. and 11 others (2012) Sources of live  $^{60}\text{Fe}$ ,  $^{10}\text{Be}$  and  $^{26}\text{Al}$  in lunar core 12025, core 15008, skim sample 69921, scoop sample 69941 and under-boulder sample 69961 (abs#1279). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Fink D., Klein J., Middleton R., Vogt S., Herzog G.F. and Reedy R.C. (1998)  $^{41}\text{Ca}$ ,  $^{26}\text{Al}$  and  $^{10}\text{Be}$  in lunar basalt 74275 and  $^{10}\text{Be}$  in double drive tube 74002/74001. *Geochim. Cosmochim. Acta* **62**, 2389-2402.
- Finkel R.C., Arnold J.R., Imamura M., Reedy R.C., Fruchter J.S., Loosli H.H., Evans J.C., Delany A.C. and Shedlovsky J.P. (1971) Depth variation of cosmogenic nuclides in a lunar surface rock and lunar fines. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1773-1789.
- Finkelman R.B. (1973) Analysis of the ultrafine fraction of the Apollo 14 regolith. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 179-189.
- Finkelman R.B., Baedeker P.A., Christian R.P., Berman S., Schnepfe M.M. and Rose H.J. (1975) Trace-element chemistry and reducing capacity of size fractions from the Apollo 16 regolith. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1385-1398.
- Finnerty A.A. and Rigden S.M. (1981) Olivine barometry: Application to pressure estimation for terrestrial and lunar rocks (abs). *Lunar Planet. Sci.* **XII**, 279-281. Lunar Planetary Institute, Houston.
- Finnila A., Hess P. and Rutherford M. (1994) Assimilation by lunar mare basalts: Melting of crustal material and dissolution of anorthosite. *J. Geophys. Res.* **99**, 14677-14690.
- Fireman E.L. (1972) Depth variation of  $^{37}\text{Ar}$  and  $^{39}\text{Ar}$  in lunar material. In **The Apollo 15 Lunar Samples**, 364-365. Lunar Science Institute, Houston.

- Fireman E.L., D'Amico J., DeFelice J. and Spannagel G. (1972) Radioactivities in returned lunar materials. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1747-1762.
- Fireman E.L., D'Amico J. and DeFelice J. (1973) Radioactivities vs. depth in Apollo 16 and 17 soil. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2131-2144.
- Fireman E.L., DeFelice J. and D'Amico J. (1976) Solar wind <sup>3</sup>H and <sup>14</sup>C abundances and solar surface processes. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 525-531.
- Fireman E.L., DeFelice J. and D'Amico J. (1977) <sup>14</sup>C in lunar soil: Temperature-release and grain-size dependence. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3749-3754.
- Fischer-Goedde Mario, Becker Harry and Wombacher F. (2010) Highly siderophile element abundances and <sup>187</sup>Os/<sup>188</sup>Os in lunar impact melt rocks: Implications for late accretion processes in the Earth-Moon system (abs#2262). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Fischer-Goedde M. and Becker H. (2011) What is the age of the Nectaris Basin? New Re-Os constraints for a pre-4.0 Ga bombardment history of the moon (abs#1414). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Fischer-Goedde M. and Becker H. (2012) Osmium isotope and highly siderophile element constraints on the ages and nature of meteoritic components in ancient lunar impact rocks. *Geochim. Cosmochim. Acta* **77**, 135-156.
- Fitoussi C., Bourdon B., Pahlevan K. and Wieler R. (2010) Si isotope constraints on the moon-forming impact (abs#2653) *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Flavill R.P., Allison R.J.J. and McDonnell J.A.M. (1978) Primary, secondary and tertiary microcrater populations on lunar rocks: Effects of hypervelocity impact microprojecta on primary populations. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2539-2556.
- Fleischer R.L. and Hart H.R. (1972) Particle track record of Apollo 15 green soil and rock. *In **The Apollo 15 Lunar Samples***, 368-370.
- Fleischer R.L. and Hart H.R. (1973a) Particle track record of Apollo 15 green soil and rock. *Earth Planet. Sci. Lett.* **18**, 357-364.
- Fleischer R.L. and Hart H.R. (1973b) Particle track record of Apollo 15 deep core from 54 to 80 cm depth. *Earth Planet. Sci. Lett.* **18**, 420-426.
- Fleischer R.L. and Hart H.R. (1974a) Uniformity of the uranium content of lunar green and orange glasses. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2251-2255.
- Fleischer R.L. and Hart H.R. (1974b) Particle track record of Apollo 16 rocks from Plum crater. *J. Geophys. Res.* **79**, 766-769.
- Fleischer R.L., Haines E.L., Hart H.R., Wood R.T. and Comstock G.M. (1970) The particle track record of the Sea of Tranquillity. *Proc. Apollo 11 Lunar Science Conference* 2103-2120.
- Fleischer R.L., Hart H.R., Comstock G.M. and Ewvarate A.O. (1971) The particle track record of the Ocean of Storms. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 2559-2568.
- Fleischer R.L., Hart H.R. and Comstock G.M. (1971) Very heavy solar cosmic rays: Energy spectrum and implications for lunar erosion. *Science* **171**, 1240-1243.

- Fleischer R.L., Hart H.R. and Giard W.R. (1973) Particle track record of Apollo 15 shocked crystalline rocks. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2307-2317.
- Flohr M.K and James O.B. (1983) Characterization of unique norite/gabbro clasts in breccias 67975 (abs). *Lunar Planet. Sci. XIV*, 197-198. Lunar Planetary Institute, Houston.
- Floran R.J., Cameron K.L., Bence A.E. and Papike J.J. (1972) Apollo 14 breccia 14313: a mineralogic and petrologic report. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 661-671.
- Floran R.J., Phinney W.C., Blanchard D.P., Warner J.L., Simonds C.H., Brown R.W., Brannon J.C. and Korotev R.L. (1976) A comparison between geochemistry and petrology of Apollo 16 – terrestrial impact melt analogs (abs). *Lunar Sci. VII*, 263-265. Lunar Science Institute, Houston.
- Florensky C.P., Basilevsky A.T., Ivanov A.V., Pronin A.A. and Rode O.D. (1977) Luna 24: geologic setting of landing site and characteristics of sample core (prelim. data). *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3257-3279.
- Flory D.A. and Simoneit B.R. (1972) Terrestrial contamination in Apollo lunar samples. *Space Life Sci.* **3**, 457-468.
- Flory D.A., Wikstrom S., Gupta S., Gibert J.M. and Oro J. (1972) Analysis of organogenic compounds in Apollo 11, 12 and 14 lunar samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2091-2108.
- Flory D.A., Oro J., Wikstrom S., Beaman D. and Nooner D. (1972) Analysis of organogenic compounds in Apollo 15 samples. In **The Apollo 15 Samples**, 275-279. LPI
- Floss C., James O.B., McGee J.J. and Crozaz G. (1998) Lunar ferroan anorthosite petrogenesis: Clues from trace distributions in FAN subgroups. *Geochim. Cosmochim. Acta* **62**, 1255-1283.
- FOCUS (1977) Friends of Crisium Unmanned Sampling – see explanation in Vaniman and Papike 1977.
- Ford C.E. (1976) Effects of explosive depressuration on lunar anorthositic gabbro melts. In Progress in Experimental Petrology. Natural Environment Research Council Rept. 3, pp. 176-178.
- Ford C.E., Biggar G.M., O'Hara M.J., Humphries D.J. and Spencer P.M. (1974) Origin of the lunar highlands (abs). *Lunar Sci. V*, 239-241. Lunar Planetary Institute, Houston.
- Ford C.E., O'Hara M.J. and Spencer P.M. (1977) The origin of lunar feldspathic liquids. *Phil. Trans. Roy. Soc. London* **A285**, 193-198.
- Foucade S. and Clayton R.N. (1984) Nitrogen isotopes in lunar highlands breccias. *Earth Planet. Sci. Lett.* **68**, 7-18.
- Fox S.W., Harada K. and Hare P.E. (1972) Amino acid precursors in lunar samples. *Space Life Sci.* **3**, 425-431.
- Fox S.W., Harada K. and Hare P.E. (1973) Accumulated analyses of amino acid precursors in returned lunar samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2241-2248.
- Freidman I., Gleason J.D. and Hardcastle K. (1970) Water, hydrogen, deuterium, carbon and <sup>12</sup>C content of selected lunar material. *Proc. Apollo 11 Lunar Science Conf.* 1103-1109.
- Freidman I., Hardcastle K. and Gleason J.D. (1974) Water and carbon in rusty rock 66095. *Science* **185**, 346-349.

Fredriksson K., Nelen J. and Melson W.G. (1970) Petrography and origin of lunar breccias and glasses. *Proc. Apollo 11 Lunar Science Conf.* 419-432.

Fredriksson K., Brenner P., Nelen J., Noonan A., Dube A. and Reid A. (1974) Comparative studies of impact glasses and breccias (abs). *Lunar Sci.* **V**, 245-247. Lunar Planetary Institute, Houston.

French B.M., Walter L.S. and Heinrich K.F.J. (1970) Quantitative mineralogy of an Apollo 11 lunar sample. *Proc. Apollo 11 Lunar Science Conf.* 433-444.

French B.M., Walter L.S., Heinrich K.F.J., Loman P.D., Doan A.S. and Adler I. (1972) Composition of major and minor minerals in five Apollo 12 crystalline rocks. NASA SP-306

French B.M. (1972) Shock metamorphism effects in the Luna 16 soil sample from Mare Fecunditatis. *Earth Planet. Sci. Lett.* **13**, 316-322.

French B.M. () What's New on the Moon.

French B.M. (1998) **Traces of Catastrophe**. LPI

Frick U., Bauer H., Funk H., Phinney D., Schafer C., Schultz L. and Signer P. (1973) Diffusion properties of light noble gases in lunar fines. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1987-2002.

Frick U., Becker R.H. and Pepin R.O. (1987) Solar wind record in the lunar regolith: nitrogen and noble gases. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 87-120. Lunar Planetary Institute, Houston

Friebele E.J., Griscom D.L., Marquardt C.L., Weeks R.A. and Prestel D. (1974) Temperature dependence of the ferromagnetic resonance linewidth of lunar soils. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2729-2736.

Friedman I., Gleason J.D. and Hardcastle K.G. (1970) Water, hydrogen, deuterium, carbon and C13 content of selected lunar material. *Proc. Apollo 11 Lunar Sci. Conf.* 1103-1109.

Friedman I., O'Neil J.R., Gleason J.D. and Hardcastle K.G. (1971) The carbon and hydrogen content and isotopic composition of some Apollo 12 materials. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1407-1415.

Friedman I., Hardcastle K.G. and Gleason J.D. (1972) Isotopic composition of carbon and hydrogen in some Apollo 14 and 15 samples. In **The Apollo 15 Lunar Samples**, 302-305. Lunar Planet. Instit. Houston.

Friedman I., Hardcastle K.G. and Gleason J.D. (1974) Water and carbon in rusty lunar rock 66095. *Science* **185**, 346-349.

Friedman B., Saal A.E., Hauri E.H., van Orman J. and Rutherford M.J. (2009) The volatile content of the Apollo 15 picritic glasses (abs#2444). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.

Friel J.J. and Goldstein J.I. (1977) Metallic phases in the Luna 24 soil samples. *Geophys. Res. Lett.* **10**, 481-483.

Fritz J.P. and Fernandes Vera (2012) The heavy bombardment of the Moon (abs#4044). Early Solar System Bombardment II, Lunar Planet. Sci. Institute, Houston.

Fron del J. W. (1975) **Lunar Mineralogy**. Wiley, N.Y. 325 pp.

Fron del C., Klein C., Ito J. and Drake J.C. (1970) Mineralogical and chemical studies of Apollo 11 lunar fines and selected rocks. *Proc. Apollo 11 Lunar Sci. Conf.* 445-474.



- Fron del C., Klein C. and Ito J. (1971) Mineralogical and chemical data on Apollo 12 lunar fines. *Proc. Second Lunar Sci. Conf.* 719-726.
- Fruchter J.S., Sto eser J.W., Lindstrom M.M. and G oles G.G. (1973) Apollo 15 clastic materials and their relationship to local geologic features. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1227-1237.
- Fruchter J.S., Kriedelbaugh S.J., Robyn M.A. and G oles G.G. (1974) Breccia 66055 and related clastic materials from the Descartes region, Apollo 16. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1035-1046.
- Fruchter J.S., Rancitelli L.A. and Perkins R.W. (1975) Primordial radionuclide variations in the Apollo 15 and 17 deep core samples and in Apollo 17 igneous rocks and breccias. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1399-1406.
- Fruchter J.S., Rancitelli L.A. and Perkins R.W. (1976) Recent and long-term mixing of the lunar regolith based on <sup>22</sup>Na and <sup>26</sup>Al measurements in Apollo 15, 16 and 17 deep drill stems and drive tubes. *Proc. 7<sup>th</sup> Lunar Planet. Sci. Conf.* 27-39.
- Fruchter J.S., Rancitelli L.A., Laul J.C. and Perkins R.W. (1977) Lunar regolith dynamics based on analysis of the cosmogenic radionuclides <sup>22</sup>Na, <sup>26</sup>Al and <sup>53</sup>Mn. *Proc. 8<sup>th</sup> Lunar Planet. Sci. Conf.* 3595-3605.
- Fruchter J.S., Rancitelli L.A., Evans J.C. and Perkins R.W. (1978a) Lunar surface processes and cosmic ray histories over the past several million years. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2019-2032.
- Fruchter J.S., Evans J.C., Rancitelli L.A. and Perkins R.W. (1978b) Lunar surface processes and cosmic ray histories over the past several million years (abs). *Lunar Planet. Sci. IX*, 350-352. Lunar Planetary Institute, Houston.
- Fruchter J.S., Reeves J.H., Evans J.C. and Perkins R.W. (1981) Studies of lunar regolith dynamics using measurements of cosmogenic radionuclides in lunar rocks, soils and cores. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 567-575.
- Fruchter J.S., Evans J.C., Reeves J.H. and Perkins R.W. (1982) Measurement of <sup>26</sup>Al in Apollo 15 core 15008 and <sup>22</sup>Na in Apollo 17 rock 74275 (abs). *Lunar Planet. Sci. XIII*, 243-244. Lunar Planetary Institute, Houston
- Fru land Ruth M. (1983) **Regolith Breccia Workbook**. Curatorial Branch Publication # 66. JSC 19045.
- Fru land R.M., Morris R.V., McKay D.S. and Clanton U.S. (1977) Apollo 17 ro py glasses. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3095-3111.
- Fru land R.M. and Reimold J.N. (1981) Introduction to the core samples from the Apollo 16 landing site. Curatorial Branch Pub. 58, JSC 17659
- Fru land R.M., Nagle J.S. and Allton J.H. (1981) Catalog of the Apollo 16 lunar core 60009/60010. Curatorial Branch Pub. 61, JSC 17172
- Fru land R.M., Cooper B.L., Gonzalez C.P. and McKay D.S. (2011) New technology/Old technology: Comparing lunar grain size distribution data and methods (abs#1587). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Fryxell R., Anderson D., Carrier D., Greenwood W. and Heiken G. (1970) Apollo 11 drive-tube core samples: an initial physical analysis of lunar surface sediment. *Proc. Apollo 11 Lunar Science. Conf.* 2121-21-26.

- Fryxell R. and Heiken G. (1971) Description, dissection and subsampling of Apollo 14 core sample 14230. Curators Report TMX 58070. MSC.
- Fryxell R. and Heiken G. (1974) Preservation of lunar core samples: Preparation and interpretation of three-dimensional stratigraphic sections. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 935-966.
- Fuchs L.H. (1970a) Fluorapatite and other accessory minerals in Apollo 11 rocks. *Proc. Apollo 11 Lunar Sci. Conf.* 475-479.
- Fuchs L.H. (1970b) Orthopyroxene-plagioclase fragments in lunar soil from Apollo 12. *Science* **169**, 866-867.
- Fuchs L.H. (1971) Orthopyroxene and orthopyroxene-bearing rock fragments rich in K, REE and P in Apollo 14 soil sample 14163. *Earth Planet. Sci. Lett.* **12**, 170-174.
- Fujii N. and Osako M. (1972) Thermal diffusivity of lunar rocks under atmospheric and vacuum conditions. *Earth Planet. Sci. Lett.* **18**, 65-71.
- Fuller M.D. (1974) Lunar magnetism. *Rev. Geophys. Space Phys.* **12**, 23-70.
- Fuller M.D. (1977) Review of effects of shock on magnetism of lunar samples. *Phil. Trans. Roy. Soc. London* **A285**, 409-416.
- Fuller M.D., Meshkov E., Ciscowski S.M. and Hale C.J. (1979) On the natural remanent magnetism of certain mare basalts. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 2211-2233.
- Fuller Mike and Weiss Ben J. (2009) The paleomagnetic record of the Apollo samples (abs#1192). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Funkhauser J.G., Schaeffer O.A., Bogard D.D. and Zahringer J. (1970) Gas analysis of the lunar surface. *Proc. Apollo 11 Lunar Sci. Conf.* 1111-1116.
- Funkhauser J.G. (1971) Noble gas analysis of KREEP fragments in lunar soil 12033 and 12070. *Earth Planet. Sci. Lett.* **12**, 263-272.
- Funkhauser J.G., Jessberger E., Muller O. and Zahringer J. (1971) Active and inert gasses in Apollo 12 and 11 samples released by crushing at room temperature and heating at low temperature. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1381-1396.
- Futaana Y., Barabash S., Wieser M., Holstrom M., Lue C., Wurz P., Schaufelberger A., Bhardwaj A., Dhanya M.B. and Asamura K. (2012) Empirical energy spectra of neutralized solar wind protons from the lunar regolith. *J. Geophys. Res.* **117**, E05005.
- Gaffney Amy M., Borg L.E. and Asmerom Y. (2005) <sup>238</sup>U-<sup>206</sup>Pb age and uranium-lead isotope systematics of mare basalt 10017 (abs#1478). *Lunar Planet. Sci.* **XXXVI**, Lunar Planetary Institute, Houston.
- Gaffney A.M., Borg L.E. and Asmerom Yemane (2007) Disturbance of Sm-Nd, Rb-Sr and U-Pb isochrons during shock and thermal metamorphism – An experimental approach (abs#1424). *Lunar Planet. Sci.* **XXXVII**, Lunar Planetary Institute, Houston.
- Gaffney A.M., Borg L.E. and Williams R.W. (2011) Combined Hf-Nd-Sr isotopic constraints on the mineralogical characteristics of Mare basalt sources (abs#1337). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.

- Gaffney A.M., Borg L.E., Asmerom Y., Shearer C.K. and Burger P.V. (2011) Disturbance of isotopic systematic during experimental shock and thermal metamorphism of a lunar basalt with implications for Martian meteorite chronology. *Meteorit. & Planet. Sci.* **46**, 35-52.
- Galbreath K.C., Shearer C.K., Papike J.J. and Shimizu N. (1990) Inter- and intra-group compositional variations in Apollo 15 pyroclastic green glass: An electron- and ion-microprobe study. *Geochim. Cosmochim. Acta* **54**, 2565-2575.
- Gale N.H. (1972) Uranium-lead systematics in lunar basalts. *Earth Planet. Sci. Lett.* **17**, 65-78.
- Galenas M.G., Gerasimenko I., James O.B., Putchel I.S. and Walker R.J. (2011) Continued study of highly siderophile element characteristics of Apollo 17 impact melt breccias (abs#1413). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Galenas M.G., Liu J.G. and Walker R.J. (2012) Os/Os and highly siderophile element characteristics of Apollo 16 and 17 impact-melt breccias (abs#4003) Early Solar System Impact Bombardment II. LPI, Houston.
- Gamble R.P., Coish R.A. and Taylor L.A. (1978) The consanguinity of the oldest Apollo 11 mare basalts. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 495-507.
- Gamble R.P. and Taylor L.A. (1979) The effects of kinetics on crystal-liquid partitioning in augite (abs). *Lunar Planet. Sci.* **X**, 419-421. Lunar Planetary Institute, Houston.
- Gamble R.P. and Taylor L.A. (1980) Crystal/liquid partitioning in augite: Effects of cooling rate. *Earth Planet. Sci. Lett.* **47**, 21-33.
- Gammage R.B. and Holmes H.F. (1975a) Blocking of the water-lunar fines reaction by air and water concentration effects. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3305-3316.
- Gammage R.B. and Holmes H.F. (1975b) Specific surface area as a maturity index of lunar fines. *Earth Planet. Sci. Lett.* **27**, 424 – 426..
- Gammage R.B. and Holmes H.F. (1977) Effect of annealing temperature on the reactivity of lunar fines towards adsorbed water. *Earth Planet. Sci. Lett.* **34**, 445-449.
- Ganapathy R., Keays R.R., Laul J.C. and Anders E. (1970) Trace elements in Apollo 11 lunar rocks: Implications for meteorite influx and origin of moon. *Proc. Apollo 11 Lunar Sci. Conf.* 1117-1142.
- Ganapathy R., Keays R.R. and Anders E. (1970) Apollo 12 lunar samples: Trace element analysis of a core and the uniformity of the regolith. *Science* **170**,533-535.
- Ganapathy R., Morgan J.W., Krahenbuhl U. and Anders E. (1973) Ancient meteoritic components in lunar highland rocks: Clues from trace elements in Apollo 15 and 16 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1239-1261.
- Ganapathy R., Morgan J.W., Higuchi H., Anders E. and Anderson A.T. (1974) Meteoritic and volatile elements in Apollo 16 rocks and in separated phases from 14306. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1659-1683.
- Gancarz A.J., Albee A.L. and Chodos A.A. (1971) Petrologic and mineralogic investigation of some crystalline rocks returned by Apollo 14 mission. *Earth Planet. Sci. Lett.* **12**, 1-18.
- Gancarz A.J., Albee A.L. and Chodos A.A. (1972) Comparative petrology of Apollo 16 sample 68415 and Apollo 14 samples 14276 and 14310. *Earth Planet. Sci. Lett.* **16**, 307-330.

- Garg A.N. and Ehmann W.N. (1976a) Zr-Hf fractionation in chemically defined lunar rock groups. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 3397-3410.
- Garg A.N. and Ehmann W.N. (1976b) Chemical fractionation in the lunar crust with emphasis on zirconium and hafnium (abs). *Lunar Sci.* **VII**, 281-283. Lunar Planetary Institute, Houston.
- Garlick G.F.J. (1977) Lunar surface movements – the evidence and the causes. *Phil. Trans. Roy. Soc. London* **A285**, 325-330.
- Garner E.L., Machlan L.A. and Barnes I.L. (1975) The isotopic composition of lithium, potassium, and rubidium in some Apollo 11, 12, 14, 15, and 16 samples. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1845-1855.
- Garrick-Bethell. I. and Weiss B.J. (2006) Blocking temperature relations for iron and the origins of lunar rock magnetism (abs#2413). *Lunar Planet. Sci.* **XXXVII**, Lunar Planetary Institute, Houston.
- Garrick-Bethell. I. and Weiss B.J. (2007) Early lunar magmatism (abs#2405). *Lunar Planet. Sci.* **XXXVIII**, Lunar Planetary Institute, Houston.
- Garrick-Bethell. I., Fernandes V.A., Weiss B.J. Shuster D.L. and Becker T.A. (2008) 4.2 billion year old ages from Apollo 16, 17 and the lunar farside: Age of the South Pole-Aitkin basin (abs)? **Workshop on Early Solar System Bombardment.** Lunar Planetary Institute, Houston.
- Garrick-Bethell. I. and Weiss B.J. (2009) Kamacite blocking temperatures and application to lunar magmatism. *Earth Planet. Sci. Lett.* **294**, 1-7.
- Garrick-Bethell. I., Weiss B.J., Shuster D.L. and Buz J. (2009) Early Lunar Magnetism. *Science* **323**, 356-359.
- Garrison J.R. and Taylor L.A. (1979) Breccia Guidebook No. 2 , 66095 “Rusty Rock”. JSC **16198**. Curatorial Branch, JSC 27 pp.
- Garrison J.R. and Taylor L.A. (1980) Genesis of highland basalt breccias: A view from 66095. In **Proc. Conf. Lunar Highland Crust** (ed. Papike and Merrill). 395-417. GCA Supp. 12, Lunar Planetary Institute, Houston.
- Garvin J.B., Head J.W. and Wilson L. (1982) Magma vesiculation in Apollo 15 mare basalts: Observations and theory (abs). *Lunar Planet. Sci.* **XIII** 255-256, Lunar Planetary Institute, Houston.
- Gast P.W. (1972) The chemical composition and structure of the moon. *The Moon* **5**, 121-148.
- Gast P.W. and Hubbard N.J. (1970a) Abundance of alkali metals, alkaline and rare earths and strontium-87/strontium-86 ratios in lunar samples. *Science* **167**, 485-487.
- Gast P.W., Hubbard N.J. and Wiesmann H. (1970b) Chemical composition and petrogenesis of basalts from Tranquillity Base. *Proc. Apollo 11 Lunar Sci. Conf.* 1143-1163.
- Gast P.W. and Hubbard N.J. (1970c) Rare earth abundances in soil and rocks from the Ocean of Storms. *Earth Planet. Sci. Lett.* **10**, 94-101.
- Gatehouse B.M., Grey I.E., Lovering J.F. and Wark D.A. (1977) Structural studies on tranquillityite and related synthetic phases. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1831-1838.
- Gattacceca J., Boustie M., Hood L., Cuq-Lelandais J.-P., Fuller M., Bezaeva N.S., deResseguier T. and Berthe L. (2010) Can the lunar crust be magnetized by shock? Sure! *Earth Planet. Sci. Lett.* **299**, 42-53.

- Gault D.E., Horz F. and Hartung J.B. (1972) Effects of microcratering on the lunar surface. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2713-2734.
- Garvin J.B., Head J.W. and Wilson L. (1982) Magma vesiculation in Apollo 15 mare basalts: observations and theory (abs). *Lunar Planet. Sci. XIII*, 255-256.
- Gay P., Bancroft G.M. and Brown M.G. (1970) Diffraction and Mossbauer studies of minerals from lunar soils and rocks. *Proc. Apollo 11 Lunar Sci. Conf.* 481-497.
- Gay P., Brown M.G. and Rickson K.O. (1970) Mineralogic studies of lunar rock 12013,10. *Earth Planet. Sci. Lett.* **9**, 124-126.
- Gay P., Brown M.G., Muir I.D., Bancroft G.M. and Williams PGL (1971) Mineralogical and petrographic investigations of some Apollo 12 samples. *Proc. Second Lunar Sci. Conf.* 377-392.
- Gay P., Brown M.G. and Muir I.D. (1972) Mineralogical and petrographic features of two Apollo 14 rocks. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 351-362.
- Gay P., Muir I.D. and Price G.G. (1972) Mineralogy and petrology of two Apollo 15 mare basalts. In **The Apollo 15 Lunar Samples**. 70-72. (Ed. Chaimberlain and Watkins) LPI
- Geake J.E., Walker G., Telfer D.J. and Mills A.A. (1977) The cause and significance of luminescence in lunar plagioclase. *Phil. Trans. Roy. Soc. London A285*, 403-408.
- Gehrke C.W. (1972) Gas-chromography in lunar organic analysis. *Space Life Sci.* **3**, 342-353.
- Gehrke C.W. and 7 authors (1972) Research for amino acids in lunar samples. *Space Life Sci.* **3**, 439-449.
- Geiss J., Eberhardt P., Grogler N., Guggisbert S., Maurer P. and Stettler A. (1977) Absolute time scale of lunar mare formation and filling. *Phil. Trans. Roy. Soc. London A285*, 151-158.
- Ghods A. and Arkani-Hamed J. (2007) Impact-induced convection as the main mechanism for the formation of lunar mare basalts. *J. Geophys. Res.* **112**, E03005
- Ghose S., Ng G. and Walter L.S. (1972) Clinopyroxenes from Apollo 12 and 14: Exsolution, domain structure and cation order (abs). *Lunar Sci.* **III**, 300-302. Lunar Planetary Institute, Houston.
- Ghose S., Ng G. and Walter L.S. (1972) Cliopyroxenes from Apollo 12 and 14: Exsolution, domain structure and cation order. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 507-531.
- Gibb F.G.F., Stumpfl E.F. and Zussman J. (1970) Opaque minerals in an Apollo 12 rock. *Earth Planet. Sci. Lett.* **9**, 217-224.
- Gibb F.G.F. and Zussman J. (1971) Zoned olivine in four Apollo 12 samples. *Earth Planet. Sci. Lett.* **11**, 161-167.
- Gibb T.C., Greatrex R., Greenwood N.N. and Battey M.H. (1972) Mossbauer studies of Apollo 14 lunar samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2479-2493.
- Gibb T.C., Greatrex R. and Greenwood N.N. (1977) An assessment of results obtained from Mosbauer spectra of lunar smples. *Phil. Trans. Roy. Soc. London A285*, 235-240.
- Gibbons R.V., Horz F. and Schaal R.B. (1976) The chemistry of some individual lunar soil agglutinates. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 405-422.

- Gibson E.K. (1977) Volatile elements, carbon, nitrogen, sulfur, potassium and rubidium in the lunar regolith. *Phys. Chem. Earth* **X**, 57-62.
- Gibson E.K. and Johnson S.M. (1971) Thermal analysis-inorganic gas release studies of lunar samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1351-1366.
- Gibson E.K. and Moore G.W. (1972a) Inorganic gas release and thermal analysis study of Apollo 14 and 15 soils. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2029-2040.
- Gibson E.K. and Moore G.W. (1972b) Compounds of the organogenic elements in Apollo 11 and 12 lunar samples: A review. *Space Life Sci.* **3**, 404-414.
- Gibson E.K. and Moore G.W. (1972c) Thermal analysis-inorganic gas release studies on Apollo 14, 15 and 16 lunar samples. *In The Apollo 15 Lunar Samples.* 307-310.
- Gibson E.K. and Hubbard N.J. (1972d) Thermal volatilization studies on lunar samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2003-2014.
- Gibson E.K. and Moore G.W. (1973a) Carbon, sulfur and inorganic gases abundances and distribution from soils collected at Shorty Crater on Apollo 17. *EOS Trans. AGU* **54**, 589-590.
- Gibson E.K. and Moore G.W. (1973b) Variable carbon contents of lunar soil 74220. *Earth Planet. Sci. Lett.* **20**, 404-408.
- Gibson E.K. and Moore G.W. (1973c) Volatile rich lunar soil: Evidence of possible cometary impact. *Science* **179**, 69-71.
- Gibson E.K. and Moore G.W. (1973) Carbon and sulfur distributions and abundances in lunar fines. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1577-1586.
- Gibson E.K. and Moore G.W. (1974a) Sulfur abundances and distributions in the valley of Taurus-Littrow. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1823-1837.
- Gibson E.K. and Moore G.W. (1974b) Total sulfur abundances and distributions in the valley of Taurus-Littrow: Evidence of mixing (abs). *Lunar Sci.* **V**, 267-269. Lunar Planetary Institute, Houston.
- Gibson E.K. and Chang S. (1974c) Abundance and isotopic composition of carbon in lunar rock 67016: suggestions of a carbonate-like phase (abs). *Lunar Sci.* **VI**, 287-289. Lunar Planetary Institute, Houston.
- Gibson E.K., Chang S., Lennon K., Moore G.W. and Pearce G.W. (1975a) Sulfur abundances and distributions in mare basalts and their source magmas. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1287-1301.
- Gibson E.K., Chang S., Lennon K., Moore G.W. and Pearce G.W. (1975b) Carbon, sulfur, hydrogen and metallic iron abundances in Apollo 15 and Apollo 17 basalts (abs). *Lunar Sci.* **VI**, 290-292. Lunar Planetary Institute, Houston.
- Gibson E.K., Usselman T.M. and Morris R.V. (1976a) Sulfur in the Apollo 17 basalts and their source regions. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1491-1505.
- Gibson E.K., Morris R.V. and Usselman T.M. (1976b) Nature of the sulfur in the Apollo 17 basalts and their source regions (abs). *Lunar Sci.* **VII**, 290-292. Lunar Planetary Institute, Houston.
- Gibson E.K., Brett R. and Andrawes F. (1977) Sulfur in lunar mare basalts as a function of bulk composition. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1417-1428.

- Gibson E.K. and Andrawes F.F. (1978a) Nature of the gases released from lunar rocks and soils upon crushing. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2433-2450.
- Gibson E.K. and Andrawes F.F. (1978b) Sulfur abundances in the 74001/74002 drive tube from Shorty Crater Apollo 17. *Proc. 9<sup>th</sup> Lunar Sci. Conf.* 2011-2017.
- Gibson E.K., Bustin R., Skaugset A., Can R.H., Wentworth S.J. and McKay D.S. (1987) Hydrogen distributions in lunar materials (abs). *Lunar Planet. Sci. XVIII*, 326-327. Lunar Planetary Institute, Houston.
- Gilbert G.K. (1893) The Moon's face – A study of the origin of its features. *Philos. Soc. Washington Bull.* **12**, 241-292.
- Giguere T., Taylor G.J., Hawke B.R. and Lucy P.G. (2000) The Ti contents of lunar mare basalts 9as seen from above). *Meteor. Planet. Sci.* **35**, 193-200.
- Gillis J.J., Jolliff B.L. and Korotev R.L. (2004) Lunar surface geochemistry: Global concentrations of Th, K, and FeO as derived from Lunar Prospector and Clementine data. *Geochim. Cosmochim. Acta* **68**, 3791-3805.
- Gillum D.E., Ehmann W.D., Wakita H. and Schmitt R.A. (1972) Bulk and rare earth abundances in Luna 16 soil levels A and D. *Earth Planet. Sci. Lett.* **13**, 444-449.
- Glass B.P. (1971) Investigation of glass recovered from Apollo 12 soil 12057. *J. Geophys. Res.* **76**, 5649-5657.
- Glass B.P. (1972) Major element composition of Apollo 15 glasses. *In The Apollo 15 Lunar Samples*, 73-75.
- Glass B. (1973) Major element composition of Luna 20 glass particles. *Geochim. Cosmochim. Acta* **37**, 841-846.
- Glass B.P. (1976a) High-silica lunar glasses in an Apollo 14 soil sample: Evidence for silicic lunar volcanism? *Earth Planet. Sci. Lett.* **33**, 79-85.
- Glass B.P. (1976b) Major element compositions of glasses from Apollo 11, 16 and 17 soil samples. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 679-693.
- Glass B.P. (1986) Lunar sample 14425: Not a lunar tektite. *Geochim. Cosmochim. Acta* **50**, 111-113.
- Glass B.P., Storzer D. and Wagner G.A. (1973) Chemistry and particle track studies of Apollo 14 glasses. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 927-937.
- Gleadow A.J.W., LeMaitre R.W., Sewell D.K.B. and Lovering J.F. (1974) Chemical discrimination of petrographically defined clast groups in Apollo 14 and 15 lunar breccias. *Chem. Geology* **14**, 39-61.
- Gnos E., Hofmann B.A., Al-Katgiri A., Lorenzetti S., Eugster O., Whitehouse M.J., Villa I.M., Jull and others (2004) Pinpointing the source of a lunar meteorite: Implications for the evolution of the Moon. *Science* **305**, 657-659.
- Goel P.S. and Kothari B.K. (1972) Total nitrogen contents of some Apollo 14 lunar samples by neutron activation analysis. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2041-2050.
- Goel P.S., Shukla P.N., Kothari B.K. and Garg A.N. (1975) Total nitrogen in lunar soils, breccias, and rocks. *Geochim. Cosmochim. Acta* **39**, 1347-1352.

- Gold T., Bilson E. and Baron R.L. (1977) The relationship of surface chemistry and albedo of lunar soil samples. *Phil. Trans. Roy. Soc. London* **A285**, 427-432.
- Gold T., Bilson E. and Baron R.L. (1976a) The surface chemical composition of lunar samples and its significance for optical properties. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 901-911.
- Gold T., Bilson E. and Baron R.L. (1976b) Electrical properties of Apollo 17 rock and soil samples and a summary of the electrical properties of lunar material at 450 MHz frequency. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2593-2603.
- Gold T., Bilson E. and Baron R.L. (1976c) Electrical properties of Apollo 17 rock and soil samples and a summary of the electrical properties of lunar material at 450 MHz frequency (abs). *Lunar Sci.* **VII**, 298-300. Lunar Planetary Institute, Houston.
- Goldberg R.H., Burnett D.S. and Tombrello T.A. (1975a) Fluorine surface films on lunar samples: Evidence for both lunar and terrestrial origins. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2189-2200.
- Goldberg R.H., Burnett D.S., Tombrello T.A. and Weller R.A. (1975b) Hydrogen, carbon and Teflon on the surfaces of lunar samples (abs). *Lunar Sci.* **VI**, 299-301. Lunar Planetary Institute, Houston.
- Goldberg R.H., Trombrello T.A. and Burnett D.S. (1976a) Fluorine as a constituent in lunar magmatic gases. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1597-1613.
- Goldberg R.H., Weller R.A., Trombrello T.A. and Burnett D.S. (1976b) Surface concentrations of F, H and C (abs). *Lunar Sci.* **VII**, 307-309. Lunar Planetary Institute, Houston.
- Goldstein J.I., Henderson E.P. and Yakowitz H. (1970) Investigation of lunar metal particles. *Proc. Apollo 11 Lunar Sci. Conf.* 499-512.
- Goldstein J.I. and Yakowitz H. (1971) Metallic inclusions and metal particles in the Apollo 12 lunar soil. *Proc. Second Lunar Sci. Conf.* 177-191.
- Goldstein J.I. and Blau P.J. (1973) Chemistry and thermal history of metal particles in Luna 20 soils. *Geochim. Cosmochim. Acta* **37**, 847-856.
- Goldstein J.I. and Axon H.J. (1972) Metallic particles from 3 Apollo 15 soils. In **The Apollo 15 Lunar Samples**, 78-80.
- Goldstein J.I., Hewins R.H. and Axon H.J. (1974) Metal silicate relationships in Apollo 17 soils. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 653-671.
- Goldstein J.I., Hewins R.H. and Romig A.D. (1976a) Carbides in lunar soils and rocks. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 807-818.
- Goldstein J.I., Hewins R.H. and Romig A.D. (1976b) Carbides in lunar soils and rocks (abs). *Lunar Sci.* **VII**, 310-312. Lunar Planetary Institute, Houston.
- Goles G. (1971) Comments on the genesis and evolution of Apollo XI soil. *Lithos* **4**, 71-81.
- Goles G. (1971b) Review of Apollo project. *Amer. Sci.* **59**, 326.
- Goles G., Randle K., Osawa M., Schmitt R.A., Wakita H., Ehmann W.D. and Morgan J.W. (1970) Elemental abundances by instrumental activation analyses in chips from 27 lunar rocks. *Proc. Apollo 11 Lunar Sci. Conf.* 1165-1176.



Goles G.G., Randle K., Osawa M., Lindstrom D.J., Jerome D.Y., Steinborn T.L., Beyer R.L., Martin M.R. and McKay S.M. (1970) Interpretations and speculations on elemental abundances in lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1177-1194.

Goles G.G., Duncan A.R., Lindstrom D.J., Martin M.R., Beyer R.L., Osawa M., Randle K., Meek L.T., Steinborn T.L. and McKay S.M. (1971) Analyses of Apollo 12 specimens: Compositional variations, differentiation processes, and lunar soil mixing models. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1063-1081.

Gomes R., Levison H.F., Tsiganis K. and Moridelli A. (2005) Origin of the cataclysmic late heavy bombardment period of the terrestrial planets. *Nature* **435**, 466-469.

Goodrich C.A., Taylor G.J., Keil K., Kallemeyn G.W. and Warren P.H. (1986) Alkali norite, troctolites, and VHK mare basalts from breccia 14304. *Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **91**, D305-D318.

Gooley R.C., Brett R. and Warner J.L. (1973) Crystallization history of metal particles in Apollo 16 rake samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 799-810.

Gooley R.C., Brett R., Warner J.L. and Smyth J.R. (1974) A lunar rock of deep crustal origin: Sample 76535. *Geochim. Cosmochim. Acta* **38**, 1329-1339.

Gopalan K. and Rao M.N. (1976) Solar cosmic ray effects in heavy noble gases of lunar soils and breccias. In *Lunar Sci.* **VII**, 316-318. The Lunar Sci. Inst. Houston.

Gopalan K., Kaushal S., Lee-Hu C. and Wetherill G.W. (1970) Rb-Sr and U, Th-Pb ages of lunar materials. *Proc. Apollo 11 Lunar Sci. Conf.* 1195-1206.

Gose S. and Wan C. (1973) Luna 20 pyroxenes: Evidence for a complex thermal history. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 901-907.

Gose W.A., Pearce G.W., Strangway D.W. and Carnes J. (1972) Magnetism of Apollo 15 samples. In **The Apollo 15 Lunar Samples** 430-434.

Gose W.A., Pearce G.W., Strangway D.W. and Larson E.E. (1972) Magnetic properties of Apollo 14 breccias and their correlation with metamorphism. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2387-2395.

Gose W.A., Strangway D.W. and Pearce G.W. (1973) A determination of the intensity of the ancient lunar magnetic field. *The Moon* **7**, 198-201.

Gose Wulf Achim and Carnes J.G. (1973) The time dependent magnetization of fine-grained iron in lunar breccias. *Earth Planet. Sci. Lett.* **20**, 100-106.

Gose W.A., Strangway D.W. and Pearce G.W. (1976) Origin of magnetization in lunar breccias: An example of thermal overprinting (abs). *Lunar Sci.* **VII**, 322-324. Lunar Planetary Institute, Houston

Gose W.A., Strangway D.W. and Pearce G.W. (1978) Origin of magnetization in lunar breccias: An example of thermal overprinting. *Earth Planet. Sci. Lett.* **38**, 373-384.

Goswami J.N. and Hutcheon I.D. (1975) Cosmic ray exposure history and compaction age of Boulder 1 from Station 2. *The Moon* **14**, 395-405.

Goswami J.N. and Lal D. (1974) Cosmic ray irradiation pattern at the Apollo 17 site: implications to lunar regolith dynamics. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2643-2662.

Goswami J.N., Braddy D. and Price P.B. (1976a) Microstratigraphy of the lunar regolith and compaction ages of lunar breccias. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 55-74.

- Goswami J.N., Hutcheon I.D. and Price P.B. (1975) Microcraters and solar flare tracks in crystals from carbonaceous chondrites and lunar breccias. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 543-562.
- Goswami J.N., Braddy D. and Price P.B. (1976b) Microstratigraphy of the lunar regolith and compaction ages of lunar breccias (abs). *Lunar Sci.* **VII**, 328-330. Lunar Planetary Institute, Houston.
- Goswami J.N. and Lal D. (1979) Depositional history of the Apollo 17 deep drill core based on particle track record. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1253-1267.
- Graham A.L. and Ringwood A.E. (1971) Lunar basalt genesis: The origin of the Europium anomaly. *Earth Planet. Sci. Lett.* **13**, 105-115.
- Graf J.C. (1993) Lunar Soils Grain Size Catalog. NASA Pub. 1265
- Graf H., Shirck J., Sun S and Walker R. (1973) Fission track astrology of three Apollo 14 gas-rich breccias. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2145-2155.
- Grange M.L., Nemchin A.A., Pidgeon R.T. and Meyer C. (2009) Early history of the moon: Zircon perspective (abs#1473). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Grange M.L., Nemchin A.A., Pidgeon R.T., Timms N., Muhling J.R. and Kennedy A.K. (2009) Thermal history recorded by Apollo 17 impact melt breccias 73217. *Geochim. Cosmochim. Acta* **73**, 3093-3107.
- Grange Marion L., Nemchin A.A. and Jourdan F. (2010) Review of ages of lunar impact rocks: Implications to the timing of Serenitatis and Imbrium impacts and the LHB model (abs#1275) *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Grange M.L., Nemchin A.A., Timms N., Pidgeon R.T. and Meyer C. (2011) Complex magmatic and impact history prior to 4.1 Ga recorded in zircon from Apollo 17 South Massif aphanitic breccia 73235. *Geochim. Cosmochim. Acta* **75**, 2213-2232.
- Grant R.W., Housley R.M., Szalkowski F.J. and Marcus H.L. (1974) Auger electron spectroscopy of lunar samples. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2423-2439.
- Green D.H., Ware N.G., Hibberson W.O. and Major A. (1971) Experimental petrology of Apollo 12 basalts: Part 1, Sample 12009. *Earth Planet. Sci. Lett.* **13**, 85-96.
- Green D.H., Ringwood A.E., Ware N.G., Hibberson W.O., Major A. and Kiss E. (1971) Experimental petrology and petrogenesis of Apollo 12 basalts. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 601-615.
- Green D.H., Ware N.G. and Hibberson W.O. (1972) Experimental evidence against the role of selective volatilization on the lunar surface. *Nature* **238**, 450.
- Green D.H. and Ringwood A.E. (1973) Significance of a primitive lunar basaltic composition present in Apollo 15 soils and breccias. *Earth Planet. Sci. Lett.* **19**, 1-8.
- Green D.H., Ringwood A.E., Ware N.G. and Hibberson W.O. (1974) Petrology and petrogenesis of Apollo 17 basalts and Apollo 17 orange glass (abs). *Lunar Sci.* **V**, 287-289. Lunar Planetary Institute, Houston.
- Green D.H., Ringwood A.E., Hibberson W.O. and Ware N.G. (1975a) Experimental petrology of Apollo 17 mare basalts. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 871-893.
- Green D.H., Ringwood A.E., Ware N.G. and Hibberson W.O. (1975b) Experimental petrology and petrogenesis of Apollo 17 mare basalts (abs). *Lunar Sci.* **VI**, 311-313. Lunar Planetary Institute, Houston.

- Green G.M., King D.T., Banholzer G.S. and King E.A. (1975) Size and modal analysis of fines and ultrafines from some Apollo 17 samples. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 517-527.
- Greenman N.N. and Gross H.G. (1972) Luminescence of Apollo 14 and Apollo 15 lunar samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2981-2995.
- Greenwood J.P., Itoh S., Sakamoto N., Taylor L.A., Warren P.H. and Yurimoto H. (2010) Water in Apollo rock samples and the D/H of lunar apatite (abs#2439). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Greenwood J.P., Itoh S., Sakamoto N., Warren P.H., Dyar M.D. and Yurimoto H. (2010) Origin of Lunar water and evidence for a wet Moon from D/H and water in lunar apatites (abs#2753). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Greenwood J.P., Itoh S., Sakamoto N., Warren P., Taylor L. and Yurimoto H. (2011) Hydrogen isotope ratios in lunar rocks indicate delivery of cometary water to the Moon. *Nature Geoscience* **4**, 79-82.
- Greenwood J.P., Itoh S., Sakamoto N., Warren P., Taylor L. and Yurimoto H. (2012). Lunar Apatite (abs). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Greenwood W.R. and Heiken G. (1970) Origin of glass deposits in lunar craters. *Science* **168**, 610-611.
- Gregor R.B. and Lytle F.W. (1983) Preliminary investigation of Ti-site geometry in lunar volcanic and impact glasses by x-ray absorption spectroscopy (abs). *Lunar Planet. Sci.* **XIV**, 257-258. Lunar Planetary Institute, Houston.
- Grieve R.A.F., McKay G.A. and Weill D.F. (1972) Microprobe studies of three Luna 16 basalt fragments. *Earth Planet. Sci. Lett.* **13**, 233-242.
- Grieve R.A.F. and Plant A.G. (1973) Partial melting on the lunar surface, as observed in glass coated Apollo 16 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 667-679.
- Grieve R.A.F., McKay G.A., Smith H.D. and Weill D.F. (1975) Lunar polymict breccia 14321: A petrographic study. *Geochim. Cosmochim. Acta* **39**, 229-245.
- Grieve R.A.F., Plant A.G. and Dence M.R. (1974) Lunar impact melts and terrestrial analogs: Their characteristics, formation and implications for crustal evolution. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 261-273.
- Grieve R.A.F., Cintala M.J. and Tagle R. (2007) Planetary Impacts. *In Encyclopedia of Solar System* (eds. McFadden, Weissman and Johnson) Elsevier
- Griffin W.L., Amli R. and Heier K.S. (1972) Whilockite and apatite from lunar rock 14310 and from odegarden, Norway. *Earth Planet. Sci. Lett.* **15**, 53-58.
- Griffiths S.A., Basu A., McKay D.S. and Nace G-A. (1981) Petrology of Apollo 15 station 9A surface and drive tube soils. *Proc. 12<sup>th</sup> Lunar Sci. Conf.* 475-484.
- Grimberg A., Bauer H., Bochsler P., Buhler F., Burnett D.S., Hays C.C., Heber V.S., Jurewicz A.J.G. and Wieler R. (2006) Solar wind neon from Genesis: Implications for the lunar noble gas record. *Science* **317**, 1133-1135.
- Griscom D.L., Friebele E.J. and Marquart C.L. (1973) Evidence for a ubiquitous, sub-microscopic "magnetite-like" constituent in lunar soils. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2709-2727.
- Griscom D.L., Marquart C.L. and Friebele E.J. (1975) Magnetic phases in lunar green and orange glass droplets: possible relics of mare volcanism (abs). *Lunar Sci.* **VI**, 315-317. Lunar Planetary Institute, Houston.

Grismore R., Llewellyn R.A., Brown M.D., Dowson S.T. and Cumblidge K. (2001) Measurements of the concentrations of <sup>26</sup>Al in lunar rocks 15555 and 60025. *Earth Planet Sci. Lett.* **187**, 163-171.

Gromme C.S. and Doell R.R. (1971) Magnetic properties of Apollo 12 lunar samples 12052 and 12065. *Proc. Second Lunar Sci. Conf.* 2491-2499.

Gros J., Takahashi H., Hertogen J., Morgan J.W. and Anders E. (1976) Composition of the projectiles that bombarded the lunar highlands. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2403-2425.

Gross J., Treiman A.H. and Filiberto J. (2011) Constraints on the geochemical variations and evolution of the lunar crust and mantle as revealed by Fe, Mn, Cr concentrations in olivine (abs). *Lunar and Planet. Sci. Conf. 42<sup>nd</sup>*, Woodlands

Gross J., Trieman A.H. and Mercer C. (2012) Sinking the lunar magma ocean: new evidence from meteorites and the retrun of serial magmatism (abs#2306). *43<sup>rd</sup> Lunar Planet. Sci. Conf.*@ The Woodlands

Grossman L., Clayton R.N. and Mayeda T.K. (1974) Oxygen isotopic constraints on the composition of the Moon. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1207-1212.

Grove T.L. (1978) Cooling histories of Luna 24 very low Ti (VLT) ferrobasalts: An experimental study. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 565-584.

Grove T.L. (1981) Compositional variations among Apollo 15 green glass spheres. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 935-948.

Grove T.L. (1982) Use of exsolution lamellae in lunar clinopyroxenes as cooling rate speedometers: an experimental calibration. *Amer. Min.* **67**, 251-268.

Grove T.L., Walker D., Longhi J., Stolper E. and Hays J.F. (1973) Petrology of 12002 and the origin of picritic basalts. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 995-1011.

Grove T.L. and Walker D. (1977) Cooling histories of Apollo 15 quartz-normative basalts. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1501-1520.

Grove T.L. and Bence A.E. (1977) Experimental study of pyroxene-liquid intractions in quartz-normative basalt 15597. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1549-1579.

Grove T.L. and Lindsley D.H. (1978) Compositional variation and origin of lunar ultramafic green glasses (abs). *Lunar Planet. Sci.* **IX**, 430-432. Lunar Planetary Institute, Houston.

Grove T.L. and Vaniman D.T. (1978) Experimental petrology of very low Ti (VLT) basalts. *In Mare Crisium*. 445-471. Lunar Planetary Institute, Houston.

Grove T.L. and Raudsepp M. (1978) Effects of kinetics on the crystallization of quartz normative basalt 15597: An experimental study. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 585-599.

Grove T.L. and Lindsley D.H. (1979) The partitioning of Fe, Mg, and Ca between pigeonite and liquid in lunar basalts (abs). *Lunar Planet. Sci.* **X**, 473-475. Lunar Planetary Institute, Houston.

Grove T.L. and Bence A.E. (1979) Crystallization kinetics in a multiply saturated basalt magma: An experimental study of Luna 24 ferrobasalt. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 439-478.

Grove T.L. and Beaty D.W. (1980) Classification, experimental petrology and possible volcanic histories of the Apollo 11 high-K basalts. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 149-177.

- Grove T.L. and Krawczynski M.J. (2009) Lunar mare volcanism: Where did the magmas come from? *Elements* **5**, 29-34.
- Guggisberg S., Eberhardt P., Geiss J., Grogler N., Stettler A., Brown G.M. and Peckett A. (1979) Classification of the Apollo-11 basalts according to Ar<sup>39</sup>-Ar<sup>40</sup> ages and petrological properties. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1-39.
- von Guten H.R., Krahenbuhl U., Grutter A., Jost D., Meyer G., Peng K., Wegmuller F. and Wytenbach A. (1978) Trace and major elements in grain size fraction of separated minerals and agglutinates of soil 70160 and implications on their origin. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2269-2286.
- von Guten H.R., Grutter A., Jost D., Krahenbuhl U., Meyer G. and Wegmuller F. (1979) Grain-size dependent distribution of elements and their origin in minerals and agglutinates of soil 75080. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1457-1468.
- von Guten H.R., Wegmuller F. and Krahenbuhl U. (1982) Low temperature volatilization on the Moon. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **87**, A279-A282.
- Haase I., Oberst J., Scholten F., Wahlisch M., Glaser P., Karachevtseva I. and Robinson M.S. (2012) Mapping the Apollo 17 landing site area based on Lunar Recon Orbiter images and Apollo surface photography. *J. Geophys. Res.* **117**, E00H20.
- Hackwill T. (2010) Stratigraphy, evolution and volume of basalts in Mare Serenitatis. *Meteoriti. & Planet Sci.* **45**, 210-219.
- Hafner S.S. and Virgo D. (1970) Temperature-dependent cation distributions in lunar and terrestrial pyroxenes. *Proc. Apollo 11 Lunar Sci. Conf.* 2183-2198.
- Hafner S.S., Virgo D. and Warburton D. (1971) Oxidation state of iron in plagioclase from lunar basalts. *Earth Planet. Sci. Lett.* **12**, 159-166.
- Hagerty J., Shearer C.K. and Papike J.J. (2005) Trace element characteristics of the Apollo 14 high-alumina basalts: Implications for early magmatism on the Moon. *Geochim. Cosmochim. Acta* **69**, 5831-5845.
- Hagerty J., Shearer C.K. and Vaniman D.T. (2006) Heat-producing elements in the lunar mantle: Insights from ion microprobe analyses of lunar pyroclastic glasses. *Geochim. Cosmochim. Acta* **70**, 3457-3476.
- Haggerty S.E. (1971a) Compositional variations in lunar spinels. *Nature* **233**, 156.
- Haggerty S.E. (1971b) Luna 16: An opaque mineral study and systematic examination of compositional variations of spinels from Mare Fecunditatis. *Earth Planet. Sci. Lett.* **13**, 328-352.
- Haggerty S.E. (1972a) Apollo 14: Subsolidus reduction and compositional variations of spinels. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 305-332.
- Haggerty S.E. (1972b) Chemical characteristics of spinels in some Apollo 15 basalts. *In The Apollo 15 Lunar Samples* 92-97. Lunar Science Institute.
- Haggerty S.E. (1972b) An enstatite chondrite from Hadley Rille. *In The Apollo 15 Lunar Samples* 85-86.
- Haggerty S.E. (1972c) Solid solution, subsolidus reduction and compositional characteristics of spinels in some Apollo 15 basalts. *Meteoritics* **7**, 353-370.

Haggerty S.E. (1972d) Luna 16: An opaque mineral study and a systematic examination of compositional variations of spinels from Mare Fecunditatis. *Earth Planet. Sci. Lett.* **13**, 328-352.

Haggerty S.E. (1973a) Amalcolite and genetically associated opaque minerals in the lunar samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 777-797.

Haggerty S.E. (1973b) Apollo 17: Armalcolite paragenesis and subsolidus reduction of chromian-ulvospinel and chromian-picro ilmenite (abs). *EOS Trans. AGU* **54**, 593-594.

Haggerty S.E. (1973) Luna 20: mineral chemistry of spinel, pleonaste, chromite, ulvospinel, ilmenite and rutile. *Geochim. Cosmochim. Acta* **37**, 857-868.

Haggerty S.E. (1973c) Ortho and para-armalcolite samples in Apollo 17. *Nature Phys. Sci.* **242**, 123-125.

Haggerty S.E. (1974) Apollo 17 orange glass: Textural and morphological characteristics of devitrification. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 193-205.

Haggerty S.E. (1975) Geochemistry of opaque oxides in troctolites and basalts from Taurus Littrow (abs). *Lunar Sci.* **VI**, 321-323. Lunar Planet. Institute, Houston.

Haggerty S.E. (1977a) Luna 24: Opaque mineral chemistry. *Geophys. Res. Lett.* **4**, 489-492.

Haggerty S.E. (1977b) Apollo 14: Oxide, metal and olivine mineral chemistries in 14072 with a bearing on the temporal relationships of subsolidus reduction. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1809-1829.

Haggerty S.E. (1978) Luna 24: Systematic in spinel mineral chemistry in the context of an intrusive petrogenetic grid. In **Mare Crisium: The view from Luna 24**. *Geochem. Cosmochim. Acta suppl.* 9, 523-536. (ed. Merrill) Pergamon Press.

Haggerty S.E., Boyd F.R., Bell P.M., Finger L.W. and Bryan W.B. (1970) Opaque minerals and olivine in lavas and breccias from Mare Tranquilitatis. *Proc. Apollo 11 Lunar Sci. Conf.* 513-538.

Haggerty S.E. and Meyer H.O.A. (1970) Apollo 12: Opaque oxides. *Earth Planet. Sci. Lett.* **9**, 379.

Haines E.L., Albee A.L., Chodos A.A. and Wasserburg G.J. (1971) Uranium-bearing minerals of lunar rock 12013. *Earth Planet. Sci. Lett.* **12**, 145-154.

Haines E.L. and Weiss J.R. (1978) KREEP fission track ages from Hadley Delta (abs). *Lunar Sci.* **IX**, 448-450.

Hale C.J., Fuller M. and Bailey R.C. (1978) On the application of microwave heating to lunar paleointensity determination. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 3165-3179.

Halliday A.N. (2000) Terrestrial accretion rates and the origin of the Moon. *Earth Planet. Sci. Lett.* **176**, 17-30.

Halliday A.N. (2004) Mixing, volatile loss and compositional change during the impact-driven accretion of the Earth. *Nature* **427**, 505-509.

Halliday A.N. (2008) A young Moon-forming giant impact at 80-110 million years accompanied by late-stage mixing, core-formation and degassing of the Earth. *Philos. Trans. R. Soc. Lond.* **A 366**, 4163-4181.

Halliday A.N. and Lee D.-C. (1999) Tungsten isotopes and the early development of the Earth and of the Moon. *Geochim. Cosmochim. Acta* **63**, 4157-4179.

- Halliday A.N., Rehkamper M., Lee D.-C. and Yi W. (1996) Early evolution of the Earth and Moon: new constraints from Hf-W isotope geochemistry. *Earth Planet. Sci. Lett.* **142**, 75-89.
- Halliday A.N., Lee D.-C. and Jacobsen S.B. (2000) Tungsten isotopes, the timing of metal-silicate fractionation, and the origin of the Earth and Moon. In **Origin of the Earth and Moon** (Canup and Righter eds)
- Hallis L.J., Anand M., Greenwood R.C., Miller M.F., Franchi I.A. and Russell S.S. (2010) The oxygen isotopic composition, petrology and geochemistry of mare-basalts: Evidence for large-scale compositional variation in the lunar mantle. *Geochim. Cosmochim. Acta* **74**, 6885-6899.
- Haloda J., Týcová P., Korotev R.L., Fernandes Vera, Burgess R., Thöni M., Jelenc M., Jakeš P., Gabzdyl P. and Košler J. (2009) Petrology, geochemistry, and age of low-Ti mare-basalt meteorite Northeast Africa 003-A: A possible member of the Apollo 15 mare basaltic suite. *Geochim. Cosmochim. Acta* **73**, 3450-3470.
- Hamilton P.B. and Nagy B. (1972) Problems in the search for amino acids in lunar fines. *Space Life Sci.* **3**, 432-38.
- Hanan B.B. and Tilton G.R. (1987) 60025: relict of primitive lunar crust? *Earth Planet. Sci. Lett.* **84**, 15-21.
- Handwerker C.A., Klein L.C., Onorato P.I.K. and Uhlmann D.R. (1977) Matrix glass vrs. intruded glass in lunar breccias 15286. *Proc. 8<sup>th</sup> Lunar Planet. Sci. Conf.* 2581-2592.
- Hansen E.C., Steele I.M. and Smith J.V. (1979a) Lunar highland rocks: Element partitioning among minerals 1: Electron microprobe analyses of Na, K, and Fe in plagioclase; mg partitioning with orthopyroxene. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 627-638.
- Hansen E.C., Steele I.M. and Smith J.V. (1979b) Minor elements in plagioclase from lunar highland rocks: New data, especially for granulitic impactites. In Papers Presented to the Conference on **the Lunar Highlands Crust**. LPI Contr. 394, 39-41. Lunar Planetary Institute, Houston.
- Hansen E.C., Steele I.M. and Smith J.V. (1979c) Minor elements in plagioclase and mafic minerals from lunar plagioclase-rich rocks (abs). *Lunar Planet. Sci.* **X**, 497-499. Lunar Planetary Institute, Houston.
- Hansen E.C., Smith J.V. and Steele I.M. (1980a) Minor elements in lunar olivine: Electron probe analyses of Na, Al, P, Ca, Ti, Cr, Mn, and Ni (abs). *Lunar Planet. Sci.* **XI**, 391-393. Lunar Planetary Institute, Houston.
- Hansen E.C., Smith J.V. and Steele I.M. (1980b) Petrology and mineral chemistry of 67667, a unique feldspathic ilmenite. *Proc. 11<sup>th</sup> Lunar Planet. Sci.* 523-533.
- Hapke B.W. (1972) Reflectance spectra of lunar dust grains with amorphous coatings. *Science* **177**, 535-536.
- Hapke B.W., Cassidy W. and Wells E. (1975) Effects of vapor-phase deposition processes on the optical, chemical and magnetic properties of the lunar regolith. *The Moon* **13**, 339-353.
- Hapke B.W., Partlow W.D., Wagner J.K. and Cohen A.J. (1978) Reflectance measurements of lunar materials in the vacuum ultraviolet. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2935-2947.
- Hare P.E. (1972) Ion-exchange chromatography in lunar organic analysis. *Space Life Sci.* **3**, 354-359.
- Hargraves R.B. and Hollister L.S. (1972) Mineralogic and petrologic study of lunar anorthosite slide 15415,18. *Science* **195**, 430-432.

- Hargraves R.B. and Dorety N. (1972a) Natural remanent magnetization in lunar breccia 14321. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2417-2421.
- Hargraves R.B. and Dorety N. (1972b) Remanent magnetism in four Apollo 15 igneous rock fragments. *In The Apollo 15 Lunar Samples* 415-417. Lunar Planetary Institute, Houston.
- Hargraves R.B. and Dorety N.F. (1975) Remanent magnetism in two Apollo 16 and two Apollo 17 rock samples (abs). *Lunar Sci.* **VI**, 331-333. Lunar Planetary Institute, Houston.
- Harrison W.J. and Horz F. (1981) Experimental shock metamorphism of calcic plagioclase (abs). *Lunar Planet. Sci.* **XII**, 395-397. Lunar Planetary Institute, Houston.
- Hart H.R., Comstock G.M. and Fleischer R.L. (1972) The particle track record of Fra Mauro. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2831-2844.
- Hartmann W.K. (2003) Megaregolith evolution and cratering cataclysm models – lunar cataclysm as a misconception (28 years later). *Meteor. & Planet. Sci.* **38**, 579-593.
- Hartmann W.K., Phillips R.J. and Taylor G.J. (1986) **Origin of the Moon.** Lunar Planetary Institute, Houston pp. 781.
- Hartung J.B. (1980) Lunar rock surfaces as detectors of solar processes. *In Proc. Conf. Ancient Sun* (Pepin et al. eds) *Geochim. Cosmochim. Acta, Suppl.* 13, 227-243. Lunar Planetary Institute, Houston.
- Hartung J.B. and Storzer D. (1974) Lunar microcraters and their solar flare track record. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2527-2541.
- Hartung J.B., Horz F. and Gault D.E. (1972) Lunar microcraters and interplanetary duct. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2735-2753.
- Hartung J.B., Horz F., Aitken F.K., Gault D.E. and Brownlee D.E. (1973) The development of microcrater populations on lunar rocks. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 3213-3234.
- Hartung J.B., Hodges F., Horz F. and Storzer D. (1975) Microcrater investigations on lunar rock 12002. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3351-3371.
- Hartung J.B., Plieninger T., Muller H.W. and Schaeffer O.A. (1977) Helium, neon, and argon on sunlit and shaded surfaces of lunar rock 12054. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 865-881
- Hartung J.B., Breig J.J. and Comstock G.M. (1977) Microcrater studies on 60015 do not support time variation of meteorite flux. *Lunar Sci.* **VIII**, 406-408.
- Hartung J.B., Hauser E.E., Horz F., Morrison D.A., Schonfeldt E., Zook H.A., Mandville J.C., Shaal R.B. and Zinner E. (1978) Lunar surface processes: Report of the 12054 consortium. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2507-2537.
- Hartung J.B., Nagel K. and El Goresy A. (1978) Chemical composition variations in microcrater pit glasses from lunar anorthosite, 65315. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2495-2506.
- Haselton J.D. and Nash W.P. (1975a) A model for the evolution of opaques in mare lavas. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 747-755.
- Haselton J.D. and Nash W.P. (1975b) Observations on titanium in lunar oxides and silicates (abs). *Lunar Sci.* **VI**, 343-345. Lunar Planetary Institute, Houston.



- Haselton J.D. and Nash W.P. (1975) Ilmenite-orthopyroxene intergrowths from the Moon and the Skaergaard intrusion. *Earth Planet. Sci. Lett.* **26**, 287-291.
- Hashizume K., Claussidon M., Marty B. and Robert F. (2000) Solar wind record on the Moon: Deciphering presolar from planetary nitrogen. *Science* **290**, 1142-1145.
- Haskin L.A. (1978) Trace element composition of Luna 24 Crisium VLT basalt. In **Mare Crisium: The View from Luna 24** (Merrill R.B. and Papike J.J., eds.) 593-611. Pergamon.
- Haskin L.A., Allen R.O., Helmke P.A., Paster T.P., Anderson M.R., Korotev R.L. and Zweifel K.A. (1970) Rare earths and other trace elements in Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1213-1231.
- Haskin L.A., Helmke P.A., Allen R.O., Anderson M.R., Korotev R.L. and Zweifel K.A. (1971) Rare-earth elements in Apollo 12 lunar materials. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1307-1317.
- Haskin L.A., Helmke P.A., Blanchard D.P., Jacobs J.W. and Telunder K. (1973) Major and trace element abundances in samples from the lunar highlands. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1275-1296.
- Haskin L.A., Shih C.-Y., Bansal B.M., Rhodes J.M., Wiesmann H. and Nyquist L.E. (1974a) Chemical evidence for the origin of 76535 as a cumulate. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1213-1225.
- Haskin L.A., Shih C.-Y., Bansal B.M., Rhodes J.M., Wiesmann H. and Nyquist L.E. (1974b) Chemical evidence for the origin of 76535 as a cumulate (abs). *Lunar Sci.* **V**, 313-315. Lunar Planetary Institute, Houston.
- Haskin L.A., Lindstrom M.M., Salpas P.A. and Lindstrom D.L. (1981) On compositional variations among lunar anorthosites. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 41-66.
- Haskin L.A. and Warren P.H. (1991) Lunar Chemistry. In **Lunar Sourcebook: a users guide to the moon**. (eds. Heiken et al. ) Cambridge Univ. Press.
- Haskin L.A., Korotev R.L., Rockow K.M. and Jolliff B.L. (1998) The case for an Imbrium origin of the Apollo thorium-rich impact-melt breccias. *Meteor. & Planet. Sci.* **33**, 959-975.
- Haskin L.A., Gillis J.J., Korotev R.L. and Jolliff B.L. (2000) The materials of the lunar Procellarum KREEP terrane: A synthesis of data from geomorphological mapping, remote sensing and sample analysis. *J. Geophys. Res.* **105**, 20403-20415.
- Haskin L.A., Moss B.E. and McKinnon W.B. (2003) On estimating the basin ejecta to regolith deposits of lunar sites. *Meteor. & Planet. Sci.* **38**, 13-33.
- Hauri E.H., Saal A.E., VanOrman J., Rutherford M.J. and Friedman B. (2009) New estimates of the water content of the moon from Apollo 15 picritic glasses (abs#2344). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Hauri E.H., Weinreich T., Saal A.E., Rutherford M.J. and VanOrman J. (2011) High Pre-eruptive water contents preserved in lunar melt inclusions. *Science* **333**, 213-215.
- Hawke B.R., Peterson C.A., Blewett D.T., Bussey D.B.J., Lucey P.G., Taylor G.J. and Spudis P.D. (2003) Distribution and modes of occurrence of lunar anorthosite. *J. Geophys. Res.* **108**, E6
- Hays J.F. and Walker D. (1977) Lunar igneous rocks and the nature of the lunar interior. In *The Soviet-American conference on cosmochemistry and the Moon and planets*. 127-151.
- Hays J.M. (1972) Extralunar sources for carbon on the moon. *Space Life Sci.* **3**, 474-483.

Hazen R.M., Mao H.K. and Bell P.M. (1977) Effects of compositional variation on absorption spectra of lunar olivines. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1081-1090.

Hazen R.M., Bell P.M. and Mao H.K. (1978) Effects of compositional variation on absorption spectra of lunar pyroxenes. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2919-2934.

Head J.W. (1974a) Morphology and structure of the Taurus-Littrow highlands (Apollo 17): Evidence for their origin and evolution. *The Moon* **9**, 355-395.

Head J.W. (1974b) Stratigraphy of the Descartes region (Apollo 16): Implications for the origin of samples. *The Moon* **11**, 77-99.

Head J.W. (1976a) Evidence for the sedimentary origin of Imbrium sculpture and lunar basin radial texture. *The Moon* **15**, 445-462.

Head J.W. (1976b) Lunar volcanism in space and time. *Rev. Geophys. Space Phys.* **14**, 265-300.

Head J.W. and Wilson L. (1992) Lunar mare volcanism: Stratigraphy, eruption conditions, and the evolution of secondary crusts. *Geochim. Cosmochim. Acta* **55**, 2155-2175.

Head J.W., Adams J.B., McCord T.B., Pieters C. and Zisk S. (1977) Regional stratigraphy and geologic history of Mare Crisium. In **Mare Crisium: The view from Luna 24**. *Geochem. Cosmochim. Acta suppl.* **9**, 43-74. (ed. Merrill) Pergamon Press.

Heavilon C.F. and Crozaz G. (1989) REE and selected minor and trace element microdistributions in some pristine lunar highlands rocks (abs). *Lunar Planet. Sci.* **XX**, 398-399. Lunar Planetary Institute, Houston.

Heber V.S., Baur H. and Wieler R. (2001) High resolution solar He record in lunar samples: Evidence for a temporal variation of the solar wind composition with time? (abs#1847) *Lunar Planet. Sci.* **XXXII**, Lunar Planetary Institute, Houston.

Heber Veronika S., Baur H. and Wieler R. (2003) Helium in lunar samples analyzed by high-resolution stepwise etching: Implications for the temporal constancy of solar wind isotopic composition. *Astrophysical J.* **597**, 602-614.

Heiken G.H. (1974) A catalog of lunar soils. *JSC Curator*

Heiken G.H. (1975) Petrology of lunar soils. *Rev. Geophys. Space Phys.* **13**, 567-587.

Heiken G. and McEwen M.C. (1972) The geologic setting of the Luna 20 site. *Earth Planet. Sci. Lett.* **17**, 3-6.

Heiken G.H., Butler P., Simonds C.H., Phinney W.C., Warner J., Schmitt H.H., Bogard D.D. and Pearce W.G. (1973a) Preliminary data on boulders at Station 6, Apollo 17 landing site. *NASA TMX-58116*, pp. 56.

Heiken G.H., McKay D.S. and Fruland R.M. (1973b) Apollo 16 soils – grain size analysis and petrography. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 251-266.

Heiken G.H. and McKay D.S. (1974) Petrology of Apollo 17 soils. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 843-860.

Heiken G.H., McKay D.S. and Brown R.W. (1974) Lunar deposits of possible pyroclastic origin. *Geochim. Cosmochim. Acta* **38**, 1703-1718.

Heiken G.H. and McKay D.S. (1977) A model for the eruption behavior of a volcanic vent in eastern Mare Serenitatis. *Proc. 8<sup>th</sup> Lunar Planet. Sci. Conf.* 3243-3255.

Heiken G.H. and McKay D.S. (1978) Petrology of a sequence of pyroclastic rocks from the valley of Taurus-Littrow (Apollo 17 landing site). *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 1933-1943.

Heiken G.H. and Vaniman D.T. (1989) Petrography of lunar ilmenite resources (abs). *Lunar Planet. Sci. XX*, 400-401. Lunar Planetary Institute, Houston.

Heiken G.H., Vaniman D.T. and French B. (1991) **Lunar Sourcebook**. Cambridge Univ. Press

Heiken G.H. and Jones Eric (2007) **On the Moon**. Springer-Praxis

Helmke P.A. and Haskin L.A. (1972) Rare earths and other trace elements in Apollo 15 samples. In **The Apollo 15 Lunar Samples** (Chamberlain J.W. and Watkins C., eds.), 217-220. Lunar Science Institute, Houston.

Helmke P.A., Haskin L.A., Korotev R.L. and Ziege K.E. (1972) Rare earths and other trace elements in Apollo 14 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1275-1292.

Helmke P.A. and Haskin L.A. (1972) Rare earths and other trace elements in Luna 16 soil. *Earth Planet. Sci. Lett.* **13**, 441-443.

Helmke P.A., Blanchard D.P., Jacobs J.W. and Haskin L.A. (1973) Rare earths, other trace elements and iron in Luna 20 samples. *Geochim. Cosmochim. Acta* **37**, 869-874.

Helmke P.A., Trelander K., Weiss C.K. and Haskin L.A. (1973) Trace elements in fines from the Apollo 15 drill. *Geochim. Cosmochim. Acta.* **37**, 706-708.

Helmke P.A., Blanchard D.P., Haskin L.A., Telander K., Weiss C. and Jacobs J.W. (1973) Major and trace elements in igneous rocks from Apollo 15. *The Moon* **8**, 129-148.

Helsley C.E. (1970) Magnetic properties of lunar samples 10022, 10069, 10084 and 10085. *Proc. Apollo 11 Lunar Sci. Conf.* 2213-2219.

Helsley C.E. (1971) Evidence for an ancient lunar magnetic field. *Proc. Second Lunar Sci. Conf.* 2485-2490.

Helz R.T. (1972) Rock 14068: An unusual lunar breccia. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 865-886.

Helz R.T. and Appleman D.E. (1973) Mineralogy, petrology and crystallization history of Apollo 16 rock 68415. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 643-659.

Helz R.T. and Appleman D.E. (1974) Poikilitic and cumulate textures in rock 77017, a crushed anorthositic gabbro (abs). *Lunar Sci.* **V**, 322-324. Lunar Planetary Institute, Houston.

Herd C.D.K., Dwarzski Rachel and Shearer Chip (2009) The behavior (bad) of Co and Ni in olivine in planetary basalts: An experimental investigation. *Amer. Mineral.* **94**, 244-255.

Herpers U., Herr W., Kulus H., Michel R., Thiel K. and Woelfle R. (1973) Manganese-53 profile, particle track studies and rhenium-187 isotopic anomaly of breccia 14305. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2157-2169.

Herr W., Herpers U. and Woelfle R. (1972) Study on the cosmic ray produced long-lived Mn<sup>53</sup> in Apollo 14 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1763-1769.

- Hertogen J., Janssens M.-J., Takahashi H., Palme H. and Anders E. (1977) Lunar basins and craters: Evidence for systematic compositional changes of bombarding population. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 17-45.
- Hertogen J. and Janssens M.-J. (1977) Is Osmium chemically fractionated in the moon? *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 47-52.
- Herzberg C.T. (1978) The bearing of spinel cataclasites on the crust-mantle structure of the Moon. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 319-336.
- Herzberg C.T. (1979) Identification of pristine lunar highland rocks: Criteria based on mineral chemistry and stability (abs). *Lunar Planet. Sci. X*, 537-539. Lunar Planetary Institute, Houston.
- Herzberg C.T. and Baker M.B. (1980) The cordierite-to-spinel-cataclasite transition: Structure of the lunar crust. *Proc. Conf. Lunar Highlands Crust.* *Geochim. Cosmochim. Acta*, Suppl. 12. Pergamon Press. 113-132. Lunar Planetary Institute, Houston.
- Herzenberg C.L. and Riley D.L. (1970) Analysis of first returned lunar samples by Mossbauer spectrometry. *Proc. Apollo 11 Lunar Sci. Conf.* 2221-2241.
- Herzenberg C.L., Moler R.B. and Riley D.L. (1971) Mossbauer instrumental analysis of Apollo 12 lunar rock and soil samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 2103-2123.
- Herzog G.F., Moynier F., Albarede F. and Brezhnoy A.A. (2009) Isotopic and elemental abundances of copper and zinc in lunar samples - - . *Geochim. Cosmochim. Acta* **73**, 5884-5904.
- Hess P.C. (1991) Diapirism and the origin of high TiO<sub>2</sub> mare glasses. *Geophys. Res. Lett.* **18**, 2069-2072.
- Hess P.C. (1994) Petrogenesis of lunar troctolites. *J. Geophys. Res.* **99**, 19083-19093.
- Hess P.C. (2000) Petrogenesis of lunar troctolites – Implications for the Moon and its evolution (abs#1389). *Lunar Planet. Sci. XXXI*, Lunar Planetary Institute, Houston.
- Hess P.C., Rutherford M.J., Guillemette R.N., Ryerson F.J. and Tudffeld H.A. (1975) Residual products of fractional crystallization of lunar magmas: An experimental study. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 895-909.
- Hess P.C., Rutherford M.J. and Campbell H.W. (1978) Ilmenite crystallization in nonmare basalt: Genesis of KREEP and high-Ti mare basalt. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 705-724.
- Hess P.C. and Parmentier E.M. (1995) A model for the thermal and chemical evolution of the Moon's interior: implications for the onset of Mare magmatism. *Earth Planet. Sci. Lett.* **134**, 501-514.
- Hess P.C. and Parmentier E.M. (2001) Thermal evolution of a thicker KREEP liquid layer. *J. Geophys. Res.* **106**, 28023-28032.
- Heuer A.H., Lally J.S., Christie J.M. and Radcliffe S.V. (1972) Phase transformations and exsolution in lunar and terrestrial calcic plagioclases. *Phil. Mag.* **26**, 465-482.
- Heuer A.H., Nord G.L., Radcliffe S.V., Fischer R.M., Lally J.S., Christie J.M. and Griggs D.T. (1972) High volatage electron peterographic study of Apollo 15 rocks. *In Apollo 15 Lunar Samples.* 98-102.
- Heuer A.H., Christie J.M., Lally J.S. and Nord G.L. (1974) Electron petrographic study of some Apollo 17 breccias. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 275-286.
- Hewins R.H. and Goldstein J.I. (1974) Metal-olivine association and Ni-Co contents in two Apollo 12 mare basalts. *Earth Planet. Sci. Lett.* **24**, 59-70.

- Hewins R.H. and Goldstein J.I. (1975a) The provenance of metal in anorthositic rocks. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 343-362.
- Hewins R.H. and Goldstein J.I. (1975b) The provenance of metal in anorthositic rocks (abs). *Lunar Sci. VI*, 358-360. Lunar Planetary Institute, Houston.
- Hewins R.H. and Goldstein J.I. (1975c) Comparison of silicate and metal geothermometers for lunar rocks (abs). *Lunar Sci. VI*, 356-358 Lunar Planetary Institute, Houston.
- Heymann D. (1975) Argon-lead isotopic correlation in samples from lunar maria: records from the ancient lunar regolith. *Earth Planet. Sci. Lett.* **27**, 445-448.
- Heymann D. (1977) The inert gases. *Phys. Chem. Earth X*, 45-55.
- Heymann D. and Yaniv A. (1970) Ar<sup>40</sup> anomaly in lunar samples from Apollo 11. *Proc. Apollo 11 Lunar Sci. Conf.* 1261-1267.
- Heymann D., Yaniv A. and Lakatos S. (1972a) Inert gases from Apollo 12, 14 and 15 fines. *Astrophys. J.* 1857-1863.
- Heymann D., Yaniv A. and Lakatos S. (1972b) Inert gas studies in (only) twelve particles. *Earth Planet. Sci. Lett.* **13**, 400-406.
- Heymann D., Yaniv A. and Lakatos S. (1972c) Inert gases from Apollo 12, 14 and 15 fines. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1857-1863.
- Heymann D. and Hubner W. (1974) Origin of the inert gases in "rusty rock" 66095. *Earth Planet. Sci. Lett.* **22**, 423-426.
- Heymann D., Jordan J.L., Walton J.R. and Lakatos S. (1974) An inert gas "borscht" from the Taurus-Littrow site (abs). *Lunar Sci. V*, 331-333.
- Heymann D., Walton J.R., Jordan J.L., Lakatos S. and Yaniv A. (1975) Light and dark soils at the Apollo 16 landing site. *The Moon* **13**, 81-110.
- Heymann D., Jordan J.L., Walker A., Dziczkaniec M., Rey J. and Palma R. (1976) Inert gas measurements in the Apollo 16 drill core and an evaluation of the stratigraphy and depositional history of this core. *Proc. 9<sup>th</sup> Lunar Sci. Conf.* 1885-1912.
- Heywood H. (1971) Particle size and shape distribution for lunar fines sample 12057,72. *Proc. Second Lunar Sci. Conf.* 1989-2001.
- Hidaka H., Ebihara M. and Yoneda S. (2000) Neutron capture effects on samarium, europium and gadolinium in Apollo 15 deep drill-core samples. *Meteor. & Planet. Sci.* **35**, 581-589.
- Hidaka H. and Yoneda S. (2006) Sm and Gd isotopic shifts for Apollo 16 and 17 drill stem samples and their implications for regolith history. *Geochim. Cosmochim. Acta* **71**, 1074-1086.
- Hiesinger H. and Head J.W. (2006) New views of lunar geoscience: An introduction and overview. *In Reviews in Mineralogy and Geochemistry* **60**, 1-81.
- Hiesinger H., Jaumann R., Neukum G. and Head J.W. (2000) Ages of mare basalts on the lunar nearside. *J. Geophys. Res.* **105**, 29239-29275.

- Higuchi H. and Morgan J.W. (1975a) Ancient meteoritic component in Apollo 17 boulders. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1625-1651.
- Higuchi H. and Morgan J.W. (1975b) Ancient meteoritic component in Apollo 17 boulders (abs). *Lunar Sci. VI*, 364-366. Lunar Planetary Institute, Houston.
- Hill S.M.R., Beaty D.W. and Albee A.L. (1980) Petrology of two Luna 24 samples: 24067,3200 and 24067,3600 (abs). *Lunar Planet. Sci. XI*, 400-402. Lunar Sci. Institute, Houston.
- Hill E., Mellin M.J., Deane B., Liu Y. and Taylor L.A. (2007) Apollo sample 70051 and high- and low-Ti lunar soil simulants MLS-1A and JSC-1A: Implications for future lunar exploration. *J. Geophys. Res.* **112**, E02006.
- Hintenberger H., Weber H.W., Voshage H, Wanke H., Begeman F. and Wlotzka F. (1970) Concentrations and isotopic abundances of the rare gases, hydrogen and nitrogen in Apollo 11 lunar fines. *Proc. Apollo 11 Lunar Sci. Conf.* 1269-1282.
- Hintenberger H., Weber H.W. and Takaoka N. (1971) Concentrations and isotopic abundances of the rare gases in lunar matter. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1607-1625.
- Hintenberger H. and Weber H.W. (1973) Trapped rare gases in lunar fines and breccias. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2003-2019.
- Hintenberger H., Weber H.W. and Schultz L. (1974a) Solar, spallogenic, and radiogenic rare gases in Apollo 17 soils and breccias. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2005-2022.
- Hintenberger H., Weber H.W. and Schultz L. (1974b) Solar, spallogenic, and radiogenic rare gases in Apollo 17 soils and breccias (abs). *Lunar Sci. V*, 334-336. Lunar Planetary Institute, Houston.
- Hintenberger H., Schultz L. and Weber H.W. (1975a) A comparison of noble gases in lunar fines and soil breccias: Implications for the origin of soil breccias. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2261-2270.
- Hintenberger H., Schultz L. and Weber H.W. (1975b) Differences of the rare gas abundance pattern between lunar soils and breccias (abs). *Lunar Sci. VI*, 367-369. Lunar Planetary Institute, Houston.
- Hintenberger H., Schultz L. and Weber H.W. (1975c) Rare gases in ilmenite and bulk samples of Apollo 17 soils and breccias (abs). *Lunar Sci. VI*, 370-372. Lunar Planetary Institute, Houston.
- Hinthorne J.R. and Andersen C.A. (1974) Uranium-lead and lead-lead ratios in lunar samples 66095 and 12013 by ion microprobe mass analysis (abs). *Lunar Science V*, 337-339. Lunar Science Institute, Houston.
- Hinthorne J.R., Conrad R.L. and Andersen C.A. (1975) Lead-lead and trace element abundances in lunar troctolite, 76535 (abs). *Lunar Sci. VI*, 373-375. Lunar Planetary Institute, Houston.
- Hinthorne J.R., Conrad R.L. and Church S.E. (1977) Lead-lead age and rare earth element determinations in lunar norite 78235 (abs). *Lunar Sci. VIII*, 444-446. Lunar Planetary Institute, Houston.
- Hinthorne J.R., Andersen C.A., Conrad R.L. and Lovering J.F. (1979) Single-grain <sup>207</sup>Pb/<sup>206</sup>Pb and U/Th age determinations with a 10-micron spatial resolution using the ion microprobe mass analyzer (IMMA). *Chem. Geology* **25**, 271-303.
- Hinton R.W. and Meyer C. (1991) Ion probe analysis of zircon and yttrium zirconate in a lunar granite (abs). *Lunar Planet. Sci. XXII*, 575-576.

- Hlava P.F., Prinz M. and Keil K. (1972) Niobian rutile in an Apollo 14 KREEP fragment. *Meteoritics* **7**, 479-485.
- Hlava P.F., Green J.A., Prinz M., Keil K., Dowty E. and Bunch T.E. (1973) Apollo 15 rake samples, microbreccias and non-mare rocks: Bulk rock, mineral and glass electron microprobe analyses. Inst. Meteoritics Spec. Publ. No 11, 51-73. Univ. New Mex. ABQ
- Hodges C.A., Muelberger W.R. and Ulrich G.E. (1973) Geologic setting of Apollo 16. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1-25.
- Hodges F.N. and Kushiro I. (1973) Petrology of Apollo 16 lunar highland rocks. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1033-1048.
- Hodges F.N. and Kushiro I. (1974a) Apollo 17 petrology and experimental determination of differentiation sequences in model Moon compositions. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 505-520.
- Hodges F.N. and Kushiro I. (1974b) Apollo 17 petrology and experimental determination of differentiation sequences in model Moon compositions (abs). *Lunar Sci.* **V**, 340-342. Lunar Planetary Institute, Houston.
- Hodgson G.W., Knenvolden K., Peterson E. and Ponnampereuma C. (1972) A quest for porphyrins in lunar soil: Samples from Apollo 11, 12, and 14. *Space Life Sci.* **3**, 419-424.
- Hoffman K.A. and Banerjee S.K. (1975) Magnetic “zig-zag” behavior in lunar rocks. *Earth Planet. Sci. Lett.* **25**, 331-337.
- Hohenberg C.M., Davis P.K., Kaiser W.A., Lewis R.S. and Reynolds J.H. (1970) Trapped and cosmogenic rare gases from stepwise heating of Apollo 11 samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1283-1309.
- Hohenberg C.M., Marti K., Podosek F.A., Reedy R.C. and Shirck J.R. (1978) Comparison between observed and predicted cosmogenic noble gases in lunar samples. *Proc. 9<sup>th</sup> Lunar Sci. Conf.* 2311-2344.
- Hohenberg C.M., Hudson B., Kennedy B.M. and Podosek F.A. (1980) Fission xenon in troctolite 76535. *In Proc. Conf. Lunar Highlands Crust.* Geochim. Cosmochim. Acta, Suppl. 12. Pergamon Press. 419-439. Lunar Planetary Institute, Houston.
- Holland P.T., Simoneit B.R., Wszolek P.C. and Burlingame A.L. (1972a) Compounds of carbon and other volatile elements in Apollo 14 and 15 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2131-2147.
- Holland P.T., Simoneit B.R., Wszolek P.C. and Burlingame A.L. (1972b) Study of carbon compounds in Apollo 12 and 14 samples. *Space Life Sci.* **3**, 551-561.
- Hollister L.S. (1973) Sample 67955: A description and a problem. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 633-641.
- Hollister L.S. and Hargraves R.B. (1970) Compositional zoning and its significance in pyroxenes from two coarse grained Apollo 11 samples. *Proc. Apollo 11 Lunar Sci. Conf.* 541-550.
- Hollister L.S., Trzcieski W.E., Hargraves R.B. and Kulick C.G. (1971) Petrogenetic significance of pyroxenes in two Apollo 12 samples. *Proc. Second Lunar Sci. Conf.* 529-557.
- Hollister L.S. and Kulick Ch.G. (1972) Luna 16 sample G36: Another crystalline product of an extremely mafic magma. *Earth Planet. Sci. Lett.* **13**, 312-315.
- Hollister L.S. and Crawford M.L. (1977) Melt immiscibility in Apollo 15 KREEP: Origin of the Fe-rich mare basalts. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2419-2432.

- Holmes H.F., Fuller E.L. and Gammage R.B. (1973) Interaction of gases with lunar materials – Apollo 12, 14 and 16 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2413-2424.
- Holmes H.F., Fuller E.L. and Gammage R.B. (1974) Some surface properties of Apollo 17 soils. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2275-2286.
- Hopper R.W., Onorato P. and Uhlmann D.R. (1974) Thermal histories and crystal distribution in partly devitrified lunar glasses cooled by radiation. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2257-2273
- Horai K. and Winkler J. (1975) Thermal diffusivity of three Apollo 17 rock samples: 70215,18, 77035,44 and 70017,77 (abs). *Lunar Sci.* **VI**, 390-392. Lunar Planetary Institute, Houston.
- Horai K. and Winkler J.L. (1976) Thermal diffusivity of four Apollo 17 rock samples. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 3183-3204.
- Horai K. and Winkler J.L. (1980) Thermal diffusivity of two Apollo 11 samples, 10020,44 and 10065,23: Effect of petrofabrics on the thermal conductivity of porous lunar rocks under vacuum. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1777-1788.
- Horn P., Jessberger E.K., Kirsten T. and Richter H. (1975a) <sup>39</sup>Ar/<sup>40</sup>Ar dating of lunar rocks: Effects of grain size and neutron irradiation. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1563-1591.
- Horn P., Kirsten T. and Jessberger E.K. (1975b) Are there Apollo 12 basalts younger than 3.1 b.y. Unsuccessful search for A12 mare basalts with crystallization ages below 3.1 b.y. *Meteoritics* **10**, 417-418.
- Horn P. and Kirsten T. (1977) Lunar highland stratigraphy and radiometric dating. *Phil. Trans. Roy. Soc. London* **A285**, 145-150.
- Hörz F. (1977) Impact cratering and regolith dynamics. *Phys. Chem. Earth* **X**, 3-15.
- Hörz F. (2000) Time-variable cratering rates? *Science* **288**, 2095.
- Hörz F., Hartung J.B. and Gault D.E. (1971a) Micrometeorite craters on lunar rock surfaces. *J. Geophys. Res.* **76**, 5770-5798.
- Hörz F., Hartung J.B. and Gault D.E. (1971b) Micrometeorite craters and related features on lunar rock surfaces. *Earth Planet. Sci. Lett.* **10**, 381-386.
- Hörz F. and Hartung J.B. (1971c) The lunar-surface orientation of some Apollo 12 rocks. *Proc. 2<sup>nd</sup> Lunar Planet. Sci.* 2629-2638.
- Hörz F., Morrison D.A. and Hartung J.B. (1972) The surface orientation of some Apollo 14 rocks. *Modern Geology* **3**, 93-104.
- Hörz F., Carrier W.D., Young J.W., Duke C.M., Nagle J.S. and Fryxell R. (1972) Apollo 16 special samples. In Apollo 16 Preliminary Science Rpt. NASA **SP-315** page 7-24 to 7-54
- Horz F., Schneider E. and Hill R.E. (1974) Micrometeoroid abrasion of lunar rocks: A Monte Carlo simulation. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2397-2412.
- Hörz F., Gibbons R.V., Gault D.E., Hartung J.B. and Brownlee D.E. (1975a) Some correlation of rock exposure ages and regolith dynamics. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3495-3508.
- Hörz F., Schneider E., Gault D.E., Hartung J.B. and Brownlee D.E. (1975b) Catastrophic rupture of lunar rocks: A Monte Carlo simulation. *The Moon* **13**, 235-258.



- Hörz F., Brownlee D.E., Fechtig H., Hartung J.B., Morrison D.A., Neukum G., Schneider E., Vedder J.F. and Gault D.E. (1975) Lunar microcraters: Implications for the micrometeoroid complex. *Planet. Space Sci.* **23**, 151-172.
- Hörz F. and Schaal R.B. (1979) Glass production in massive versus porous basalts via shock (abs). *Lunar Planet. Sci.* **X**, 573-575. Lunar Planetary Institute, Houston.
- Houck K.J. (1982a) Petrologic variations in Apollo 16 surface soils. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* J. Geophys. Res. **87**, A197-A209.
- Houck K.J. (1982b) Modal petrology of six soils from Apollo 16 double drive tube core 64002. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* in J. Geophys. Res. **87**, A210-A220.
- Housley R.M. (1977) Solar wind and micrometeorite effects in the lunar regolith. *Phil. Trans. Roy. Soc. London* **A285**, 363-368.
- Housley R.M., Blander M., Abdel-Gawad M., Grant R.W. and Muir A.H. (1970) Mossbauer spectroscopy of Apollo 11 samples. *Proc. Apollo 11 Lunar Sci. Conf.* 2251-2268.
- Housley R.M., Grant R.W. and Abdel-Gawad M. (1972) Study of excess Fe metal in the lunar fines by magnetic separation, Mossbauer spectroscopy and microscopic examination. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1065-1076.
- Housley R.M., Cirlin E.H. and Grant R.W. (1973) Characterization of fines from the Apollo 16 site. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2729-2735.
- Housley R.M., Cirlin E.H., Paton N.E. and Goldberg I.B. (1974) Solar wind and micrometeorite alteration of the lunar regolith. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2623-2642.
- Housley R.M., Cirlin E.H., Goldberg I.B., Crowe H., Weeks R.A. and Perhac R. (1975) Ferromagnetic resonance as a method of studying the micrometeorite bombardment history of the lunar surface. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3173-3186.
- Housley R.M. and Grant R.W. (1976) ESCA studies of the surface chemistry of lunar fines. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 881-889.
- Housley R.M., Cirlin E.H., Goldberg I.B. and Crowe H. (1976) Ferromagnetic resonance studies of lunar core stratigraphy. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 13-26.
- Housley R.M. and Grant R.W. (1977) An XPS (ESCA) study of lunar surface alteration profiles.. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3885-3899.
- Howard K.A., Williams D.E. and Scott D.H. (1974) Lunar basin formation and highland stratigraphy. *Rev. Geophys. Space Phys.* **12**, 309-327.
- Howard K.A., Head J.W. and Swann G.A. (1972) Geology of the Hadley Rille: Preliminary Rpt.. Interagency Rpt. 41
- Hoyt H.P., Kardos J.L., Miyajima M., Seitz M.G., Sun S.S., Walker R.M. and Wittels M.C. (1970) Thermoluminescence, X-ray and stored energy measurements of Apollo 11 samples. *Proc. Apollo 11 Lunar Science Conf.* 2269-2287.
- Hoyt H.P., Walker R.M., Zimmerman D.W. and Zimmerman J. (1972) Thermoluminescence of individual grains and bulk samples of lunar fines. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2997-3007.

- Hu H-N. and Taylor L.A. (1978) Soils from Mare Crisium: Agglutinate glass chemistry and soil development. In **Mare Crisium: The view from Luna 24**. *Geochem. Cosmochim. Acta* suppl. 9, 291-302. (ed. Merrill) Pergamon Press.
- Hu H-N. and Taylor L.A. (1977) Lack of chemical fractionation in major and minor elements during agglutinate formation. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3645-3656.
- Hua C.T., Dollfus A. and Mandeville J-C. (1976) Ultraviolet diffuse reflectance spectroscopy for lunar, meteoritic and terrestrial samples. *Proc. 7<sup>th</sup> Lunar Planet. Sci. Conf.* 2605-2622.
- Hubbard N.J., Gast P.W. and Wiesmann H. (1970) Rare earth, alkaline and alkali metal and <sup>87/86</sup>Sr data for subsamples of lunar sample 12013. *Earth Planet. Sci. Lett.* **9**, 181-184.
- Hubbard N.J. and Gast P.W. (1971) Chemical composition and origin of nonmare lunar basalts. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 999-1020.
- Hubbard N.J., Meyer C., Gast P.W. and Wiesmann H. (1971a) The composition and derivation of Apollo 12 soils. *Earth Planet. Sci. Lett.* **10**, 341-350.
- Hubbard N.J., Gast P.W., Meyer C., Nyquist L.E. and Shih C.-Y. (1971b) Chemical composition of lunar anorthosites and their parent liquids. *Earth Planet. Sci. Lett.* **13**, 71-75.
- Hubbard N.J., Gast P.W., Rhodes J.M., Bansal B.M., Wiesmann H. and Church S.E. (1972a) Nonmare basalts: Part II. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1161-1179.
- Hubbard N.J., Nyquist L.E., Rhodes J.M., Bansal B.M., Wiesmann H. and Church S.E. (1972b) Chemical features of the Luna 16 regolith sample. *Earth Planet. Sci. Lett.* **13**, 423-428.
- Hubbard N.J., Rhodes J.M. and Gast P.W. (1973a) Chemistry of lunar basalts with very high alumina contents. *Science* **181**, 339-342.
- Hubbard N.J., Rhodes J.M., Gast P.W., Bansal B.M., Shih C.-Y., Wiesmann H. and Nyquist L.E. (1973b) Lunar rock types: The role of plagioclase in non-mare and highland rock types. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1297-1312.
- Hubbard N.J., Rhodes J.M., Wiesmann H., Shih C.Y. and Bansal B.M. (1974) The chemical definition and interpretation of rock types from the non-mare regions of the Moon. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1227-1246.
- Hubbard N.J. and Minear J.W. (1976) Petrogenesis in a moderately endowed moon. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 3421-3437.
- Hubbard N.J., Vinogradov A.P., Ramendik G.I. and Chupakhin M.S. (1977) New data for the Luna 20 core and a survey of published chemical data, 259-275. In **Soviet-American Conf. on Cosmochemistry of the Moon and Planets**. NASA-SP370.
- Huber H. and Warren P.H. (2008) Enigmatic, largely granitic 73217: A lunar mixed melt-breccia, but is it impact melt? (abs#2405) *Lunar Planet. Sci.* **XXXIX**, Lunar Planetary Institute, Houston.
- Hubner W., Kirsten T and Kiko J. (1975) Rare gases in Apollo 17 soils with emphasis on analysis of size and mineral fractions of soil 74241. *Proc. 6<sup>th</sup> Lunar sci. Conf.* 2009-2026.
- Hudgins J.A. and Spray J.G. (2006) Lunar impact-fludized dikes: Evidence from Apollo 17 Station 7, Taurus-Littrow valley (abs#1176). *Lunar Planet. Sci.* **XXXVII**, Lunar Planetary Institute, Houston.

Hudgins J.A., Spray J.G., Kelley S.P., Korotev R.L. and Sherlock S. (2008) A laser probe  $^{40}\text{Ar}/^{39}\text{Ar}$  and INAA investigation of four Apollo granulitic breccias (abs). M&PS JAPAN

Hudgins J.A., John G. Spray, Simon P., Kelley S.P., Korotev R.L. and Sherlock S.C. (2008) A laser probe  $^{40}\text{Ar}/^{39}\text{Ar}$  and INAA investigation of four Apollo granulitic breccias. *Geochim. Cosmochim. Acta* **72**, 5781-5798.

Hudgins J.A. and Spray J.G. (2009) Lunar granulitic breccias: Differences between Apollo and meteorite samples (abs). *Meteorit. & Planet. Sci.* FRANCE

Hudgins J.A., Kelley S.P., Korotev R.L. and Spray J.G. (2011a) Mineralogy, geochemistry and  $^{40}\text{Ar}/^{39}\text{Ar}$  geochronology of lunar granulitic breccias NWA3163 and paired stones: Comparison with Apollo samples. *Geochim. Cosmochim. Acta* **75**, 2865-2881.

Hudgins J.A., Spray J.G. and Hawkes C.D. (2011b) Element diffusion rates in lunar granulitic breccias: Evidence for contact metamorphism on the Moon. *Amer. Mineral.* **96**, 1673-1685.

Huebner J.S. (1976) Diffusively rimmed xenocrysts in 77115 (abs). *Lunar Sci.* **VII**, 396-398. Lunar Planetary Institute, Houston.

Huebner J.S., Ross M. and Hickling N. (1975a) Significance of exsolved pyroxenes from lunar breccia 77215. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 529-546.

Huebner J.S., Ross M. and Hickling N.L. (1975b) Cooling history and significance of exsolved pyroxene in lunar noritic breccia 77215 (abs). *Lunar Sci.* **VI**, 408-410. Lunar Planetary Institute, Houston.

Huebner J.S., Lipin B.R. and Wiggins L.B. (1976) Partitioning of chromium between silicate crystals and melts. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1195-1220.

Huffman G.P., Schwerer F.C., Fisher R.M. and Nagata T. (1974) Iron distribution and metallic-ferrous ratios for Apollo lunar samples: Mossbauer and magnetic analyses. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2779-2794.

Huffman G.P. and Dunmyre G.R. (1975) Superparamagnetic clusters of Fe+2 spins in lunar olivine: Dissolution by high-temperature annealing. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 757-772,

Hughes T.C., Keays R.R. and Lovering J.F. (1973) Siderophile and volatile trace elements in Apollo 14, 15 and 16 rocks and fines: Evidence for extralunar component and Tl-, Au- and Ag-enriched rocks in the ancient lunar crust (abs). *Lunar Sci.* **IV**, 400-402. Lunar Planetary Institute, Houston.

Hughes J.M., Jolliff B.L. and Gunter Micky. E. (2006) The atomic arrangement of merrillite from the Fra Mauro Formation, Apollo 14 lunar mission: The first structure of merrillite from the Moon. *Amer. Mineral.* **91**, 1547-1552.

Hughes J.M., Jolliff B.L. and Rakovan J. (2008) The crystal chemistry of whitlockite and merrillite and dehydrogenation of whitlockite to merrillite. *Amer. Mineral.* **93**, 1300-1305.

Hughes S.S. and Schmitt R.A. (1985) Zr-Hf-Ta fractionation during lunar evolution. *Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf.* D31-45. in *J. Geophys. Res.* **90**.

Hughes S.S., Delano J.W. and Schmitt R.A. (1988) Apollo 15 yellow-brown volcanic glass: Chemistry and petrogenetic relations to green volcanic glass and olivine-normative basalts. *Geochim. Cosmochim. Acta* **52**, 2379-2391.

Hughes S.S., Delano J.W., and Schmitt R.A. (1989) Petrogenetic modeling of 74220 high-Ti orange volcanic glasses and the Apollo 11 and 17 high-Ti mare basalts. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 175-188. Lunar Planetary Institute, Houston.

- Hughes S.S., Delano J.W., and Schmitt R.A. (1990) Chemistries of individual mare volcanic glasses: Evidence for distinct regions of hybridized mantle and a KREEP component in Apollo 14 magmatic sources. *Proc. 20<sup>th</sup> Lunar Planet. Sci. Conf.* 127-138.
- Hughes S.S., Neal C.R. and Taylor L.A. (1990) Petrogenesis of Apollo 14 high-alumina (HA) parental basaltic magma (abs). *Lunar Planet. Sci. XXI*, 540-541. Lunar Planetary Institute, Houston.
- Huffman G.P., Schwerer F.C. and Fisher R.M. (1972) Mossbauer analysis of Apollo 15 samples. In **The Apollo 15 Samples**, 440-441. Lunar Planetary Institute, Houston.
- Huffman G.P., Schwerer F.C., Fisher R.M. and Nagata T. (1974a) Iron distributions and metallic-ferrous ratios for Apollo lunar samples: Mossbauer and magnetic analyses. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2779-2794.
- Huffman G.P., Schwerer F.C., Fisher R.M. and Nagata T. (1974b) Iron distributions and metallic-ferrous ratios for Apollo lunar samples: Mossbauer and magnetic analyses (abs). *Lunar Sci. V*, 372-374. Lunar Planetary Institute, Houston.
- Huffman G.P. and Dunmyre G.R. (1975) Superparamagnetic clusters of Fe<sup>2+</sup> spins in lunar olivine: Dissolution by high temperature annealing. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 757-772.
- Hughes S.S. and Schmitt R.A. (1985) Zr-Hf-Ta fractionation during lunar evolution. *Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* D31-D45.
- Hughes S.S. and Schmitt R.A. (1988) Confirmation of Zr-Hf fractionation in lunar petrogenesis - an interim report (abs). *Lunar Planet. Sci. XV*, 385-386. Lunar Planetary Institute, Houston.
- Hughes S.S., Delano J.W. and Schmitt R.A. (1988) Apollo 15 yellow-brown volcanic glass: Chemistry and petrogenetic relations to green volcanic glass and olivine-normative mare basalts. *Geochim. Cosmochim. Acta* **52**, 2379-2391.
- Hughes S.S., Delano J.W. and Schmitt R.A. (1990) Chemistries of individual mare volcanic glasses: Evidence for distinct regions of hybridized mantle and a KREEP component in Apollo 14 magmatic sources. *Proc. 20<sup>th</sup> Lunar Planet. Sci. Conf.* 127-138. Lunar Planetary Institute, Houston.
- Hughes S.S., Dasch E.J. and Nyquist L.E. (1993) Petrologic models of 15388, a unique Apollo 15 mare basalt (abs). *Lunar Planet. Sci. XXIV*, 683-684. Lunar Planetary Institute, Houston.
- Hui H., Neal Clive, Shih C-Y. and Nyquist L.E. (2012) Derivation of Apollo 14 high-Al basalts at discrete times: Rb-Sr isotopic constraints (abs). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Hui H. and Neal C.R. (2012) Preliminary study of olivine melt inclusions of Apollo 12 and 14 basalts (abs#2563) *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Hui H., Oshrin J.G. and Neal C.R. (2012) Investigations into petrogenesis of Apollo 14 high-Al basaltic melts through crystal stratigraphy of plagioclase. *Geochim. Cosmochim. Acta* **75**, 6439-6460.
- Hulme G. and Fielder G. (1977) Effusion rates and rheology of lunar lavas. *Phil. Trans. Roy. Soc. London* **A285**, 227-234.
- Humphries D.J., Biggar G.M and O'Hara M.J. (1972) Phase equilibria and origin of Apollo 15 basalts etc. In **The Apollo 15 Lunar Samples**. 103-107. Lunar Planetary Institute, Houston.
- Huneke J.C. (1978) <sup>40</sup>Ar-<sup>39</sup>Ar microanalysis of single 74220 glass balls and 72435 breccia clasts. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2345-2362.

- Huneke J.C., Podosek F.A., Burnett D.S. and Wasserburg G.J. (1972a) Rare gas studies of the galactic cosmic ray irradiation history of lunar rocks. *Geochim. Cosmochim. Acta* **36**, 269-301.
- Huneke J.C., Podosek F.A. and Wasserburg G.J. (1972b) Gas retention and cosmic-ray exposure ages of a basalt fragment from Mare Fecunditatis. *Earth Planet. Sci. Lett.* **13**, 375-383.
- Huneke J.C., Podosek F.A. and Wasserburg G.J. (1973a) An argon bouillabaisse including ages from the Lunar 20 site (abs). *Lunar Sci.* **IV**, 403-405. Lunar Planetary Institute, Houston.
- Huneke J.C., Jessberger E.K., Podosek F.A. and Wasserburg G.J. (1973b)  $^{40}\text{Ar}/^{39}\text{Ar}$  measurements in Apollo 16 and 17 samples and the chronology of metamorphic and volcanic activity in the Taurus-Littrow region. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1725-1756.
- Huneke J.C., Jessberger E.K. and Wasserburg G.J. (1974) The age of metamorphism of a highland breccia (65015) and a glimpse at the age of its protolith (abs). *Lunar Sci.* **V**, 375-377. Lunar Planetary Institute, Houston.
- Huneke J.C. and Wasserburg G.J. (1975) Trapped  $^{40}\text{Ar}$  in troctolite 76535 and evidence for enhanced  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  age plateaus (abs). *Lunar Sci.* **VI**, 417-419. Lunar Planetary Institute, Houston.
- Huneke J.C. and Wasserburg G.J. (1978)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  ages of single orange glass balls and highland breccia phenocrysts (abs). *Lunar Planet. Sci.* **IX**, 567-569. Lunar Planetary Institute, Houston.
- Huneke J.C., Radicati di Brozolo F. and Wasserburg G.J. (1977)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  measurements on lunar highlands rocks with primitive  $^{87}\text{Sr}/^{86}\text{Sr}$  (abs). *Lunar Sci.* **VIII**, 481-483. Lunar Planetary Institute, Houston.
- Hunter R.H. and Taylor L.A. (1981a) Rusty rock 66095: A paradigm for volatile-element mobility in highland rocks. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 261-280.
- Hunter R.H. and Taylor L.A. (1981b) Rust and schreibersite in Apollo 16 highland rocks: Manifestations of volatile-element mobility. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 253-259.
- Hunter R.H. and Taylor L.A. (1983) The magma ocean from the Fra Mauro shoreline: An overview of the Apollo 14 crust. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **88**, A591-A602.
- Hurley P.M. and Pinson W.H. (1971) Whole-rock Rb-Sr isotopic age relationships in Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Sample Conference* 1311-1315.
- Husain L. (1972)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  and cosmic ray exposure ages of the Apollo 15 crystalline rocks, breccias and glasses (abs). In **The Apollo 15 Lunar Samples**, 374-375. Lunar Planetary Institute, Houston.
- Husain L. (1974)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  chronology and cosmic ray exposure ages of the Apollo 15 samples. *J. Geophys. Res.* **79**, 2588-2606.
- Husain L. and Schaeffer O.A. (1973a) Lunar volcanism: Age of the glass in the Apollo 17 orange soil. *Science* **180**, 1358-1360.
- Husain L. and Schaeffer O.A. (1973b)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  crystallization ages and  $^{38}\text{Ar}$ - $^{37}\text{Ar}$  ray exposure ages of samples from the vicinity of the Apollo 16 landing site (abs). *Lunar Sci.* **IV**, 406-408. The Lunar Sci. Institute, Houston.
- Husain L. and Schaeffer O.A. (1975) Lunar evolution: The first 600 million years. *Geophys. Res. Lett.* **2**, 29-32.

- Husain L., Sutter J.F. and Schaeffer O.A. (1971) Ages of crystalline rocks from Fra Mauro. *Science* **173**, 1235-1236.
- Husain L., Schaeffer O.A. and Sutter J.F. (1972a) Age of a lunar anorthosite. *Science* **175**, 428-430.
- Husain L., Schaeffer O.A., Funkhouser J. and Sutter J. (1972b) The ages of lunar material from Fra Mauro, Hadley Rille and Spur Crater. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1557-1567.
- Hutcheon I.D., Braddy D., Phakey P.P. and Price P.B. (1972) Study of solar flares, cosmic dust and lunar erosion with vesicular basalts. In **The Apollo 15 Lunar Samples**, 412-414. Lunar Planetary Institute, Houston.
- Hutcheon I.D. (1975a) Microcraters in oriented vugs - evidence for an anisotropy in the micrometeoroid flux (abs). *Lunar Sci.* **VI**, 420-422. Lunar Planetary Institute, Houston.
- Hutcheon I.D. (1975b) Micrometeorites and solar flare particles in and out of the ecliptic. *J. Geophys. Res.* **80**, 4471-4483.
- Hutcheon I.D. and Price P.B. (1972) Plutonium-244 fission tracks: Evidence in a lunar rock 3.95 billion years old. *Science* **176**, 909-911.
- Hutcheon I.D., Phakey P.P. and Price P.B. (1972) Studies bearing on the history of lunar breccias. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2845-2866.
- Hutcheon I.D., Macdougall D. and Price P.B. (1974a) Improved determination of the long-term average Fe spectrum from 1 to 460 MeV/amu. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2561-2576.
- Hutcheon I.D., Macdougall D. and Stevenson J. (1974b) Apollo 17 particle track studies: surface residence times and fission track ages for orange glass and large boulders. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2597-2608.
- Hutcheon I.D., Macdougall D. and Price P.B. (1974c) Rock 72315: A new lunar standard for solar flare and micrometeorite exposure (abs). *Lunar Sci.* **V**, 378-380. Lunar Planetary Institute, Houston.
- Imamura M., Finkel R.C. and Wahlen M. (1973) Depth profile of <sup>53</sup>Mn in the lunar surface. *Earth Planet. Sci. Lett.* **20**, 107-112.
- Imamura M., Nishiizumi K., Honda M., Finkle R.C., Arnold J.R. and Kohl C.P. (1974) Depth profiles of <sup>53</sup>Mn in lunar rocks and soils. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2093-2104.
- Ireland T. and Wlotzke F. (1992) The oldest zircons in the solar system. *Earth Planet. Sci. Lett.* **109**, 1-10.
- Ireland T., Holden P., Norman M.D. and Clarke J. (2006) Isotopic enhancements of <sup>17</sup>O and <sup>18</sup>O from solar wind particles in the lunar regolith. *Nature* **439**, 776-778.
- Irving A.J. (1975) Chemical, mineralogical, and textural systematics of non-mare melt rocks: implications for lunar impact and volcanic processes. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 363-394.
- Irving A.J. (1977a) Chemical and experimental constraints on the genesis of Apollo 15 and Apollo 17 KREEP basalts (abs). *Lunar Sci.* **VIII**, 493-495. Lunar Planetary Institute, Houston.
- Irving A.J. (1977b) Chemical variation and fractionation of KREEP basalt magmas. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2433-2448.
- Irving A.J., Merrill R.B. and Singleton D.E. (1978) Experimental partitioning of rare earth elements and scandium among armalcolite, olivine, and mare basalt liquids. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 601-612.

- Irving A.J., Steele I.M. and Smith J.V. (1974) Lunar noritic fragments and associated diopside veins. *Am. Mineral.* **59**, 1062-1068.
- Isaacson P.J., Pieters C.M., Klima R.L., Hiei T., Sarbadhikari A.B., Liu Y. and Taylor L.A. (2009) The lunar rock and mineral characterization consortium integrated analysis and mineral endmembers from mare basalts (abs#1821). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Ishii T., Miyamoto M. and Takeda H. (1976) Pyroxene geothermometry and crystallization, subsolidus equilibration temperatures of lunar and, achondritic pyroxenes (abs). *Lunar Sci.* **VII**, 408-410. Lunar Planetary Institute, Houston.
- Ishii T., McCallum I.S. and Ghose S. (1980) Multiple impact history of a gneiss breccia 73217 as inferred from pyroxene crystallization sequences (abs). *Lunar Planet. Sci.* **XI**, 499-501. Lunar Planetary Institute, Houston.
- Ishii T., Ghose S. and McCallum I.S. (1981) Inversion, decomposition, and exsolution phenomena of lunar pyroxenes observed in breccia 73217 (abs). *Lunar Planet. Sci.* **XII**, 494-496. Lunar Planetary Institute, Houston.
- Ishii T., McCallum S. and Ghose S. (1983) Petrological and thermal histories of a lunar breccia 73217 as inferred from pyroxene crystallization sequences, exsolution phenomena, and pyroxene geothermometry. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **88**, A631-A644.
- Ivanov A.V., Tarsov L.S., Rode O.D., and Florensky K.P. (1973) Comparative characteristics of regolith samples delivered from the lunar mare and highland regions by automatic stations Luna 16 and Luna 20. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 351-364.
- Ivanov A.V., Nazarov M.A., Rode O.D. and Shevarevskii I.D. (1976) Chondrule-like particles from Luna 16 and Luna 20 regolith samples. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 743-757.
- Jackson E.D., Sutton R.L. and Wilshire H.G. (1975) Structure and petrology of a cumulus norite boulder sampled by Apollo 17 in Taurus-Littrow valley, the Moon. *Geol. Soc. Am. Bull.* **86**, 433-442.
- Jacobsen S.B. (2005) The Hf-W isotopic system and the origin of the earth and moon. *Ann. Rev. Earth Sci.* 531-570.
- Jacobsen S.B., Premo J.L., Petaev M.L. and Sasselov D.D. (2009) Hf-W chronometry and the timing of the giant moon-forming impact on Earth (abs#2054). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Jacobsen S.B., Ramen M.C., Chakrabarti R., Farkas J., Huang S., Parai R., Yu G. and Zindler A. (2010) The isotopic composition of the lunar crust and the age and origin of the Moon: Evidence from lunar soils (abs#2596). *41<sup>st</sup> Lunar Planet Sci. Conf.* @ The Woodlands
- Jagodzinski H. and Korekawa M. (1973) Diffuse x-ray scattering by lunar materials. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 933-951.
- Jagodzinski H. and Korekawa M. (1975) Diffuse scattering by domains in lunar and terrestrial plagioclases (abs). *Lunar Sci.* **VI**, 429-431. Lunar Planetary Institute, Houston.
- Jagodzinski H., Korekawa M., Muller W.F. and Schropfer L. (1975a) X-ray diffraction and electron microscope studies of clinopyroxenes from lunar basalts 75035 and 75075. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 773-778.
- Jagodzinski H., Korekawa M., Muller W.F. and Schropfer L. (1975b) X-ray study of clinopyroxenes of lunar basalts 75035 and 75075 (abs). *Lunar Sci.* **VI**, 432-434. Lunar Planetary Institute, Houston.

- Jakes P., Warner J., Ridley W.I., Reid A.M., Harmon R.S., Brett R. and Brown R.W. (1972) Petrology of a portion of the Mare Fecunditatis regolith. *Earth Planet. Sci. Lett.* **13**, 257-271.
- James O.B. (1970) Petrology of lunar microbreccia 12013,6. USGS Interagency Report: Astrogeology 23.
- James O.B. (1972) Lunar anorthosite 15415: Texture, mineralogy and metamorphic history. *Science* **175**, 432-436.
- James O.B. (1973) Crystallization history of lunar feldspathic basalt 14310. U.S. Geol. Survey Prof. Paper 841, 29 pages.
- James O.B. (1975) Petrography of the matrix of light gray (consortium) breccia 73215 (abs). *Lunar Sci.* **VI**, 438-440. Lunar Planetary Institute, Houston.
- James O.B. (1976a) Petrology of aphanitic lithologies in consortium breccia 73215. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2145-2178.
- James O.B. (1976b) Petrology of aphanitic lithologies in consortium breccia 73215 (abs). *Lunar Sci.* **VII**, 420-422. Lunar Planetary Institute, Houston.
- James O.B. (1977a) Petrology of four clasts from consortium breccia 73215 (abs). *Lunar Sci.* **VIII**, 502-504. Lunar Planetary Institute, Houston.
- James O.B. (1980) Rocks of the early lunar crust. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 365-393.
- James O.B. (1981a) Tentative classification of the Apollo 16 breccias (abs). *Lunar Planet. Sci.* **XII**, 506-508.
- James O.B. (1981b) Petrologic and age relations of the Apollo 16 rocks: Implications for subsurface geology and the age of the Nectaris Basin. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 209-233.
- James O.B. (1982) Subdivision of the Mg-suite plutonic rocks into Mg-norites and Mg-gabbronorites (abs). *Lunar Planet. Sci.* **XIII**, 360-362. Lunar Planetary Institute, Houston.
- James O.B. (1993) The ancient lunar crust, Apollo 17 region (abs). *In Workshop on Geology of the Apollo 17 Landing Site*. LPI Tech. Rpt. 92-09, 17-18. Lunar Planetary Institute, Houston.
- James O.B. (1994) Siderophile and volatile elements in Apollo 17 impact melts (abs). *Lunar Planet. Sci.* **XXV**, 617-618. Lunar Planetary Institute, Houston.
- James O.B. (1995) Siderophile elements in lunar impact melts: Nature of the impactors (abs). *Lunar Planet. Sci.* **XXVI**, 671-672. Lunar Planetary Institute, Houston.
- James O.B. (1996) Siderophile elements in lunar impact melts define nature of the impactors (abs). *Lunar Planet. Sci.* **XXVII**, 603-604. Lunar Planetary Institute, Houston.
- James O.B. (2002) Distinctive meteoritic components in lunar "cataclysm" impact breccias (abs#1210). *Lunar Planet. Sci.* **XXXIII**, Lunar Planetary Institute, Houston.
- James O.B. and Jackson E.D. (1970) Petrology of the Apollo 11 ilmenite basalts. *J. Geophys. Res.* **75**, 5793-5824.
- James O.B. and Wright T.L. (1972) Apollo 11 and 12 mare basalts and gabbros: Classification, compositional variations and possible petrogenetic relations. *Geol. Soc. Am. Bull.* **83**, 2357-2382.



- James O.B. and Blanchard D.P. (1976) Consortium studies of light-gray breccia 73215: Introduction, subsample distribution data, and summary of results. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2131-2143.
- James O.B. and Hammarstrom J.G. (1977) Petrology of four clasts from consortium breccia 73215. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2459-2494.
- James O.B. and Hedenquist J.W. (1978a) Consortium breccia 73255: Petrology of aphanitic lithologies (abs). *Lunar Planet. Sci. IX*, 585-587. Lunar Planetary Institute, Houston
- James O.B. and Hedenquist J.W. (1978b) Spinel-bearing troctolitic basalt 73215,170: Texture, mineralogy, and history (abs). *Lunar Planet. Sci. IX*, 588-590. Lunar Planetary Institute, Houston
- James O.B. and Marti K. (1977) Consortium breccia 73255: Matrix petrography and exposure history (abs). *Lunar Sci. VIII*, 505-507. Lunar Planetary Institute, Houston.
- James O.B. and McGee J.J. (1979a) Consortium breccia 73255: Genesis and history of two coarse-grained "norite" clasts. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 713-743.
- James O.B. and McGee J.J. (1979b) Consortium breccia 73255: Genesis and history of two coarse-grained "norite" clasts (abs). *Lunar Planet. Sci. X*, 616-618. Lunar Planetary Institute, Houston.
- James O.B. and McGee J.J. (1980a) Petrology of mare-type basalt clasts from consortium breccia 73255. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 67-86.
- James O.B. and McGee J.J. (1980b) Petrology of ancient mare-type basalt clasts from breccia 73255 (abs). *Lunar Planet. Sci. XI*, 505 -507. Lunar Planetary Institute, Houston.
- James O.B. and McGee J.J. (1980c) Petrology of felsite clasts from Consortium breccia 73255 (abs). *Lunar Planet. Sci. XI*, 508-510. Lunar Planetary Institute, Houston.
- James O.B., Brecher A., Blanchard D.P., Jacobs J.W., Brannon J.C., Korotev R.L., Haskin L.A., Higuchi H., Morgan J.W., Anders E., Silver L.T., Marti K., Braddy D., Hutcheon I.D., Kirsten T., Kerridge J.F., Kaplan I.R., Pillinger C.T. and Gardiner L.R. (1975a) Consortium studies of light gray breccias 73215. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 547-577.
- James O.B., Marti K., Braddy D., Hutcheon I.D., Brecher A., Silver L.T., Blanchard D.P., Jacobs J.W., Brannon J.C., Korotev R.L. and Haskin L.A. (1975b) Consortium studies of matrix of light gray breccia 73215 (abs). *Lunar Sci. VI*, 435-437. Lunar Planetary Institute, Houston.
- James O.B., Blanchard D.P., Jacobs J.W., Brannon J.C., Haskin L.A., Brecher A., Compston W., Marti K., Lugmair G.W., Gros J., Takahashi H. and Braddy D. (1976) Consortium studies of aphanitic lithologies and two anorthositic gabbro clasts in breccia 73215 (abs). *Lunar Sci. VII*, 423-525. Lunar Planetary Institute, Houston.
- James O.B., Hedenquist J.W., Blanchard D.P., Budahn J.R. and Compston W. (1978) Consortium breccia 73255: Petrology, major and trace element chemistry, and Rb-Sr systematics of aphanitic lithologies. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 789-819.
- James O.B. and Flohr M.K. (1983) Subdivision of the Mg-suite noritic rocks into Mg-gabbro-norites and Mg-norites. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf. in J. Geophys. Res.*, A603-A614.
- James O.B., Flohr M.K. and Lindstrom M.M. (1984) Petrology and geochemistry of lunar dimict breccia 61015. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf. in J. Geophys. Res.* **89**, C63-C86.
- James O.B., Lindstrom M.M. and Flohr M.K. (1987) Petrology and geochemistry of alkali gabbro-norites from lunar breccia 67975. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf. in J. Geophys. Res.* E314-E330.

- James O.B., Lindstrom M.M and Flohr M.K. (1989) Ferroan anorthosite from lunar breccia 64435: Implications for the origin and history of lunar ferroan anorthosites. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 219-243. Lunar Planetary Institute, Houston.
- James O.B., Lindstrom M.M. and McGee J.J. (1991) Lunar ferroan anorthosite 60025: Petrology and chemistry of mafic lithologies. *Proc. 21<sup>st</sup> Lunar Planet. Sci. Conf.* 63-87. Lunar Planetary Institute, Houston.
- James O.B. and Lindstrom M.M. (1991) Apollo 16 dimict breccias: I. Sample 64425 (abs). *Lunar Planet. Sci. VII*, 635-636. Lunar Planetary Institute, Houston.
- James O.B., Floss C. and McGee J.J. (2002) Rare earth element variations resulting from inversion of pigeonite and subsolidus reequilibration in ferroan anorthosites. *Geochim. Cosmochim. Acta* **65**, 1269-1284.
- James O.B., Ash R.D., McDonough W.F., Puchtel I.S. and Walker R.J. (2007) Fractionation and volatile redistribution of siderophile elements in metal grains from lunar impact-melt breccia 76215 (abs#1094). *Lunar Planet. Sci. XXXVIII*, Lunar Planetary Institute, Houston.
- James O.B., Cohen B.A., Taylor L.A. and Nazarov M.A. (2007) Comment on: "New" lunar meteorites: Impact melt and regolith breccias and large-scale heterogeneity of the upper lunar crust, by Warren et al. *Meteor. & Planet. Sci. Lett.* **42**, 1029-1032.
- Janghorbani M., Miller M.D., Ma M-S., Chyi L.L. and Ehmann W.D. (1973) Oxygen and other elemental abundance data for Apollo 14, 15, 16 and 17 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1115-1126.
- Janssens M.-J., Palme H., Hertogen J., Anderson A.T., and Anders E. (1978) Meteoritic material in lunar highland samples from the Apollo 11 and 12 sites. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 1537-1550.
- Jarosewich E. and Mason B. (1977) Compositions of lunar basalts 10069, 10071 and 12008. In **Lunar Sample Studies**. (ed. W. Phinney) NASA SP-418
- Javoy M. and Fourcade S. (1974)  $^{18}\text{O}/^{16}\text{O}$  ratios in lunar fines and rocks. *Earth Planet. Sci. Lett.* **21**, 377-382.
- Jeanloz R.F. and Ahrens T.J. (1976) Alkali mobility in shocked basalt (abs). *Lunar Sci. VII*, 428-430. Lunar Planetary Institute, Houston.
- Jeanloz R.F. and Ahrens T.J. (1978) The equation of state of a lunar anorthosite: 60025. *Proc. 9<sup>th</sup> Lunar Sci. Conf.* 2789-2803.
- Jeanloz R.F. and Ahrens T.J. (1979) Equation of state of a lunar anorthosite and anorthite, criteria for impact melting and vaporization (abs). *Lunar Sci. X*, 622-6244. Lunar Planetary Institute, Houston.
- Jedwab J. (1971) Surface morphology of free-growing ilmenites and chromites from vuggy rocks 10072 and 12036. *Proc. Second Lunar Sci. Conf.* 923-935.
- Jedwab J. (1972) Mineralogical notes on Apollo 15 samples. In **The Apollo 15 Lunar Samples**, 108-109.
- Jerde E.A., Warren P.H., Morris R.V., Heiken G.H. and Vaniman D.T. (1987) A potpourri of regolith breccias: "New" samples from the Apollo 14, 16 and 17 landing sites. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **92**, E526-E536.

- Jerde E.A., Morris R.V. and Warren P.H. (1990) In quest of lunar regolith breccias of exotic provenance: a uniquely anorthositic sample from the Fra Mauro (Apollo 14) highlands. *Earth Planet. Sci. Lett.* **98**, 90-108.
- Jerde E.A., Snyder G.A., Taylor L.A., Liu Y.-G. and Schmitt R.A. (1994) The origin and evolution of lunar high-Ti basalts: Periodic melting of a single source at Mare Tranquillitatis. *Geochim. Cosmochim. Acta* **58**, 515-527.
- Jerome D.Y. and Philipott J.-C. (1973) Chemical composition of Luna 20 soil and rock fragments. *Geochim. Cosmochim. Acta* **37**, 909-914.
- Jerome D.Y., Philippot J.C. and Bricchet E. (1972) Determination of 29 elements in Luna 16 soil by non-destructive activation analysis. *Earth Planet. Sci. Lett.* **13**, 436-440.
- Jessberger E.K. (1983)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  dating of North Ray Crater ejecta (abs). *Lunar Planet. Sci.* **XIV**, 349-350. Lunar Planetary Institute, Houston.
- Jessberger E.K. (1979) Ancient pink-spinel-bearing troctolitic basalt in Apollo 17 breccia 73215 (abs). *Lunar Planet. Sci.* **X**, 625-627. Lunar Planetary Institute, Houston.
- Jessberger E.K., Huneke J.C. and Wasserburg G.J. (1974) Evidence for a ~ 4.5 aeon age of plagioclase clasts in a lunar highland breccia. *Nature* **248**, 199-202.
- Jessberger E.K., Huneke J.C., Podosek F.A. and Wasserburg G.J. (1974) High resolution argon analysis of neutron-irradiated Apollo 16 rocks and separated minerals. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1419-1449.
- Jessberger E.K., Horn P. and Kirsten T. (1975)  $^{39}\text{Ar}$ - $^{40}\text{Ar}$  dating of lunar rocks: A methodical investigation of mare basalt 75075 (abs). *Lunar Sci.* **VI**, 441-443. Lunar Planetary Institute, Houston.
- Jessberger E.K., Kirsten T. and Staudacher T. (1976a) Argon-argon ages of consortium breccia 73215. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2201-2215.
- Jessberger E.K., Kirsten T. and Staudacher T. (1976b) Ages of plutonic clasts in consortium breccia 73215 (abs). *Lunar Sci.* **VII**, 431-433. Lunar Planetary Institute, Houston.
- Jessberger E.K., Dominik B., Kirsten T. and Staudacher T. (1977a) New  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  ages of Apollo 16 breccias and 4.42 AE old anorthosites (abs). *Lunar Sci.* **VIII**, 511-513. Lunar Planetary Institute, Houston.
- Jessberger E.K., Kirsten T. and Staudacher T. (1977b) One rock and many ages - further K-Ar data on consortium breccia 73215. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2567-2580.
- Jessberger E.K., Staudacher T., Dominik B. and Kirsten T. (1978) Argon-argon ages of aphanite samples from consortium breccia 73255. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 841-854.
- Jin Y. and Taylor L.A. (1990) Parental magmas of Mare Fecunditatis: Evidence from pristiner glasses. *Proc. 20<sup>th</sup> Lunar Planet. Sci. Conf.* 139-143.
- Johan Z. and Christophe M. (1974) Origin of pyroxene and silica exsolutions in anorthite from 60016,95 polished thin section (abs). *Lunar Sci.* **V**, 385-387. Lunar Planetary Institute, Houston.
- Johnson J.R., Shepard M.K., Paige D.A., Foote E.J. and Grundy W. (2009) Spectrogoniometric measurements and modeling of Apollo 11 soil 10084 (abs#1427). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.

- Johnson D., Jolliff B., Ziegler R. and Carpenter P. (2009) Distribution of Ti in glass and mineral components of lunar soils 10084 and 71501: Grain size fraction 100 to 210 micron (abs#2346). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Johnson R.D and Davis C.C. (1970) Total organic carbon in the Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Science Conf.* 1805-1812.
- Jolliff B.L. (1991) Fragments of quartz-monzodiorite and felsite in Apollo 14 soil particles. *Proc. 21<sup>st</sup> Lunar Planet. Sci. Conf.* 101-118. Lunar Planetary Institute, Houston.
- Jolliff B.L. (1999) Large scale separation of K-frac and REEP-frac in the source regions of Apollo impact-melt breccias, and a revised estimate of the KREEP composition. In **Taylor Volume**, GSA 135-154. Bellweather Press.
- Jolliff B.L. (2000) Introduction to special section: New Views of the Moon. *J. Geophys. Res.* **105**, 4173 - -
- Jolliff B.L. (2008) The composition of the lunar crust and some unanswered questions (abs#2535). *Lunar Planet. Sci.* **XXXIX**, Lunar Planetary Institute, Houston.
- Jolliff B.L., Korotev R.L. and Haskin L.A. (1991) Geochemistry of 2-4mm particles from Apollo 14 soil (14161) and implications regarding igneous components and soil forming processes. *Proc. 21<sup>st</sup> Lunar Planet. Sci. Conf.* 193-220. Lunar Planetary Institute, Houston.
- Jolliff B.L., Haskin L.A., Colson R.O. and Wadhwa M. (1993a) Partitioning in REE-saturating minerals: Theory, experiment, and modeling of whitlockite, apatite, and evolution of lunar residual magmas. *Geochim. Cosmochim. Acta* **57**, 4069-4094.
- Jolliff B.L., Bishop K.M. and Haskin L.A. (1993b) Possible petrogenetic associations among igneous components in North Massif Soils: Evidence in 2-4 mm soil particles from 76503. In **Workshop on Geology of the Apollo 17 Landing Site**. LPI Tech. Rpt. 92-09. Lunar Planetary Institute, Houston.
- Jolliff B.L., Korotev R.L. and Haskin L.A. (1993c) An iridium-rich iron micrometeorite with silicate inclusions from the moon (abs#729). *Lunar Planet. Sci.* **XXIV**, Lunar Planetary Institute, Houston.
- Jolliff B.L. and Haskin L.A. (1995) Cogenetic rock fragments from a lunar soil: evidence of a ferroan noritic-anorthosite pluton on the Moon. *Geochim. Cosmochim. Acta* **59**, 2345-2374.
- Jolliff B.L., Rockow K.M., Korotev R.L. and Haskin L.A. (1996) Lithologic distributions and geologic history of the Apollo 17 site: The record in soils and small rock particles from the highlands massifs. *Meteor. & Planet. Sci.* **31**, 116-145.
- Jolliff B.L., Korotev R.L. and Rockow K.M. (1998) Geochemistry and petrology of lunar meteorite Queen Alexandra Range 94281, a mixed mare and highlands regolith breccia, with special emphasis on very-low-titanium mafic components. *Meteor. & Planet. Sci.* **33**, 581-601.
- Jolliff B.L., Gillis J.J., Haskin L.A., Korotev R.L. and Wieczorek M.A. (2000) Major lunar crustal terrances: Surface expressions and crust-mantle origins. *J. Geophys. Res.* **105**, 4197-4216.
- Jolliff B.L., Korotev R.L., Zeigler R.A. and Floss C. (2003) Northwest Africa 773: Lunar mare breccia with a shallow-formed olivine-cumulate component, inferred very-lowTi (VLT) heritage, and a KREEP connection. *Geochim. Cosmochim. Acta* **67**, 4857-4879.
- Jolliff B.L., Hughes J.M., Freeman J.J. and Zeigler R.A. (2006) Crystal chemistry of lunar merrillite and composition of other meteoritic and planetary suites of whitlockite and merrillite. *Amer. Mineral.* **91**, 1583-1595.

- Jones J.H. and Drake M.J. (1993) Rubidium and cesium in the Earth and the Moon. *Geochim. Cosmochim. Acta* **57**, 3785-3792.
- Jordan J.L. and Heymann D. (1975) Inert gases in fines at three levels of the trench at Van Serg Crater. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2201-2218.
- Jorgensen U., Appel P., Hatsukawa Y., Frei R., Oshima M., Toh Y. and Kimura A. (2009) The Earth – Moon system during the late heavy bombardment period – geochemical support for impacts dominated by comets. *Icarus* **204**, 368-380.
- Jost D.T. and Marti K. (1982) Pu-Nd-Xe dating: Progress towards a "solar system" Pu/Nd ratio (abs). *Lunar Planet. Sci.* **XIII**, 371-372. Lunar Planetary Institute, Houston.
- Jovanovic S., Jensen K. and Reed G.W. (1973a) The halogens, U, Li, Te and P<sub>2</sub>O<sub>5</sub> in five Apollo 17 soil samples. *EOS Trans. AGU* **54**, 595-596.
- Jovanovic S. and Reed G.W. (1973b) Volatile trace elements and the characterization of the Cayley formation and the primitive lunar crust. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1313-1324.
- Jovanovic S. and Reed G.W. (1974a) Labile and nonlabile element relationships among Apollo 17 samples. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1685-1701.
- Jovanovic S. and Reed G.W. (1974b) Labile trace elements in Apollo 17 samples (abs). *Lunar Sci.* **V**, 391-393. Lunar Planetary Institute, Houston.
- Jovanovic S. and Reed G.W. (1975a) Cl and P<sub>2</sub>O<sub>5</sub> systematics: Clues to early lunar magmas. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1737-1751.
- Jovanovic S. and Reed G.W. (1975b) Soil breccia relationships and vapor deposits on the moon. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1753-1759.
- Jovanovic S. and Reed G.W. (1975c) History of Boulder 1 at Station 2, Apollo 17 based on trace element interrelationships. *The Moon* **14**, 385-393.
- Jovanovic S. and Reed G.W. (1975d) Studies on regolith processes: Apollo 15 and 17 labile trace element implications (abs). *Lunar Sci.* **VI**, 451-453. Lunar Planetary Institute, Houston.
- Jovanovic S. and Reed G.W. (1976a) Chemical fractionation of Ru and Os in the Moon. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 3437-3446.
- Jovanovic S. and Reed G.W. (1976b) Convection cells in the early lunar magma ocean: trace-element evidence. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 3447-3459.
- Jovanovic S. and Reed G.W. (1977) Trace element geochemistry and the early lunar differentiation. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 623-632.
- Jovanovic S. and Reed G.W. (1978) Trace element evidence for a laterally inhomogeneous Moon. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 59-80.
- Jovanovic S., Jensen K.J. and Reed G.W. (1978) Luna 24 origins: Some trace element constraints. *In Mare Crisium: The view from Luna 24*. *Geochem. Cosmochim. Acta* suppl. 9, 695-700. (ed. Merrill) Pergamon Press.
- Jovanovic S. and Reed G.W. (1979) Regolith layering processes based on studies of low-temperature volatile elements in Apollo core samples. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1425-1435.

- Jovanovic S. and Reed G.W. (1980b) P<sub>2</sub>O<sub>5</sub>, U and Br associated with mineral separates from a low and a high Ti mare basalt. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 125-134.
- Jovanovic S. and Reed G.W. (1980c) Cl, P<sub>2</sub>O<sub>5</sub>, Br and U partitioning among mineral separates from mare basalt 75055 (abs). *Lunar Planet. Sci. XI*, 517-519. Lunar Planetary Institute, Houston.
- Jovanovic S. and Reed G.W. (1981) Chlorine and phosphorus-bearing phases in lunar samples: The significance of Cl/P<sub>2</sub>O<sub>5</sub> ratios: A response (abs). *Lunar Planet. Sci. XII*, 516-519. Lunar Planetary Institute, Houston.
- Jovanovic S. and Reed G.W. (1981) Aspects of the history of 66095 based on trace elements in clasts and whole rock. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 295-304.
- Jovanovic S. and Reed G.W. (1983) The role of phosphorus in lunar samples - a chemical study. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* A705-A712.
- Jovanovic S., Jensen K.J. and Reed G.W. (1976) Trace elements and the evolution of lunar rocks (abs). *Lunar Sci. VII*, 437-439. Lunar Planetary Institute, Houston.
- Jovanovic S., Jensen K.J. and Reed G.W. (1977) Further insights into the evolution of the early Moon: Convection cells, II. Ru-Os partitioning and mixing (abs). *Lunar Sci. VIII*, 516-518. Lunar Planetary Institute, Houston.
- Jovanovic S. and Reed G.W. (1980a) Candidate samples for the earliest lunar crust. *In Proc. Conf. Lunar Highlands Crust*, *Geochim. Cosmochim. Acta, Suppl.* 12. Pergamon Press. 101-111. Lunar Planetary Institute, Houston.
- Jordan J.L., Heymann D. and Lakatos S. (1974) Inert gas patterns in regolith at Apollo 15 landing site. *Geochim. Cosmochim. Acta.* **38**, 65-78.
- Joy Katie., Burgess R., Hinton R., Fernades Vera, Crawford I.A., Kearsley A.T. and Irving Tony (2011) NWA4472. *Geochim. Cosmochim. Acta* **75**, 2420
- Joy K.H., Crawford I.A., Russell S.S. and Kearsley A.T. (2010) Lunar meteorite regolith breccias by ICP-MS. *Meteorit. & Planet. Sci.* **45**, 917-946
- Joy K.H., Kring D.A., Zolensky M.E., McKay D.S. and Ross D.K. (2011) Investigating the sources and timing of projectiles striking the lunar surface (abs#2103). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Joy K.H., Kring D.A., Bogard D.D., McKay D.S. and Zolensky M.E. (2012a) Re-examination of the formation ages of the Apollo 16 regolith breccias. *Geochem. Cosmochim. Acta* **75**, 7208-7225.
- Joy K.H., Zolensky M.E., Ross D.K., McKay D.S. and Kring D.A. (2012b) Direct detection of projectile relicts on the Moon (abs#4035). *Early Solar System Impact Bombardment II.* Lunar Planet. Sci. Institute, Houston.
- Joy K.H., Zolensky M.E., Nagashima K., Huss G.R., Ross D.K., McKay D.S. and Kring D.A. (2012c) Direct detection of projectile relicts from the end of the lunar basin-forming epoch. *Science* **336**, 1426-1429.
- Juan V.C., Chen J.C., Huang C.K., Chen P.Y. and Wang Lee C.M. (1972) Petrology and chemistry of some Apollo 14 lunar samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 687-705.
- Juan V.C., Chen J.C., Huang C.K., Chen P.Y. and Wang Lee C.M. (1972a) Petrology and chemistry of some Apollo 15 regoliths. *In The Apollo 15 Lunar Samples*, 116-122. Lunar Planetary Institute, Houston.

- Juan V.C., Chen J.C., Huang C.K., Chen P.Y. and Wang Lee C.M. (1972b) Petrology and chemistry of some Apollo 15 crystalline rocks. In **The Apollo 15 Lunar Samples**, 110-115.
- Juan V.C., Chen J.C., Huang C.K., Chen P.Y. and Wang Lee C.M. (1973) Petrology and chemistry of Apollo 16 gabbroic anorthosite 68416 (abs). *Lunar Sci.* **IV**, 421-423. Lunar Planetary Institute, Houston.
- Juan V.C., Chen J.C., Huang C.K., Chen P.Y. and Wang Lee C.M. (1974) Petrology and chemistry of some Apollo 16 lunar samples (abs). *Lunar Sci.* **V**, 394-396. Lunar Planetary Institute, Houston.
- Jull A.J.T., Donahue D.J. and Reedy R.C. (1992)  $^{14}\text{C}$  depth profiles in lunar rock 68815 (abs). *Lunar Planet. Sci.* **XXIII**, 639-640. Lunar Planetary Institute, Houston.
- Jull A.J.T., Lal D. and Donahue D.J. (1995) Evidence for a non-cosmogenic implanted  $^{14}\text{C}$  component in lunar samples. *Earth Planet. Sci. Lett.* **136**, 693-702.
- Jull A.J.T., Cloudt S., Donahue D.J., Sisterson J.M., Reedy R.C. and Masarik J. (1998)  $^{14}\text{C}$  depth profiles in Apollo 15 and 17 cores and lunar rock 68815. *Geochim. Cosmochim. Acta* **62**, 3025-3063.
- Kaiser W.A. (1971) Rare gas measurements in three mineral separates of rock 12013. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1627-1641.
- Kaiser W.A. (1972) Rare gas studies in Luna 16-G-7 fines by stepwise heating techniques: A low fission solar wind Xe. *Earth Planet. Sci. Lett.* **13**, 387-399.
- Kaiser W.A. (1977) The excitation functions of Ba-Xe in the energy range 38-600 MeV; the use of cosmogenic xenon for estimating burial depths and real exposure ages. *Phil. Trans. Roy. Soc. London* **A285**, 337-362.
- Kan Parker, van M., Agee C.B., Duncan M.S. and Westrenen van W. (2011a) Compressibility of molten Apollo 17 orange glass and implications for the density crossovers in the lunar mantle. *Geochim. Cosmochim. Acta* **75**, 1161-1172.
- Kan Parker, van M., Mason P.R.D. and Westrenen van W. (2011b) Trace element partitioning between ilmenite, armalcolite and anhydrous silicate melt: Implications for the formation of lunar high-Ti mare basalts. *Geochim. Cosmochim. Acta* **75**, 4179-4193.
- Kanamori H., Mitzutani H. and Hamano Y. (1971) Elastic wave velocities of Apollo 12 rocks at high pressure. *Proc. Second Lunar Sci. Conf.* 2323-2326.
- Kaplan I.R. (1972) Distribution and isotopic abundance of biogenic elements in lunar samples. *Space Life Sci.* **3**, 382-403.
- Kaplan I.R. and Smith J.W. (1970) Carbon and sulfur concentration and isotopic composition in Apollo 11 lunar samples. *Science* **167**, 541-543.
- Kaplan I.R., Smith J.W. and Ruth E. (1970) Carbon and sulfur concentration and isotopic composition in Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1317-1329.
- Kaplan I.R. and Petrowski C. (1971) Carbon and sulfur isotope studies on Apollo 12 lunar samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1397-1406.
- Kaplan I.R., Pillinger C.T. and Gardiner L.R. (1975a) Consortium studies of matrix of light gray breccia 73215. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 547-577.

- Kaplan I.R., Kerridge J.F. and Petrowski C. (1976) Light element geochemistry of the Apollo 15 site. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 481-492.
- Karner J.M., Papike J.J. and Schearer C.K. (2003) Olivine from planetary basalts: Chemical signatures that indicate planetary parentage and those that record igneous setting and process. *Am. Mineral.* **88**, 806-816.
- Karner J.M., Papike J.J. and Schearer C.K. (2004) Plagioclase from planetary basalts: Chemical signatures that reflect planetary volatile budgets, oxygen fugacity, and styles of igneous differentiation. *Am. Mineral.* **89**, 1101-1109.
- Karner J.M., Sutton S.R., Papike J.J., Shearer C.K., Jones J.H. and Newville M. (2006) Application of a new vanadium valance oxybarometer to basaltic glasses from the Earth, Moon and Mars. *Am. Mineral.* **91**, 270-277.
- Karner Jim, Papike J.J. and Shearer C.K. (2006) Comparative planetary mineralogy: Pyroxene etc. *Amer. Mineral.* **91**, 1574-1582.
- Karner J.M., Papike J.J. Sutton S.R., Shearer C.K., McKay G., Le L. and Burger P. (2007) Valance state partitioning of Cr between pyroxene-melt: Effects of pyroxene and melt composition and direct determination of Cr valance states by XANES. Application to Martian basalt QUE94201 composition. *Amer. Mineral.* **92**, 2002-2005.
- Karner J.M., Papike J.J. Shearer C.K., McKay G., Le. L. and Burger P. (2007) Valance state partitioning of Cr and V between pyroxene-melt: Estimates of oxygen fugacity for martian basalt QUE 94201. *Amer. Mineral.* **92**, 1238-1241.
- Karner J.M., Papike J.J. Shearer C.K., McKay G. and Burger P. (2006) Valance state partitioning of Cr and V between pyroxene – melt: Estimate of oxygen fugacity for martian basalt QUE 94201 (abs).
- Karner J.M., Papike J.J. Sutton S.R., Shearer C.K., Burger P., McKay G. and Le L. (2008) Valance state partitioning of vanadium between pyroxene-melt: Effects of pyroxene and melt composition and direct determination of V valance by XANES (abs#1110). *Lunar Planet. Sci.* **XXXIX**. Lunar Planetary Institute, Houston.
- Karner J.M., Papike J.J., Sutton S.R., Schearer C.K., Burger P., McKay G. and Le L. (2008) Valance state partitioning of V between pyroxene-melt: Effects of pyroxene and melt composition, and direct determination of V valance states by XANES. Application to Martain basalt QUE 94201 composition.. *Meteor. & Planet. Sci.* **43**, 1275-1285.
- Kashkarov L.L., Genaev L.I. and Lavrukhina A.K. (1978) Track studies in four samples of Luna 24 core. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2125-2135.
- Katsube T.J. and Collett L.S. (1971) Electrical properties of Apollo 11 and Apollo 12 lunar samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 2367-2379.
- Katsube T.J. and Collett L.S. (1973a) Electrical characteristics of Apollo 16 lunar samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 3101-3110.
- Katsube T.J. and Collett L.S. (1973b) Electrical characteristics of rock and their application to planetary and terrestrial EM-sounding. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 3111-3131.
- Keays R.R., Ganapathy R., Laul J.C., Krahenbuhl Y. and Morgan J.W. (1974) The simultaneous determination of 20 trace elements in terrestrial, lunar, and meteoritic material by radiochemical neutron activation analysis. *Anal. Chim. Acta* **72**, 1-29.



- Keihm S.J. and Langseth M.G. (1973) Surface brightness temperatures at the Apollo 17 heat flow site: thermal conductivity of the upper 15 cm of regolith. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2503-2513.
- Keil K., Bunch T.E. and Prinz M. (1970) Mineralogy and composition of Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 561-598.
- Keil K., Prinz T.E. and Bunch T.E. (1971) Mineralogy, petrology and chemistry of some Apollo 12 samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 319-341.
- Keil K., Dowty E., Prinz M. and Bunch T.E. (1972) Description, classification and inventory of 151 Apollo 16 rake samples from the LM area and station 5. Curator's Catalog, JSC.
- Keil K., Kurat G., Prinz M. and Green J.A. (1972) Lithic fragments, glasses and chondrules from Luna 16 fines. *Earth Planet. Sci. Lett.* **13**, 243-256.
- Keil K., Dowty E. and Prinz M. (1974) Description, classification and inventory of 113 Apollo 17 rake samples from stations 1A, 2, 7 and 8. Curator's Catalog, pp. 149.
- Keil K., Warner R.D., Prinz M. and Dowty E. (1975) Rocks 60618 and 65785: Evidence for admixture of KREEP in lunar impact melts. *Geophys. Res. Lett.* **2**, 369.
- Keith J.E., Clark R.S. and Richardson K.A. (1972) Gamma-ray measurements of Apollo 12, 14 and 15 lunar samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1671-1680.
- Keith J.E., Clark R.S. and Bennett L.J. (1974a) Determination of natural and cosmic ray induced radionuclides in Apollo 17 lunar samples. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2121-2138.
- Keith J.E., Clark R.S. and Bennett L.J. (1974b) Determination of natural and cosmic ray induced radionuclides in Apollo 17 lunar samples (abs). *Lunar Sci.* **V**, 402-404. Lunar Planetary Institute, Houston.
- Keith J.E., Clark R.S. and Bennett L.J. (1975) The saturation activities of <sup>22</sup>Na, <sup>54</sup>Mn and <sup>56</sup>Co and the depth of sampling of soils. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1879-1890.
- Keller L.P. and McKay D.S. (1992) Micrometer-sized glass spheres in Apollo 16 soil 61181: Implications for impact volatilization and condensation. *Proc. 22<sup>nd</sup> Lunar Planet. Sci. Conf.* 137-141.
- Keller L.P. and McKay D.S. (1993) Discovery of vapor deposits in the lunar regolith. *Science* **261**, 1305-1307.
- Keller L.P. and McKay D.S. (1997) The nature and origin of rims on lunar soil grains. *Geochim. Cosmochim. Acta* **61**, 2331-2341.
- Keller L.P., Wentworth S.J. and McKay D.S. (1998) Space weathering effects on Apollo 17 breccia 76015: Reflectance spectroscopy and microstructure (abs). *Lunar Planet. Sci.* **XXVIII**, Lunar Planetary Institute, Houston.
- Kelley S.P., Tindle A.G. and others (2011) The Open Univ-NASA Apollo Virtual Microscope – a tool for Education (abs#1799). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Kempa M.J., Papike J.J. and White C. (1980) The Apollo 16 regolith: A petrographically-constrained chemical mixing model. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1341-1355.
- Kempa M.J. and Papike J.J. (1980) The Apollo 16 regolith: Comparative petrology of the >20 micron and 20-10 micron soil fractions, lateral transport and differential volatilization. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1635-1661.

- Kempa M.J. and James O.B. (1982) Apollo 16 anorthosites (abs). *Lunar Planet Sci.* **XIII**, 377-378. Lunar Planet. Institute, Houston.
- Kenvolden K.A. (1972) Review of methods used in lunar organic analyses: Extraction and hydrolysis techniques. *Space Life Sci.* **3**, 330-341.
- Kerridge J.F. (1975) Solar nitrogen: Evidence for a secular increase in the ratio of nitrogen-15 to nitrogen-14. *Science* **188**, 162-164.
- Kerridge J.F. (1989) What caused the secular increase in solar nitrogen-15? *Science* **245**, 480-486.
- Kerridge J.F. (1993) Long term compositional variation in solar corpuscular radiation – evidence from nitrogen isotopes in lunar regolith. *Rev. Geophys.* **31**, 423-437.
- Kerridge J.F. (2001) Isotopic variability of nitrogen in lunar regolith. *Science* **293**, 1947
- Kerridge J.F., Kaplan I.R. and Petrowski C. (1975a) Evidence for meteoritic sulfur in the lunar regolith. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2151-2162.
- Kerridge J.F., Kaplan I.R. and Petrowski C. (1975b) Nitrogen in the lunar regolith: Solar origin and effects. *Lunar Sci.* **VI**, 469-471.
- Kerridge J.F., Kaplan I.R., Petrowski C. and Chang S. (1975) Light element geochemistry of Apollo 16 rocks and soils. *Geochim. Cosmochim. Acta* **39**, 137-162.
- Kerridge J.F., Kaplan I.R., Lingenfelter R.E. and Boyton W.V. (1977) Solar wind nitrogen: Mechanisms for isotopic evolution. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3773-3789.
- Kerridge J.F., Kaplan I.R. and Petrowski C. (1978) Carbon isotope systematic in Apollo 16 regolith (abs). *Lunar Planet. Sci.* **IX**, 618-620. Lunar Planetary Institute, Houston.
- Kerridge J.F., Kaplan I.R., Kung C.C., Winter D.A., Friedman D.L. and DesMarais D.J. (1978) Light element geochemistry of the Apollo 12 site. *Geochim. Cosmochim. Acta* **42**, 391-402.
- Kerridge J.F., Eugster O., Kim J.S. and Marti K. (1991) Nitrogen isotopes in the 74001/74002 double drive tube from Shorty Crater, Apollo 17. *Proc. 21<sup>st</sup> Lunar Planet. Sci. Conf.* 291-299.
- Kerridge J.F., Bochsler P., Eugster O. and Geiss J. (1992a) Modeling the evolution of N and <sup>15</sup>N/<sup>14</sup>N in the lunar regolith: Mixing models involving two components. *Proc. 22<sup>nd</sup> Lunar Planet. Sci. Conf.* 239-248.
- Kerridge J.F., Kim J.S., Kim Y. and Marti K. (1992b) Evolution of isotopic signatures in lunar-regolith nitrogen: Noble gases and nitrogen in grain-size fractions from regolith breccia 79035. *Proc. 22<sup>nd</sup> Lunar Planet. Sci.* 215-224. Lunar Planetary Institute, Houston.
- Kerridge J.F., Kim Y., Kim J. and Marti K. (1993) Nitrogen isotopic signatures in agglutinates from breccia 79035 (abs). *Lunar Planet. Sci.* **XXIV**, 795-796. Lunar Planetary Institute, Houston.
- Kesson S.E. (1975a) Mare basalt petrogenesis. In Papers presented to the **Conference on Origins of Mare Basalts and their Implications for Lunar Evolution**, 81-85. Lunar Planetary Institute, Houston.
- Kesson S.E. (1975b) Mare basalts: melting experiments and petrogenetic interpretations. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 921-944.
- Kesson S.E. (1975c) Melting experiments on synthetic mare basalts and their petrogenetic implications (abs). *Lunar Sci.* **VI**, 475-477. Lunar Planetary Institute, Houston.

- Kesson S.E. (1975d) Experimental investigations of reaction coronas on olivine in Apollo 14 high-grade breccias. *Earth Planet. Sci. Lett.* **28**, 65-68.
- Kesson S.E. (1977) Mare basalt petrogenesis. *Phil. Trans. Roy. Soc. London* **A285**, 159-168.
- Kesson S.E. and Lindsley D.H. (1976) Mare basalt petrogenesis – A review of experimental studies. *Rev. Geophys. Space Phys.* **14**, 361-373.
- Kesson S.E. and Ringwood A.E. (1976) Mare basalt petrogenesis in a dynamic Moon. *Earth Planet. Sci. Lett.* **30**, 155-163.
- Khan A., Maclennam J., Taylor S.R. and Connolly J.A.D. (2006) Are the Earth and Moon compositionally alike? Inferences on lunar composition and implications for lunar origin and evolution from geophysical modeling. *J. Geophys. Res.* **111**, E05005
- Kharkar D.P. and Turekian K.K. (1970) Neutron activation analysis of milligram quantities of Apollo 11 lunar rocks and soil. *Proc. Apollo 11 Lunar Sci. Conf.* 1659-1664.
- Kharkar D.P. and Turekian K.K. (1971) Analyses of Apollo 11 and Apollo 12 rocks and soils by neutron activation. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1301-1305.
- Khisima N., Nazarov M., Senin V. and Mohov A. (2009) Cr-Ca symplectite lamellae in an olivine grain from the Luna-24 regolith (abs#1053). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Kiko J., Kirsten T. and Ries D. (1978) Distribution properties of implanted rare gases in individual olivine crystals from the lunar regolith. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 1655-1665.
- Kiefer W.S., Macke R.J., Britt D.T., Irving A.J. and Consolmagno G.J. (2012) The density and porosity of lunar rocks. *Geophys. Res. Lett.* **39**, L07201
- Kimura K., Lewis R.S. and Anders E. (1974) Distribution of gold and rhenium between nickel-iron and silicate melts: Implications for the abundance of siderophile elements on the Earth and Moon. *Geochim. Cosmochim. Acta* **38**, 683-701.
- Kim J.S., Kim Y., Marti K. and Kerridge J.F. (1995) Nitrogen. *Nature* **375**, 383.
- King E.A. *and a cast of thousands* (1969) Lunar Sample Information Catalog, Apollo 11. Lunar Receiving Laboratory, MSC 412 pp
- King E.A. (1977) The lunar regolith: physical characteristics and dynamics. *Phil. Trans. Roy. Soc. London* **A285**, 273-278.
- King E.A., Carman M.F. and Butler J.C. (1970) Mineralogy and petrology of coarse particulate material from the lunar surface at Tranquillity base. *Proc. Apollo 11 Lunar Sci. Conf.* 599-606.
- King E.A., Butler J.C. and Carman M.F. (1971) The lunar regolith as sampled by Apollo 11 and 12: Grain size analyses, modal analyses and origins of particles. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 737-746.
- King E.A., Butler J.C. and Carman M.F. (1972) Chondrules in Apollo 14 samples and size analyses of Apollo 14 and 15 fines. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 673-686.
- King P.L., Lee R.J., Ramsey M.S., McCutcheon W.A., Schofield C.M.D. and Shearer C.K. (2011) using thermal infrared spectroscopy of glasses to unravel composition and thermal history – a new thermometer for lunar glass beads? (abs#2069). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.

- Kirsten T. (1977) Rare gases implanted in lunar fines. *Phil. Trans. Roy. Soc. London* **A285**, 391-396.
- Kirsten T., Muller O., Steinbrunn F. and Zahringer J. (1970) Study of the distribution and variations of rare gases in Lunar Material by a microprobe technique. *Proc. Apollo 11 lunar science Conf.* 1331-1344.
- Kirsten T., Steinbrunn F. and Zahringer J. (1971) Location and variation of trapped rare gases on Apollo 12 lunar samples. *Proc. Second Lunar Sci. Conf.* 1651-1669.
- Kirsten T., Deubner J., Horn P., Kaneoka I., Kiko J., Schaeffer O.A. and Thio S.K. (1972) The rare gas record of Apollo 14 and 15 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1865-1889.
- Kirsten T., Horn P. and Kiko J. (1973a) <sup>39</sup>Ar/<sup>40</sup>Ar dating and rare gas analysis of Apollo 16 rocks and soils. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1757-1784.
- Kirsten T., Horn P. and Heymann D. (1973b) Chronology of the Taurus-Littrow region. 1 Ages of two major rock types from the Apollo 17 site. *Earth Planet. Sci. Lett.* **20**, 125-130.
- Kirsten T., Horn P., Heymann D., Hubner W. and Storzer D. (1973c) Apollo 17 crystalline rocks and soils: Rare gases, ion tracks, and ages (abs). *EOS trans AGU* **54**, 595-597.
- Kirsten T., Horn P. and Kiko J. (1973d) Ar<sup>40</sup>-Ar<sup>39</sup> dating of Apollo 16 and Apollo 15 rocks and rare gas analysis of Apollo 16 soils (abs). *Lunar Sci.* **IV**, 438-440. The Lunar Sci. Institute, Houston.
- Kirsten T. and Horn P. (1974a) Chronology of the Taurus-Littrow region III: ages of mare basalts and highland breccias and some remarks about the interpretation of lunar highland rock ages. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1451-1475.
- Kirsten T. and Horn P. (1974b) <sup>39</sup>Ar-<sup>40</sup>Ar-chronology of the Taurus-Littrow region II: A 4.28 b.y. old troctolite and ages of basalts and highland breccias (abs). *Lunar Sci.* **V**, 419-421. Lunar Planetary Institute, Houston.
- Kirsten T. and Horn P. (1977) <sup>39</sup>Ar-<sup>40</sup>Ar dating of basalts and rock breccias from Apollo 17 and the Marvin Achondrite. In **Soviet-American Conf. on Cosmochemistry of the Moon and Planets**, 525-540. NASA-**SP370**.
- Kitts B. Kathy, Podeseck F.A., Nichols R.H., Brannon J.C., Ramezani J., Korotev R.L. and Jolliff B.L. (2003) Isotopic composition of surface-correlated chromium in Apollo 16 lunar soils. *Geochim. Cosmochim. Acta* **67**, 4881-4893.
- Klein C., Drake J.C. and Frondel C. (1971) Mineralogical, petrological, and chemical features of four Apollo 12 lunar microgabbros. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 265-284.
- Klein C. and Drake J.C. (1972) Mineralogy, petrology and surface features of some fragmental material from the Fra Mauro site. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1095-1113.
- Klein J., Middleton R., Fink D., Dietrich J.W., Aylmer D. and Herzog G.F. (1988) Beryllium-10 and aluminum-26 contents of lunar rock 74275 (abs). *Lunar Planet. Sci.* **XIX**, 607-608. Lunar Planetary Institute, Houston.
- Klein L., Onorato P.I.K., Uhlmann D.R. and Hopper R.W. (1975a) Viscous flow, crystallization behaviour, and thermal histories of lunar breccias 70019 and 79155. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 579-593.
- Klein L., Uhlmann D.R. and Hopper R.W. (1975b) Viscous flow, crystallization behaviour and thermal history of lunar breccias 70019 and 79155 (abs). *Lunar Sci.* **VI**, 481-483. Lunar Planetary Institute, Houston.

Klein L.C. and Uhlmann D.R. (1976) The kinetics of lunar glass formation, revisited. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1113-1121.

Kleine T., Munker C., Mezger K. and Palme H. (2002) Rapid accretion and early core formation on asteroids and the terrestrial planets from Hf-W chronometry. *Nature* **418**, 952-955.

Kleine T., Palme H., Mezger K. and Halliday A.N. (2005) Hf-W chronometry of lunar metals and the age and early differentiation of the Moon. *Science* **310**, 1671-1674.

Kleinmann B. and Ramdohr P. (1971) Corundum from the lunar dust. *Earth Planet. Sci. Lett.* **13**, 19-22.

Klima R.L., Pieters C.M. and Dyar M.D. (2009) Pyroxene spectroscopy: probing composition and thermal history of the lunar surface (abs#2155). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.

Knoll H.-D. and Stöffler D. (1979) Characterization of the basic types of lunar highland breccias by quantitative textural analysis (abs). *Lunar Planet. Sci.* **X**, 673-675. Lunar Planetary Institute, Houston.

Kohl C.P., Murell M.T., Russ G.P. III and Arnold J.R. (1978) Evidence for the constancy of the solar cosmic ray flux over the past ten million years: <sup>53</sup>Mn and <sup>26</sup>Al measurements. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2299-2310.

Kolopus J., Kline D., Chatelain A. and Weeks R.A. (1971) Magnetic resonance properties of lunar samples – mostly Apollo 12. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 2501-2414.

Korotev R.L. (1976a) Rare earths and other elements in two size fractions of soils from the Taurus-Littrow valley floor (abs). *Lunar Sci.* **VII**, 457-459. Lunar Planetary Institute, Houston.

Korotev R.L. (1976b) Geochemistry of grain-size fractions of soils from the Taurus-Littrow valley floor. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 695-726.

Korotev R.L. (1981) Compositional trends in Apollo 16 soils. *Proc. 12<sup>th</sup> Lunar Sci. Conf.* 577-605.

Korotev R.L. (1982) Comparative geochemistry of Apollo 16 surface soils and samples from cores 64002 and 60002 thru 60007. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* A269-A278. J. Geophys. Res.

Korotev R.L. (1987a) Mixing levels, the Apennine front soil component, and compositional trends in the Apollo 15 soils. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* in J. Geophys. Res. **92**, E411-E431.

Korotev R.L. (1987b) The meteorite component of Apollo 16 noritic impact melt breccias. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* in J. Geophys. Res. E491-E512.

Korotev R.L. (1990) Cobalt and nickel concentrations in the “komatiite component” of Apollo 16 polymict samples. *Earth Planet. Sci. Lett.* **96**, 481-489.

Korotev R.L. (1991) Geochemical stratigraphy of two regolith cores from the Central Highlands of the Moon. *Proc. 21<sup>st</sup> Lunar Planet. Sci. Conf.* 229-289. Lunar Planetary Institute, Houston.

Korotev R.L. (1993) The Apollo 17 regolith. *In Workshop on Geology of the Apollo 17 Landing Site* (abs). LPI Tech. Rpt. 92-09. 26-27. Lunar Planetary Institute, Houston.

Korotev R.L. (1994) Compositional variation in Apollo 16 impact melt breccias and inferences for the geology and bombardment history of the central highlands of the Moon. *Geochim. Cosmochim. Acta* **58**, 3931-3969.

- Korotev R.L. (1996) On the relationship between the Apollo 16 ancient regolith breccias and feldspathic fragmental breccias, and the composition of the prebasin crust in the Central Highlands of the Moon. *Meteor. & Planet. Sci.* **31**, 403-412.
- Korotev R.L. (1997) Some things we can infer about the Moon from the composition of the Apollo 16 regolith. *Meteor. & Planet. Sci.* **32**, 447-478.
- Korotev R.L. (1998) Concentrations of radioactive elements in lunar materials. *J. Geophys. Res.* **103**, 1691-1701.
- Korotev R.L. (2000) The great lunar hot spot and the composition and origin of the Apollo mafic ("LKFM") impact-melt breccias. *J. Geophys. Res.* **105**, 4317-4345.
- Korotev R.L. (2005) Lunar Meteorites. *Chemie de Erde* **65**, 297-346.
- Korotev R.L. and Haskin L.A. (1975) Inhomogeneity of trace element distributions from studies of the rare earths and other elements in size fractions of crushed basalt 70135. In Papers presented to the Conference on **Origins of Mare Basalts** and their Implications for Lunar Evolution (Lunar Science Institute, Houston), 86-90.
- Korotev R.L., Haskin L.A. and Lindstrom M.M. (1980) A synthesis of lunar highlands compositional data. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 395-429.
- Korotev R.L., Morris R.V. and Lauer H.V. (1984) Stratigraphy and geochemistry of the Stone Mountain Core (64001/2). *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* C143-160.
- Korotev R.L. and Haskin L.A. (1988) Europium mass balance in polymict samples and implications for plutonic rocks of the lunar crust. *Geochim. Cosmochim. Acta* **52**, 1795-1813.
- Korotev R.L. and Kremser D. (1992) Compositional variations in Apollo 17 soils and their relationships to the geology of the Taurus-Littrow site. *Proc. 22<sup>nd</sup> Lunar Planet. Sci. Conf.* 275-301.
- Korotev R.L. and Morris R.V. (1993) Composition of Apollo 16 regolith core 60013/14. *Geochim. Cosmochim. Acta* **57**, 4813-4826.
- Korotev R.L., Haskin L.A. and Jolliff B.L. (1995) A simulated geochemical rover mission to the Taurus-Littrow valley of the Moon. *J. Geophys. Res.* **100**, 14403-14420.
- Korotev R.L., Jolliff B.L. and Rockow K.M. (1996) Lunar meteorite Queen Alexandra Range 93069 and the iron concentration of the lunar highlands surface. *Meteor. & Planet. Sci.* **31**, 909-924.
- Korotev R.L., Morris R.V., Jolliff B.L. and Schwarz C. (1997) Lithological variation with depth and decoupling of maturity parameters in Apollo 16 regolith core 68001/2. *Geochim. Cosmochim. Acta* **61**, 2989-3002.
- Korotev R.L. and Gillis J.J. (2001) A new look at the Apollo 11 regolith and KREEP. *J. Geophys. Res.* **106**, 12339-12353.
- Korotev R.L. and Jolliff B.L. (2001) The curious case of the lunar magnesium granulitic breccias (abs#1455). *Lunar Planet. Sci.* **XXXII**, Lunar Planetary Institute, Houston.
- Korotev R.L., Gillis J.J., Haskin L.A. and Jolliff B.L. (2002) On the age of the Nectaris basin (abs). *In* The Moon beyond 2002: Next steps in Lunar Sci. and Exploration. Lunar Planet. Inst. Houston.

- Korotev R.L., Jolliff B.L., Zeigler R.A., Gillis J.J. and Haskin L.A. (2003) Feldspathic lunar meteorites and their implications for compositional remote sensing of the lunar surface and the composition of the lunar crust. *Geochim. Cosmochim. Acta* **67**, 4895-4923.
- Korotev R.L., Zeigler R.A., Irving A.J. and Bunch T.E. (2009a) Keeping up with the lunar meteorites – 2009 (abs#1137). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Korotev R.L., Zeigler R.A., Irving A.J. and Bunch T.E. (2009b) Compositional and lithological diversity among brecciated lunar meteorites of intermediate iron concentration. *Meteorit. & Planet. Sci.* **44**, 1287-1322.
- Korotev R.L., Jolliff B.L. and Zeigler R.A. (2010a) On the origin of the Moon's feldspathic highlands, pure anorthosite, and feldspathic lunar meteorites (abs#1440). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Korotev R.L., Zeigler R.A. and Floss C. (2010b) On the origin of impact glass in the Apollo 16 regolith. *Geochim. Cosmochim. Acta* **74**, 7362-7388.
- Korotev R.L., Jolliff B.L. and Carpenter P.K. (2011a) Miller Range feldspathic lunar meteorites (abs#1999). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Korotev R.L., Jolliff B.L., Zeigler R.A., Seddio S.M. and Haskin L.A. (2011b) Apollo 12 revisited. *Geochim. Cosmochim. Acta* **75**, 1540-1573.
- Korotev Randy, Irving Tony and Bunch Ted (2012c) Keeping up with curiosity lunar meteorites (abs#1152). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Kothari B.K. and Goel P.S (1972) Total nitrogen abundances in five Apollo-15 samples (Hadley-Apennine region) by neutron activation analysis. In **The Apollo 15 Lunar Samples**, 282-283. Lunar Planet. Inst. Houston.
- Kothari B.K. and Goel P.S. (1973) Nitrogen in lunar samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1587-1596.
- Kozar M.P., Kraemer M.T., Fox A., Larsson L. and Alton J. (2001) Lunar dust: a negative control for biomarker analyses of extraterrestrial samples? *Geochim. Cosmochim. Acta* **65**, 3307-3317.
- Krahenbuhl U. (1980) Distribution of volatile and non volatile elements in grain-size fractions of Apollo 17 drive tube 74001/2. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1551-1564.
- Krahenbuhl U., Ganapathy R., Morgan J.W. and Anders E. (1973a) Volatile elements in Apollo 16 samples: Possible evidence for outgassing of the Moon. *Science* **180**, 858-861.
- Krahenbuhl U., Ganapathy R., Morgan J.W. and Anders E. (1973b) Volatile elements in Apollo 16 samples: Implications for highland volcanism and accretion history of the moon. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1325-1348.
- Krahenbuhl U., Grutter A., von Gunten H.R., Meyer G., Wegmuller F. and Wyttenbach A. (1977) Volatile and non-volatile elements in grain-size fractions of Apollo 17 soils 75081, 72461 and 72501. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3901-3916.
- Krahenbuhl U., von Gunten H.R., Jost D., Meyer G. and Wegmuller F. (1979) Major and trace elements in four strata of Apollo 17 drive tube 74001/2. *Meteoritics* **14**, 461-463.
- Kratschmer W. and Gentner W. (1975) The feasibility of ion identification on cosmic-ray tracks in lunar feldspars. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3577-3585.

- Kratschmer W. and Gentner W. (1976) The long-term average of the galactic cosmic-ray iron group composition studied by the track method. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 501-511.
- Kramer F.E., Twedell D.B. and Walton W.J.A. (1977) **Apollo 11 Lunar Sample Information Catalogue** (revised). Curator's Office, JSC 12522
- Kramer F.E. and Twedell D.B. (1977) Apollo 14 coarse fines (4-10 mm) sample location and classification. JSC 12922
- Kramers J.D. (1998) Reconciling siderophile element data in the Earth and Moon, W isotopes and the upper lunar age limit in a simple model of homogeneous accretion. *Chem. Geol.* **145**, 461-478.
- Krawczynski M.J., Sutton S.R., Barr J.A. and Grove T.L. (2010) Titanium valence in lunar ultramafic glasses and olivine-diogenites (abs#1825). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Krawczynski M.J. and Grove T.L. (2012) Experimental investigation of the influence of oxygen fugacity on the source depths for high titanium ultramafic magmas. *Geochim. Cosmochim. Acta* **79**, 1-19.
- Kreutzberger M.E., Drake M.J. and Jones J.H. (1986) Origin of the Earth's moon: Constraints from alkali volatile trace elements. *Geochim. Cosmochim. Acta* **50**, 91-98.
- Kridelbaugh S.J., Grieve RAF and Weill D.F. (1972) Glass compositions in breccias 15028 and 15059. *In The Apollo 15 Lunar Samples*, 123-125.
- Kridelbaugh S.J. and Weill D.F. (1973) The mineralogy and petrology of ilmenite basalt 75055 (abs). *EOS Trans. AGU* **54**, 597-598.
- Kridelbaugh S.J. and Weill D.F. (1973) The mineralogy and petrology of the Luna 20 soil sample. *Geochim. Cosmochim. Acta* **37**, 915-926.
- Kridelbaugh S.J., McKay G.A. and Weill D.F. (1973) Breccias from the lunar highlands: Preliminary petrographic report on Apollo 16 samples 60017 and 63335. *Science* **179**, 71-74.
- Kring D.A. (2008) Deciphering the chronology and implications of impact cratering on the Moon: A high science priority for lunar exploration (abs#1251). *Lunar Planet. Sci.* **XXXIX**, Lunar Planetary Institute, Houston.
- Kring D.A. and Cohen B.A. (2002) Cataclysmic bombardment throughout the inner solar system 3.9 – 4.0 Ga. *J. Geophys. Res.* **107**, E2: 5009, doi: 10.1029/2001JE001529
- Kuehner S.M., Iring A.J., Korotev R.L., Hupe G.M. and Ralew S. (2009) Zircon-baddeleyite-bearing silica-K-feldspar granophyric clasts in KREEP-rich lunar breccias Northwest Africa 4472 and 4485 (abs#1516). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Kurat G., Keil K., Prinz M. and Nehru C.E. (1972) Chondrules of lunar origin. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 707-721.
- Kurat G., Keil K. and Prinz M. (1974a) Petrology of some lithic fragments of alkalic high-alumina basalt composition from Apollo 12 coarse fines. *Tschermak's Min. Pet. Mitt.* **21**, 179-195.
- Kurat G., Keil K. and Prinz M. (1974b) Rock 14318: A polymict lunar breccia with chondritic texture. *Geochim. Cosmochim. Acta* **38**, 1133-1146.
- Kurat G., Kracher A., Keil K., Warner R. and Prinz M. (1976) Composition and origin of Luna 16 aluminous mare basalts. *Proc. 7<sup>th</sup> Lunar Planet. Sci.* 1301-1321.



- Kurat G. and Kracher A. (1981) Magnesian feldspathic basalts and KREEP from Luna 24 core sample 24114. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 1-20.
- Kushiro I. (1972) Petrology of some Apollo 15 basalts. In **The Apollo 15 Lunar Samples** (Chamberlain and Watkins eds.), 128-130. Lunar Science Institute, Houston.
- Kushiro I. and Nakamura Y. (1970) Petrology of some lunar crystalline rocks. *Proc. Apollo 11 Lunar Sci. Conf.* 607-626.
- Kushiro I. and Haramura H. (1971) Major element variation and possible source materials of Apollo 12 crystalline rocks. *Science* **171**, 1235-1237.
- Kushiro I., Nakamura Y., Kitayama K. and Akimoto S-I. (1971) Petrology of some Apollo 12 crystalline rocks. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 481-495.
- Kushiro I., Ikeda Y. and Nakamura Y. (1972) Petrology of Apollo 14 high-alumina basalt. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 115-129.
- Kvenvolden K.A. and Ponnampereuma C. (1970) A search of carbon and its compounds in lunar samples from Mare Tranquillitatis. NASA SP-257
- Labotka T.C., Vaniman D.T. and Papike J.J. (1979) The Apollo 17 drill core: Comparative modal petrology and phase chemistry of the >20 micron and <20 micron soil fractions. *Geophys. Res. Lett.* **6**, 503-506.
- Labotka T.C., Kempa M.J., White C., Papike J.J. and Laul J.C. (1980) The lunar regolith: Comparative petrology of the Apollo sites. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1285-1305.
- Lakatos S., Heymann D. and Yaniv A. (1973) Green spherules from Apollo 15: Inferences about their origin from inert gas measurements. *The Moon* **7**, 132.
- Lal D. (1972) Hard rock cosmic ray archeology. *Space Sci. Rev.* **14**, 3-102.
- Lal D. (1977) Irradiation and accretion of solids in space based on observations of lunar rocks and grains. *Phil. Trans. Roy. Soc. London* **A285**, 69-96.
- Lal D., Macdougall D., Wilkening L. and Arrhenius G. (1970) Mixing of the lunar regolith and cosmic ray spectra: Evidence from particle-track studies. *Proc. Apollo 11 Lunar Science Conf.* 2295-2303.
- Lally J.S., Fischer R.M., Christie J.M., Griggs D.T., Heuer A.H., Nord G.L. and Radcliffe S.V. (1972) Electron petrography of Apollo 14 and 15 rocks. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 401-422.
- Lally J.S., Christie J.M., Nord G.L. and Heuer A.H. (1976a) Deformation, recovery, and recrystallization of lunar dunite 72417. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1845-1863.
- Lally J.S., Christie J.M., Heuer A.H. and Nord G.L. (1976b) Electron microscopy of lunar dunite 72417 (abs). *Lunar Sci.* **VII**, 468-470. Lunar Planetary Institute, Houston.
- Lambert G., Le Roulleu J.C. and Bristeau P. (1977) Accumulation and circulation of gaseous radon between lunar fines. *Phil. Trans. Roy. Soc. London* **A285**, 331-336.
- Langevin T.C. and Naugle J.S. (1980) The depositional history of the Apollo deep drill core: A reappraisal. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1415-1434.
- Langevin Y. and Arnold J.R. (1977) The evolution of the lunar regolith. *Ann. Rev. Earth Planet. Sci.* **5**, 449-489.

- Larochelle A. and Schwarz E.J. (1970) Magnetic properties of Apollo 11 sample 10048,22. *Proc. Apollo 11 Lunar Sci. Conf.* 2305-2308.
- Laul J.C. (1986) Chemistry of the Apollo 12 highland component. *Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf.* D251-D261.
- Laul J.C. (1977) Chemical composition of Luna 24 melt rocks (24077,4; 24077,62; 24174,7; 24182,12; 24210,50) and gabbro (24182,8). In **Papers Presented to the Conference on Luna 24**, 94-97. Lunar Science Institute, Houston.
- Laul J.C., Keys R.R., Ganapathy R. and Anders E. (1970) Abundance of 14 trace elements in lunar rock 12013,10. *Earth Planet. Sci. Lett.* **9**, 211-215.
- Laul J.C., Morgan J.W., Ganapathy R. and Anders E. (1971) Meteoritic material in lunar samples: Characterization from trace elements. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1139-1158.
- Laul J.C., Wakita H., Showalter D.L., Boynton W.V. and Schmitt R.A. (1972a) Bulk, rare earth, and other trace elements in Apollo 14 and 15 and Luna 16 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1181-1200.
- Laul J.C., Ganapathy R., Morgan J.W. and Anders E. (1972b) Meteoritic and non-meteoritic trace elements in Luna 16 samples. *Earth Planet. Sci. Lett.* **13**, 450-454.
- Laul J.C., Wakita H. and Schmitt R.A. (1972c) Bulk and REE abundances in anorthosites and noritic fragments. In **The Apollo 15 Lunar Samples**, 221-224. Lunar Planetary Institute, Houston.
- Laul J.C. and Schmitt R.A. (1973a) Chemical composition of Luna 20 rocks and soil and Apollo 16 soils. *Geochim. Cosmochim. Acta* **37**, 927-942.
- Laul J.C. and Schmitt R.A. (1973b) Chemical composition of Apollo 15, 16, and 17 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1349-1367.
- Laul J.C. and Schmitt R.A. (1974a) Chemical composition of boulder-2 rocks and soils, Apollo 17, Station 2. *Earth Planet. Sci. Lett.* **23**, 206-219.
- Laul J.C. and Schmitt R.A. (1974b) Chemical composition of Apollo 17 boulder-2 rocks and soils (abs). *Lunar Sci.* **V**, 438-440. Lunar Planetary Institute, Houston.
- Laul J.C. and Schmitt R.A. (1974c) Siderophile and volatile trace elements in Apollo 17 boulder-2 rocks and soils (abs). *Lunar Sci.* **V**, 441-443. Lunar Planetary Institute, Houston.
- Laul J.C., Hill D.W. and Schmitt R.A. (1974d) Chemical studies of Apollo 16 and 17 samples. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1047-1066.
- Laul J.C. and Schmitt R.A. (1975a) Dunite 72417: A chemical study and interpretation. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1231-1254.
- Laul J.C. and Schmitt R.A. (1975b) Dunite 72417: A chemical study (abs). *Lunar Sci.* **VI**, 495-497. Lunar Planetary Institute, Houston.
- Laul J.C. and Schmitt R.A. (1975c) Chemical composition of Apollo 17 samples: Boulder breccias (2), rake breccias (8), and others (abs). *Lunar Sci.* **VI**, 489-491. Lunar Planetary Institute, Houston.
- Laul J.C., Murali A.V., Schmitt R.A. and Wakita H. (1975a) Apollo 17 basalts and lunar evolution constraints. In Conference on **Origins of Mare Basalts** and their Implications for Lunar Evolution (Lunar Science Institute, Houston), 91-93.

- Laul J.C., Schmitt R.A., Robyn M. and Goles G.G. (1975b) Chemical composition of 18 Apollo 17 rake basalts and one basalt-breccia (abs). *Lunar Sci.* **VI**, 492-494. Lunar Planetary Institute, Houston.
- Laul J.C., Vaniman D.T. and Papike J.J. (1978) Chemistry, mineralogy and petrology of seven >1mm fragments from mare Crisium. *In Mare Crisium: The View from Luna 24*. (ed. Merrill and Papike) 537-568. Lunar Planetary Institute, Houston.
- Laul J.C., Vaniman D.T., Papike J.J. and Simon S. (1978) Chemistry and petrology of the size fractions of the Apollo 17 deep core 70009-70006. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2065-2097.
- Laul J.C., Lepel E.A., Vaniman D.T. and Papike J.J. (1979) The Apollo 17 drill core: Chemical systematics of the grain size fractions. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1269-1298.
- Laul J.C. and Papike J.J. (1980a) The lunar regolith: Comparative chemistry of the Apollo sites. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1307-1340.
- Laul J.C. and Papike J.J. (1980b) The Apollo 17 drill core: Chemistry of size fractions and the nature of the fused soil component. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1395-1413.
- Laul J.C., Papike J.J. and Simon S.B. (1981) The lunar regolith: Comparative studies of the Apollo and Luna 16, 20 and 24. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 389-407.
- Laul J.C., Papike J.J., Simon S.B. and Shearer C.K. (1983) Chemistry of the Apollo 11 highland component. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* *J. Geophys. Res.* **88**, B139-149.
- Laul J.C., Rode O.D., Simon S.B. and Papike J.J. (1987) The lunar regolith: Chemistry and petrology of Luna 24 ultra-fine grain size fractions. *Geochim. Cosmochim. Acta* **51**, 661-673.
- Laul J.C., Simon S.B. and Papike J.J. (1988) Chemistry and petrology of the Apennine Front, Apollo 15, Part II: Impact melt rocks. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 203-217. Lunar Planetary Institute, Houston.
- Laurenzi M.A., Turner G. and McConville P. (1988) Laser probe  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  dating of impact melt glasses in lunar breccias 15466. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 299-306. Lunar Planetary Institute, Houston.
- Lawrence S.J., Taylor G.J., Norman M.D. and Keil K. (2007) Trace element geochemistry of Apollo 17 mafic impact melt breccias (abs#1696). *Lunar Planet. Sci.* **XXXVIII**, Lunar Planetary Institute, Houston.
- Lawrence D.J., Feldman W.C., Barraclough B.L., Binder A.B., Elphic R.C., Maurice S., Miller M.C. and Prettyman T.H. (2000) Thorium abundances on the lunar surface. *J. Geophys. Res.* **105**, 20307-20331.
- Le Bas M.J. (2001) Report of the working party on the classification of the lunar igneous rocks. *Meteor. & Planet. Sci.* **36**, 1183-1188.
- Lee D.-C., Halliday A.N., Snyder G.A. and Taylor L.A. (1997) Age and origin of the Moon. *Science* **278**, 1098-1103.
- Lee D.-C., Halliday A.N., Snyder G.A. and Taylor L.A. (2000) Lu-Hf systematics and evolution of the moon (abs#1288). *Lunar Planet. Sci.* **XXXI**, Lunar Planetary Institute, Houston.
- Lee D.-C., Halliday A.N., Leya I., Wieler R. and Weichert U. (2002) Cosmogenic tungsten and the origin and earliest differentiation of the Moon. *Earth Planet. Sci. Lett.* **198**, 267-274.
- Le Feuvre M. and Wieszorek M.A. (2011) Nonuniform cratering of the Moon and a revised crater chronology of the inner solar system. *Icarus* **214**, 1-20.

- Leich D.A., Tombrello T.A. and Burnett D.S. (1973a) The depth distribution of hydrogen and fluorine in lunar samples. *Earth Planet. Sci. Lett.* **19**, 305-314.
- Leich D.A., Tombrello T.A. and Burnett D.S. (1973b) The depth distribution of hydrogen and fluorine in lunar samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1597-1612.
- Leich D.A., Goldberg R.H., Burnett D.S. and Tombrello T.A. (1974) Hydrogen and fluorine in the surfaces of lunar samples. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1869-1884.
- Leich D.A., Kahl S.B., Kirschbaum A.R., Niemeyer S. and Phinney D. (1975a) Rare gas constraints on the history of Boulder 1, Station 2, Apollo 17. *The Moon* **14**, 407-444.
- Leich D.A., Kahl S.B., Kirschbaum A.R., Niemeyer S. and Phinney D. (1975b) Rare gas studies on Boulder 1, Station 2, Apollo 17 (abs). *Lunar Sci.* **VI**, 501-503. Lunar Planetary Institute, Houston.
- Leich D.A. and Niemeyer S. (1975) Trapped xenon in lunar anorthosite breccia 60015. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1953-1965.
- Levine J., Becker T.A., Muller R.A. and Renne P.R. (2005)  $^{40}\text{Ar}/^{39}\text{Ar}$  dating of Apollo 12 impact spherules. *Geophys. Res. Lett.* **32**, L15201
- Levine Jonathan, Renne P.R. and Muller R.A. (2006) Solar and cosmogenic argon in dated lunar impact spherules. *Geochim. Cosmochim. Acta* **71**, 1624-1635.
- Levine J. and Rohde R.A. (2006) Inverse modeling of argon step release data from lunar impact spherules. *J. Geophys. Res. – Planets* **111**, E06015
- Levinson H.F., Dones L., Chapman C.R., Stern S.A., Duncan M.J. and Zahnle K. (2001) Could the lunar “late heavy bombardment” have been triggered by the formation of Uranus and Neptune? *Icarus* **151**, 286-306.
- Levsky L.K., Verchovski A.B. and Chorev A.N. (1981) Argon and xenon adsorption on mineral surfaces: Cosmochemical and geochemical consequences (abs). *Lunar Planet. Sci.* **XII**, 613-615. Lunar Planetary Institute, Houston.
- Leya Ingo, Wieler R. and Halliday A.N. (2000) Cosmic-ray production of tungsten isotopes in lunar samples and meteorites and its implication for Hf-W cosmochemistry. *Earth Planet. Sci. Lett.* **175**, 1-12.
- Leya I., Wieler R. and Halliday A.N. (2003) The influence of cosmic-ray production on extinct nuclide systems. *Geochim. Cosmochim. Acta* **67**, 529-541.
- Liang Y. and Hess P.C. (2009) Simple models for trace element fractionation during melting and melt migration in an upwelling heterogeneous lunar mantle (abs#2117). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Lightner B.D. and Marti K. (1974) Lunar trapped xenon. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2023-2031.
- Lin Y., Shen W., Liu Y., Xu L., Hofmann B.A., Mao Q, Tang G.Q., Wu F. and Li X.H. (2012) Very high-K KREEP-rich clasts in the impact melt breccias of the lunar meteorite SAU 169: New constraints on the lat residue of the Lunar Magma Ocean. *Geochim. Cosmochim. Acta.* **85**, 19-40.
- Lindsay J.F. (1971a) Mixing models and the recognition of end-member groups in Apollo 11 and 12 soils. *Earth Planet. Sci. Lett.* **12**, 67-72.
- Lindsay J.F. (1971b) Sedimentology of Apollo 11 and 12 lunar soils. *J. Sediment. Petrol.* **41**, 780-797.

- Lindsay J.F. (1972) Development of soil on the lunar surface. *J. Sediment. Petrol.* **42**, 876-888.
- Lindsay J.F. (1976) **Lunar Stratigraphy and Sedimentology**. Elsevier, N.Y.
- Lindsley D.H., King H.E. and Turnock A.C. (1974) Composition of synthetic augite and hypersthene coexisting at 810 deg C: Application to pyroxenes from the lunar highland rocks. *Geophys. Res. Lett.* **1**, 134-136.
- Lindstrom D.J. (1999) Trace element analyses of grain size separates from disaggregated soil (abs#). *Lunar Planet. Sci.* **XXX**, Lunar Planetary Institute, Houston.
- Lindstrom D.J., Wentworth S.J., Martinez R. R. and McKay D.S. (1994) Trace element identification of three chemically distinct VLT basalt glasses from Apollo 17. *Geochim. Cosmochim. Acta* **58**, 1367-1375.
- Lindstrom D.J., Wentworth S.J., Martinez R.R. and McKay D.S. (1993) Geochemistry of HASP, VLT and other glasses from the double drive tube 79001/2 (abs). In **Workshop on Geology of the Apollo 17 Landing Site**. LPI Tech. Rpt. 92-09. 27-28. Lunar Planetary Institute, Houston.
- Lindstrom M.M. (1984) Alkali gabbro-norite, ultra-KREEPy melt rock and the diverse suite of clasts in north ray crater feldspathic fragment breccia 67975. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* C50-C62. *J. Geophys. Res.* **89**
- Lindstrom M.M. (1985) Compositional distinctions among lunar granulites (abs). *Lunar Planet. Sci.* **XVI**, 491-492. Lunar Planetary Institute, Houston.
- Lindstrom M.M. (1986) Diversity of rock types in Apennine Front breccias (abs). *Lunar Planet. Sci.* **XVII**, 486-487. Lunar Planetary Institute, Houston.
- Lindstrom M.M., Duncan A.R., Fruchter J.S., McKay S.M., Stoesser J.W., Goles G.G. and Lindstrom D.J. (1972) Compositional characteristics of some Apollo 14 clastic materials. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1201-1214.
- Lindstrom M.M., Nielsen R.L. and Drake M.J. (1977) Petrology and geochemistry of lithic fragments separated from the Apollo 15 deep-drill core. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2869-2888.
- Lindstrom M.M., Nava D.F., Lindstrom D.J., Winzer S.R., Lum R.K.L., Schuhmann P.J., Schumann S. and Philpotts J.A. (1977) Geochemical studies of the White Breccia Boulders at North Ray Crater, Descartes region of the lunar highlands. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2137-2151.
- Lindstrom M.M. and Haskin L.A. (1978) Causes of compositional variations within mare basalt suites. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 465-486.
- Lindstrom M.M. and Salpus P.A. (1981) Geochemical studies of rocks from North Ray Crater Apollo 16. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 305-322.
- Lindstrom M.M. and Salpus P.A. (1982) Geochemical studies of feldspathic fragmental breccias and the nature of North Ray Crater Ejecta. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* A671-A683. *J. Geophys. Res.*
- Lindstrom M.M., Knapp S.A., Shervais J.W. and Taylor L.A. (1984) Magnesian anorthosites and associated troctolites and dunite in Apollo 14 breccias. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **89**, C41-C49.
- Lindstrom M.M. and Lindstrom D.J. (1986) Lunar granulites and their precursor anorthositic norites of the early lunar crust. *Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **91**, D263-D276.

- Lindstrom M.M. and Marvin U.B. (1987) Geochemical and petrological studies of clasts in Apennine Front breccia 15459 (abs). *Lunar Planet. Sci.* **XVIII**, 554-555. Lunar Planetary Institute, Houston..
- Lindstrom M.M., Marvin U.B., Vetter S.K. and Shervais J.W. (1988) Apennine front revisited: Diversity of Apollo 15 highland rock types. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 169-185. Lunar Planetary Institute, Houston.
- Lindstrom M.M., Marvin U.B. and Mittlefehldt D.W. (1989a) Apollo 15 Mg- and Fe-norites: A redefinition of the Mg-suite differentiation trend. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 245-254. Lunar Planetary Institute, Houston.
- Lindstrom M.M., Marvin U.B., Holmberg B.B. and Mittlefehldt D.W. (1989b) Geochemistry and petrology of recrystallized gabbroic breccias from the Apollo 15 site (abs). *Lunar Planet. Sci.* **XX**, 576-577. Lunar Planetary Institute, Houston.
- Lindstrom M.M., Marvin U.B., Holmberg B.B. and Mittlefehldt D.W. (1990) Apollo 15 KREEP-poor impact melts. *Proc. 20<sup>th</sup> Lunar Planet. Sci. Conf.* 77-90. Lunar Planetary Institute, Houston.
- Lindstrom M.M., Schwartz C., Score R. and Mason B. (1991) MacAlpine Hills 88104 and 88105 lunar highland meteorites: General description and consortium overview. *Geochim. Cosmochim. Acta* **55**, 2999-3007.
- Ling Z.C. et al. (2009) Raman spectra of quartz in lunar soils from Apollo 14 and 15 missions (abs#1823). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Ling, Wang and Jolliff () A systematic spectroscopic study of four Apollo lunar soils. *J. Earth Sci.* **22**, 578-585.
- Lingner S. (1989) Aufbau und Genese der oberen lunaren Kruste im Hochland und Fra Mauro (Apollo 14). Ph.D. dissertation. Munster
- Lingner S., Bobe K.D., Palme H., Spettel B., Stoffler D. and Wanke H. (1989) Fra Mauro Formation, Apollo 14: I Composition and frequency distribution of igneous and metamorphic rocks. In **Workshop on the Moon in Transition: Apollo 14, KREEP and evolved rocks**. (eds. Taylor and Warren) LPI Tech Rpt. 89-03, 58-61. Lunar Planetary Institute, Houston.
- Lingner S., Spettel B. and Stoffler D. (1989) Fra Mauro Formation, Apollo 14: II I Calculated composition of the primordial lunar crust in the Imbrium region. In **Workshop on the Moon in Transition: Apollo 14, KREEP and evolved rocks**. (eds. Taylor and Warren) LPI Tech Rpt. 89-03, 62-65. Lunar Planetary Institute, Houston.
- Lipschutz M.E., Balsiger H., Rey P., Pelly I.Z. and Mendia M.D. (1973) Vanadium isotopic composition and ferromagnesian element contents of three Apollo 15 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1369-1378.
- Liu D., Wan Y., Zhang Y., Dong C., Jolliff B.L., Ziegler R.A. and Korotev R.L. (2009) Age of zircons in the impact-melt breccia in SAU 169 lunar meteorite: Beijing SHRIMP II study (abs#2499). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Liu D., Jolliff B.L., Ziegler R.A., Wan Y., Zhang Y., Dong C. and Korotev R.L. (2010) A 3.91 billion year age for Apollo 12 high-thorium impact-melt breccias: Products of Imbrium, or an older impact basin in the Procellarium KREEP terrain? (abs#2477) *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Liu D., Jolliff B.L., Ziegler R.A., Korotev R.L., Wan Y., Xie H., Zhang Y., Dong C. and Wang W. (2012) Comparative zircon U-Pb geochronology of impact melt breccias from Apollo 12 and lunar meteorite SaU, and implications for the age of the Imbrium impact. *Earth Planet. Sci. Lett.* **319**, 277-286.

- Liu J.G., Galenas M.G., Putchel I.S. and Walker R.J. (2012) Late heavy bombardment of the Moon: Evidence from Os isotope and highly siderophile element characteristics of lunar impact-melt breccias (abs#2366). *Lunar Planet. Sci. Conf. XLIII*, Lunar Planetary Institute, @ The Woodlands.
- Liu Y.L., Thompson J.R., Taylor L.A. and Park Jaesung (2006) Magnetic properties of unique Apollo 17 soil 70051 (abs#1945). *Lunar Planet. Sci. XXXVII*, Lunar Planetary Institute, Houston.
- Liu Y., Talyor L., Thompson J., Schnare D.W. and Park J. (2007) Unique properties of lunar impact glass: Nanophase metallic Fe synthesis. *Am. Mineral.* **92**, 1420-11427.
- Liu Y., Spicuzza M.J., Valley J.W. and Taylor L.A. (2009) Oxygen isotopes of lunar rocks: Different sources for different Hi-Ti basalts? (abs#2291). *Lunar Planet. Sci. XL*, Luanr Planetary Institute @ The Woodlands.
- Liu Y., Zhang A. and Taylor L.A. (2009) Fragments of asteroids in lunar rocks (abs). *Meteorit. & Planet Sci.* FRANCE
- Liu Y., Spicuzza M.J., Valley J.W., Day J.M.D., Riches A.J.V., Singer K.I. and Taylor L.A. (2010) Diversity in high-titanium lunar mare basalts (abs#1669). *41<sup>st</sup> Lunar Planet. Sci. Conf.* Lunar Planetary Inst. @ The Woodlands
- Liu Y., Boyce J.W., Rossman G.R., Guan Y., Eiler J. and Taylor L.A. (2010) Water in lunar mare basalt: Confirmation from apatite in lunar basalt 14053 (abs#2547). *41<sup>st</sup> Lunar Planet. Sci. Conf.* Lunar Planeraty Institute @ The Woodlands
- Liu Y., Spicuzza M.J., Craddock P.R., Day J.M.D., Valley J.W., Dauphas N. and Taylor L.A. (2010) Oxygen and iron isotopic constraints on the near-surface fractionation effects and the composition of lunar mare basalt source regions. *Geochim. Cosmochim. Acta* **74**, 6249-6262.
- Liu Y., Mosenfelder J.L., Guan Y., Rossman G.R., Eiler J.M. and (of course) Larry Taylor (2012) SIMS analysis of water abundance in nominally anhydrous minerals in lunar basalts (abs#1866). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* Lunar Planetary Institute @ The Woodlands
- Lofgren G.E. (1971a) Spherulitic textures in glassy and crystalline rocks. *J. Geophys. Res.* **76**, 5635-5648.
- Lofgren G.E. (1971b) Devitrified glass fragments from Apollo 11 and Apollo 12 lunar samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 949-955
- Lofgren G.E. (1977) Dynamic crystallization experiments bearing on the origin of textures in impact-generated liquids. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2079-2095.
- Lofgren G.E., Donaldson C.H., Williams R.J., Mullins O. and Usselman T.M. (1974) Experimentally reproduced textures of Apollo 15 basalts. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 549-567.
- Lofgren G.E., Donaldson C.H. and Usselman T.M. (1975) Geology, petrology and crystallization of Apollo 15 quartz-normative basalts. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 79-99.
- Lofgren G.E., Smith D.P. and Brown R.W. (1978) Dynamic crystallization and kinetic melting of the lunar soil. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 959-975.
- Lofgren G.E., Grove T.L., Brown R.W. and Smith D.P. (1979) Comparison of dynamic crystallization techniques on Apollo 15 quartz normative basalts. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 423-438.
- Lofgren G.E. and Lofgren E.M. (1981) Catalog of lunar mare basalts greater than 40 grams. LPI Cont. 438. Lunar Planetary Institute, Houston.

- Lofgren G.E. and Allton J.H. (2008) Special unopened lunar samples: Is it time to examine them? (abs#2199). *Lunar Planet. Sci.* **XXXIX** Lunar Planetary Institute, Houston.
- Longhi J. (1978) Pyroxene stability and the composition of the lunar magma ocean. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 285-306.
- Longhi J. (1981) Preliminary modeling of high pressure partial melting: Implications for early lunar differentiation. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 1001-1018.
- Longhi J. (1982) Effects of fractional crystallization and cumulus processes on mineral composition trends of some lunar and terrestrial rock series. *J. Geophys. Res.* **87**, A54-A64.
- Longhi J. (1987) On the connection between mare basalts and picritic volcanic glasses. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **92**, E349-E360.
- Longhi J. (1990) Silicate liquid immiscibility in isothermal crystallization experiments. *Proc. 20<sup>th</sup> Lunar Planet. Sci. Conf.* 13-24. Lunar Planetary Institute, Houston.
- Longhi J. (1992) Origin of picritic green glass magmas by polybaric fractional fusion. *Proc. 22<sup>nd</sup> Lunar Planet. Sci. Conf.* 343-353. Lunar Planetary Institute, Houston.
- Longhi J. (1992b) Experimental petrology and petrogenesis of mare volcanics. *Geochim. Cosmochim. Acta* **56**, 2235-2251.
- Longhi J. (1995) Liquidus equilibria of some primary lunar and terrestrial melts in the garnet stability field. *Geochim. Cosmochim. Acta* **56**, 2375-2386.
- Longhi J. (2003) A new view of lunar ferroan anorthosites: Postmagma ocean petrogenesis. *J. Geophys. Res.* **108**(E8) 5083, doi:10.1029/2002JE001941
- Longhi J. (2006) Petrogenesis of picritic mare magmas: Constraints on the extent of early lunar differentiation. *Geochim. Cosmochim. Acta* **70**, 5919-5934.
- Longhi J. (2009) Origin of the magnesian suite cumulates (abs#2356). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Longhi J., Walker D. and Hays J.F. (1972) Petrology and crystallization history of basalts 14310 and 14072. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 131-139.
- Longhi J., Walker D., Stolper E.N., Grove T.L. and Hays J.F. (1972) Petrology of mare/rille basalts 15555 and 15065. In **The Apollo 15 Lunar Samples**, 131-134. Lunar Sci. Institute, Houston.
- Longhi J., Walker D., Grove T.L., Stolper E.M. and Hays J.F. (1974) The petrology of the Apollo 17 mare basalts. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 447-469.
- Longhi J., Walker D. and Hays J.F. (1976) Fe and Mg in plagioclase. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1281-1300.
- Longhi J., Walker D. and Hays J.F. (1978) The distribution of Fe and Mg between olivine and lunar basaltic liquids. *Geochim. Cosmochim. Acta* **42**, 1545-1558.
- Longhi J. and Boudreau A.E. (1979) Complex igneous processes and the formation of the primitive lunar crustal rocks. *Proc. 10<sup>th</sup> Lunar Sci. Conf.* 2085-2105.
- Longhi J. and Ashwal L.D. (1985) Two-stage models for lunar and terrestrial anorthosites: Petrogenesis without a magma ocean. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.*, in *J. Geophys. Res.* **90**, C571-C584.



- Longhi J., Durand S.R. and Walker D. (2010) The pattern of Ni and Co abundances in lunar olivines. *Geochim. Cosmochim. Acta* **74**, 784-798.
- Lorenzetti S., Busemann H. and Eugster O. (2005) Regolith history of lunar meteorites. *Meteoritics Planet. Sci.* **40**, 315-327.
- Lorin J.C., Pellas P., Poupeau G., Schultz L. and Signer P. (1973) Irradiation et pre-irradiation de la breche 14307. *The Moon* **8**, 149-175.
- Losiak A. and 7 authors (2010) A new lunar impact crater database (abs1532). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ the Woodlands
- Loubet M., Birck J.L. and Allegre C.J. (1972a) Teneurs en  $^{87}\text{Rb}$ - $^{87}\text{Sr}$ , Terres rare et K. Rb, Sr, Ba dans le sol lunaire ramene par la sonde sovietique Luna 20. *Comptes-Rendus Acad. Sci.* **D275**, 1095-1097.
- Loubet M., Birck J.L. and Allegre C.J. (1972b) Teneurs en K. Rb, Sr, Ba et terres rares des echantillons ramenes par la sonde sovietique Luna 20 de la region du cratere Apollonius (montagnes lunaires). *Earth Planet. Sci. Lett.* **17**, 19-23.
- Lovering J.F. and Ware N.G. (1970a) Electron probe microanalyses of minerals and glasses in Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 633-654.
- Lovering J.F. and Kleeman J.D. (1970b) Fission track uranium distribution studies on Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 627-631.
- Lovering J.F. and Butterfield D. (1970) Neutron activation analysis of rhenium and osmium in Apollo 11 lunar material. *Proc. Apollo 11 Lunar Sci. Conf.* 1351-1355.
- Lovering J.F. and 14 authors (1971) Tranquillityite: A new silicate mineral from Apollo 11 and Apollo 12 basaltic rocks. *Proc. Second Lunar Science Conf.* 39-45.
- Lovering J.F. and Wark D.A. (1971) Uranium-enriched phases in Apollo 11 and Apollo 12 basaltic rocks. *Proc. Second Lunar Sci. Conf.* 151-158.
- Lovering J.F. and Hughes T.C. (1971) Re and Os determinations and meteoritic contamination levels in Apollo 11 and Apollo 12 lunar samples. *Proc. Second Lunar Sci. Conf.* 1331-1335.
- Lovering J.F., Wark D.A., Geadow A.J.W. and Sewell D.K.B. (1972) Uranium and potassium fractionation in pre-Imbrian lunar crstrial rocks. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 281-294.
- Lovering J.F., Wark D.A., Gleadow A.J.W. and Britten R. (1974) Lunar monazite: A late-stage (mesostasis) phase in mare basalt. *Earth Planet. Sci. Lett.* **21**, 164-168.
- LSPET (1969) Preliminary examination of lunar samples from Apollo 11. *Science* **165**, 1211-1227.
- LSPET (1970) Preliminary examination of lunar samples from Apollo 12. *Science* **167**, 1325-1339.
- LSPET (1971a) Preliminary examination of lunar samples from Apollo 14. *Science* **173**, 681-693.
- LSPET (1971b) Preliminary examination of lunar samples from Apollo 14. *In Apollo 14 Preliminary Sci. Rpt. NASA SP-272*
- LSPET (1972a) The Apollo 15 lunar samples: A preliminary description. *Science* **175**, 363-375.

- LSPET (1972b) Preliminary examination of lunar samples. *In* Apollo 15 Preliminary Science Report. NASA SP-289, 6-1--6-28.
- LSPET (1972c) Preliminary examination of lunar samples. *In* Apollo 16 Preliminary Science Report. NASA SP-315, 7-1--7-58.
- LSPET (1973b) The Apollo 16 lunar samples: Petrographic and chemical description. *Science* **179**, 23-34.
- LSPET (1973a) Apollo 17 lunar samples: Chemical and petrographic description. *Science* **182**, 659-690.
- LSPET (1973c) Preliminary examination of lunar samples. *In* Apollo 17 Preliminary Science Report. NASA SP-330, 7-1--7-46.
- Lu F., Taylor L.A. and Jin Y. (1989) Basalts and gabbros from Mare Crisium: Evidence for extreme fractional crystallization. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 199-207. Lunar Planetary Institute, Houston.
- Lucchitta B.K. (1977) Crater clusters and light mantle at the Apollo 17 site: A result of secondary impact from Tycho. *Icarus* **30**, 80-96.
- Lucchitta B.K. (1979) Relative age of Camelot crater and crater clusters near the Apollo 17 site. *Icarus* **37**, 46-50.
- Lucey P., Taylor G.J. and Malaret E. (1995) Abundance and distribution of iron on the Moon. *Science* **268**, 1150-1153.
- Lucey P.G., Blewett D.T. and Jolliff B.L. (2000) Lunar iron and titanium abundance algorithms based on initial processing of Clementine ultraviolet-visible images. *J. Geophys. Res.* **105**, 20,297-20,305.
- Lucey P.G. and 17 authors (1991) Understanding the lunar surface and space-Moon interaction. *In* **New Views of the Moon** (eds Jolliff et al). Reviews in Mineralogy and Geochemistry Vol 60 MSA and Geo. Soc.
- Lugmair G.W. (1975) Sm-Nd systematics of some Apollo 17 basalts. *In* **Papers presented to the Conference on Origins of Mare Basalts** and their Implications for Lunar Evolution (Lunar Science Institute, Houston), 107-110.
- Lugmair G.W. and Marti K. (1971) Neutron capture effects in lunar gadolinium and the irradiation histories of some lunar rocks. *Earth Planet. Sci. Lett.* **13**, 32-42.
- Lugmair G.W. and Marti K. (1972) Exposure ages and neutron capture record in lunar samples from Fra Mauro. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1891-1897.
- Lugmair G.W., Scheinin N.B. and Marti K. (1975a) Sm-Nd age and history of Apollo 17 basalt 75075: Evidence for early differentiation of the lunar interior. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1419-1429.
- Lugmair G.W., Scheinin N.B. and Marti K. (1975b) Sm-Nd age of Apollo 17 basalt 75075: Two-stage igneous processes (abs). *Lunar Sci.* **VI**, 531-533. Lunar Planetary Institute, Houston.
- Lugmair G.W., Marti K., Kurtz J.P. and Scheinin N.B. (1976a) History and genesis of lunar troctolite 76535 or: How old is old? *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2009-203.
- Lugmair G.W., Kurtz J.P., Marti K. and Scheinin N.B. (1976b) The low Sm/Nd region of the Moon: Evolution and history of a troctolite and a KREEP basalt (abs). *Lunar Sci.* **VII**, 509-511. Lunar Planetary Institute, Houston

Lugmair G. and Marti K. (1977) Evolution of the lunar interior: Sm-Nd systematics of A15 green glass and the question of the lunar initial  $^{143}\text{Nd}/^{144}\text{Nd}$  (abs). *Lunar Sci.* **VIII**, 597-599. Lunar Planetary Institute, Houston.

Lugmair G. and Marti K. (1978) Lunar initial  $^{143}\text{Nd}/^{144}\text{Nd}$ : differential evolution of the lunar crust and mantle. *Earth Planet. Sci. Lett.* **39**, 349-357.

Lugmair G.W. and Carlson R.W. (1978) The Sm-Nd history of KREEP. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 689-704.

Lunatic Asylum (1970) Mineralogic and isotopic investigations on lunar rock 12013. *Earth Planet. Sci. Lett.* **9**, 137-163.

Lunatic Asylum (1978) Petrology, chemistry, age and irradiation history of Luna 24 samples. In **Mare Crisium: The view from Luna 24**. *Geochim. Cosmochim. Acta Suppl.* **9**, 657-678.

Luvine J., Renne P.R. and Muller R.A. (2007) Solar and cosmogenic argon in dated lunar impact spherules. *Geochim. Cosmochim. Acta* **71**, 1624-1635.

Ma M.-S. (1980) VLT mare basalt and aluminous mare basalt from Apollo 17 drill core (abs). *Lunar Planet. Sci.* **XI**, 655-657. Lunar Planetary Institute, Houston.

Ma M.-S., Murali A.V. and Schmitt R.A. (1976) Chemical constraints for mare basalt genesis. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1673-1695.

Ma M.-S., Schmitt R.A., Taylor G.J., Warner R.D., Lange D.E. and Keil K. (1977a) Luna 24 soils: A chemical study. In **Papers Presented to the Conference on Luna 24**, 102-105. Lunar Science Institute, Houston.

Ma M.-S., Murali A.V., Schmitt R.A., Quick J.E. and Albee A.L. (1977b) Major minor and trace element compositions of two petrologically significant lithologies in 12013 (abs). *Lunar Sci.* **VIII**, 602-604. Lunar Sci. Institute, Houston.

Ma M.-S., Schmitt R.A., Warner R.D., Taylor G.J. and Keil K. (1978a) Genesis of Apollo 15 olivine normative mare basalts: Trace element correlations. *Proc. 9<sup>th</sup> Lunar Sci. Conf.* 523-533.

Ma M.-S., Schmitt R.A., Taylor G.J., Warner R.D., Lange D.E. and Keil K. (1978b) Chemistry and petrology of Luna 24 lithic fragments and <250  $\mu\text{m}$  soils: Constraints on the origin of VLT basalts. In **Mare Crisium: The View from Luna 24** (Merrill R.B. and Papike J.J., eds.) 569-592. Pergamon.

Ma M.-S., Schmitt R.A., Nielson R.L., Taylor G.J., Warner R.D. and Keil K. (1979a) Petrogenesis of Luna 16 aluminous mare basalt. *Geophys. Res. Lett.* **6**, 909-912.

Ma M.-S., Schmitt R.A., Warner R.D., Taylor G.J. and Keil K. (1979b) Composition, petrography, and genesis of Apollo 17 high-Ti mare basalts (abs). *Lunar Planet. Sci.* **X**, 765-767. Lunar Planetary Institute, Houston.

Ma M.-S., Schmitt R.A., Beaty D.W. and Albee A.L. (1980) The petrology and chemistry of basaltic fragments from the Apollo 11 soil: Drive tubes 10004 and 10005. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 37-47.

Ma M.-S. and Schmitt R.A. (1980) Luna 24 VLT microgabbro and recrystallized basalt – new chemical data (abs). *Lunar Planet. Sci.* **XI**, 646-648. Lunar Sci. Institute, Houston.

- Ma M.-S., Schmitt R.A., Warner R.D., Taylor G.J., Barker S. and Keil K. (1980a) Aluminous mare basalts and basaltic-textured KREEPy rocks from Apollo 14 coarse fines (abs). *Lunar Planet. Sci.* **XI**, 652-654. Lunar Planetary Institute, Houston.
- Ma M.-S. and Schmitt R.A. (1980b) Petrogenesis of Apollo 11 basalts: New chemical data of 30 basaltic fragments from cores 10004 and 10005 (abs). *Lunar Sci.* **XI**, 649-651.
- Ma M.-S., Schmitt R.A., Taylor G.J., Warner R.D. and Keil K. (1981) Chemical and petrographic study of spinel troctolite 67435: Implications for the origin of Mg-rich plutonic rocks (abs). *Lunar Planet. Sci.* **XII**, 640-642. Lunar Planetary Institute, Houston.
- Ma M.-S., Liu Y.-G. and Schmitt R.A. (1981) A chemical study of individual green glasses and brown glasses from 15426: Implications for their petrogenesis. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 915-933.
- Ma M.-S. and Schmitt R.A. (1982) Chemistry of the matrix, the glass coating and an olivine clast from poymictic ANT breccia 60035 (abs). *Lunar Sci.* **XIII**, 453-454. Lunar Planetary Institute, Houston.
- MacDougall D., Rajan R.S., Hutcheon I.D. and Price P.B. (1973) Irradiation history and accretionary processes in lunar and meteoritic breccias. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2319-2336.
- MacDougall D., Hutcheon I.D. and Price P.B. (1974) Irradiation records in orange glass and two boulders from Apollo 17 (abs). *Lunar Sci.* **V**, 483-485. Lunar Planetary Institute, Houston.
- Macke R.J., Kiefer W.S., Britt D.T., Irving A.J. and Consolmagno G.J. (2012) Density and porosity of Apollo lunar basalts and breccias (abs#1299). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Magna T., Wiechert U. and Halliday A.N. (2006) New constraints on the lithium isotope compositions of the Moon and terrestrial planets. *Earth Planet. Sci. Lett.* **243**, 336-353.
- Mahmood A., Mitchell J.K. and Carrier W.D. (1974) Grain orientation in lunar soil. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2347-2354.
- Maloy A.K. and Treiman A.H. (2007) Bulk and REE geochemistry of lunar magnesian granulites in ALH81005 and Dh0309: A widespread lunar material (abs#5109). *Meteorit. & Planet. Sci.* **42**,
- Mandeville J.-C. (1975) Microcraters observed on 15015 breccia and micrometeoroid flux. *Proc. 6<sup>th</sup> Lunar Planet. Sci.* 3403-3408.
- Mandeville J.-C. (1976) Microcraters on lunar rocks. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1031-1038.
- Mandeville J.-C. and Dollfus A. (1977) Optical properties of lunar and terrestrial rock samples submitted to micrometeoroid bombardment (abs). *Lunar Sci.* **VIII**, 616-618. Lunar Planetary Institute, Houston
- Manka R.H. and Michel F.C. (1970) Lunar atmosphere as a source of argon-40 and other lunar surface elements. *Science* **169**, 278-280.
- Mao H.K., Virgo D. and Bell P.M. (1973a) Sample 74220: Analysis of the Apollo 17 orange soil from Shorty Crater. *EOS Trans. AGU* **54**, 598.
- Mao H.K., Virgo D. and Bell P.M. (1973b) Analytical and experimental study of iron and titanium in orange glass from Apollo 17 soil sample 74220. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 397-412.
- Mao H.K., El Goresy A. and Bell P.M. (1974a) Evidence of extensive chemical reduction in lunar regolith samples from the Apollo 17 site. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 673-683.

- Mao H.K., El Goresy A. and Bell P.M. (1974b) Orange glasses: Reaction of molten liquids with Apollo 17 soil breccia (70019) and gabbro (79155) (abs). *Lunar Sci.* **V**, 489-491. Lunar Planetary Institute, Houston.
- Mao H.K., Bell P.M. and Haggerty S.E. (1975) Chemical reduction of glasses in breccia 70019,93: The most reduced Apollo sample (abs). *Lunar Sci.* **VI**, 548-549. Lunar Planetary Institute, Houston.
- Marchi S., Bothke W.F., Kring D.A. and Morbidelli A. (2012) Two populations of early lunar impactors as recorded in its ancient crater populations (abs). Early Solar System Impact Bombardment II, Lunar Planet. Sci. Institute, Houston.
- Marchi S., Bothke W.F., Kring D.A. and Morbidelli A. (2012) The onset of the lunar cataclysm as recorded in its ancient crater populations. *Earth Planet. Sci. Lett.* **325**, 27-38.
- Mark R.K., Lee-Hu C.-N. and Wetherill G.W. (1974) Rb-Sr age of lunar igneous rocks 62295 and 14310. *Geochim. Cosmochim. Acta* **38**, 1643-1648.
- Mark R.K., Cliff R.A., Lee-Hu C. and Wetherill G.W. (1973) Rb-Sr studies of lunar breccias and soils. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1785-1795.
- Mark R.K., Lee-Hu C.-N. and Wetherill G.W. (1974) Equilibration and ages: Rb-Sr studies of breccias 14321 and 15265. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1477-1485.
- Mark R.K., Lee-Hu C. and Wetherill G.W. (1975) More on Rb-Sr in lunar breccia 14321. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1501-1507.
- Marti K. (1967) Mass-spectrometric detection of cosmic-ray produced  $\text{Kr}^{81}$  in meteorites and the possibility of Kr-Kr dating. *Phys. Rev. Lett.* **18**, 264-266.
- Marti K. (1983) Recoils: New opportunities to study and date early solar system processes (abs). *Lunar Planet. Sci.* **XIV**, 462-463. Lunar Planetary Institute, Houston.
- Marti K., Lugmair G.W. and Urey H.C. (1970) Solar wind gases, cosmic ray spallation products and the irradiation history of Apollo 11 samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1357-1367.
- Marti K. and Lugmair G.W. (1971)  $\text{Kr}^{81}$ -Kr and Kr-Ar<sup>40</sup> ages, cosmic-ray spallation products and neutron effects in lunar samples from Oceanus Procellarum. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1591-1605.
- Marti K. and Lightner B.D. (1972) Rare gas record in the largest Apollo 15 rock. *Science* **175**, 421-422.
- Marti K., Lightner B.D. and Osborn T.W. (1973) Krypton and Xenon in some lunar samples and the age of North Ray Crater. *Proc. 4<sup>th</sup> Lunar Sc. Conf.* 2037-2048.
- Marti K., Lightner B.D. and Lugmair G.W. (1973) On <sup>244</sup>Pu in lunar rocks from Fra Mauro and implications regarding their origin. *The Moon* **8**, 241-250.
- Marti K., Aeschlimann U., Eberhardt P., Geiss J., Grogler N., Jost D.T., Laul J.C., Ma M.-S., Schmitt R.A. and Taylor G.J. (1983) Pieces of the ancient lunar crust: Ages and composition of clasts in consortium breccia 67915. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **88**, B165-B175.
- Martinez R. and Ryder G. (1989) A granite fragment from the Apennine Front – brother of QMD? (abs) *Lunar Planet. Sci.* **XX**, 620-621. Lunar Planetary Institute, Houston.
- Marquardt C.L. and Griscom D.L. (1976) On the spectral reflectance and maturation darkening of lunar soils. *The Moon*, **15**, 15-30.

- Marvin U.B. (1971) Lunar niobian rutile. *Earth Planet. Sci. Lett.* **11**, 7-9.
- Marvin U.B. (1972) Apollo 16 coarse fines (4-10 mm): Sample classification, description and inventory. Curators office, JSC.
- Marvin U.B. (1975) The Boulder. *The Moon* **14**, 315-326.
- Marvin U.B. (1976a) A unique eucritic gabbro from the Descartes Highlands (abs). *Meteoritics* **11**, 329-330.
- Marvin U.B. (1976b) Apollo 16 sample 61224,6: A lunar or meteoritic eucrite? (abs) *EOS* **57**, 277-278.
- Marvin U.B. (1976c) Sample 15405: Hand Specimen Descriptions and Processing. *In* Wood and others
- Marvin U.B. (1978) Apollo 12 coarse fines (2-10 mm): Sample locations, description and inventory. Curators office, JSC. #14434
- Marvin U.B. (1980) Breccia guidebook no. 4. 67015. Curatorial publication 61, JSC 16671.
- Marvin U.B., Wood J.A., Taylor G.J., Reid J.B., Powell B.N., Dickey J.S. and Bower J.F. (1971) Relative proportions and probable sources of rock fragments in the Apollo 12 soil samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 679-699.
- Marvin U.B. and Walker D. (1978) Implications of a titanium-rich glass clod at Oceanus Procellaru. *Am. Mineral.* **63**, 924-929.
- Marvin U.B. and Mosie A.B. (1980) Apollo 16 soil catalog 61220: Classification and description of 1-4 mm fines. JSC Curator Pub #53.
- Marvin U.B. and Warren P.H. (1980) A pristine eucrite-like gabbro from Descartes and its exotic kindred. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 508-521.
- Marvin U.B. and Lindstrom M.M. (1983) Rock 67015: A feldspathic fragmental breccias with KREEP-rich melt clasts. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* A659-670.
- Marvin U.B. and Walker D. (1985) A transient heating event in the history of a highlands troctolite from Apollo 12 soil 12033. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* C421-C429.
- Marvin U.B., Lindstrom M.M., Bernatowicz T.J. and Podosek F.A. (1987) The composition and history of breccia 67015 from North Ray Crater. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* E471-E490 in *J. Geophys. Res.* **92**.
- Marvin U.B., Hohenberg B.B. and Lindstrom M.M. (1990) New pieces of the lunar granite-quartz monzodiorite puzzle (abs). *Lunar Planet. Sci.* **XXI**, 738-739. Lunar Planetary Institute, Houston.
- Marvin U.B., Lindstrom M.M., Holmberg B.B. and Martinez R.R. (1991) New observations of quartz monzodiorite-granite suite. *Proc. 21<sup>st</sup> Lunar Planet. Sci. Conf.* 119-136. Lunar Planetary Institute, Houston.
- Mason B., Fredricksson K., Henderson P., Jarosewich E., Melson W., Towe K. and White J.S. (1970) Mineralogy and petrology of lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 655-660.
- Mason B. (1972a) Lunar tridymite and cristobalite. *Am. Mineral.* **57**, 1530-1535.
- Mason B. (1972b) Mineralogy and petrology of polymict breccia 15498. *In The Apollo 15 Lunar Samples*, 137-139.

Mason B. (1972c) Mineralogy and petrology of lunar samples 15264,19, 15274,12 and 15314,59. *In The Apollo 15 Lunar Samples*, 135-136.

Mason B., Jarosewich E., Melson W.G. and Thompson G. (1972) Mineralogy, petrology, and chemical composition of lunar samples 15085, 15256, 15271, 15471, 15475, 15476, 15535, 15555 and 15556. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 785-796.

Mason B., Jacobson S., Nelen J.A., Melson W.G., Simkin T. and Thompson G. (1974) Regolith composition from the Apollo 17 mission. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 879-885.

Mason B., Jarosowich E., Jacobson S. and Thompson G. (1977) Composition of eight Apollo 17 basalts. *In Lunar Sample Studies*. Pp41 JSC (Phinney ed.)

Masterson Amanda and Yoshitoshi (1979) **Index to the Proceedings of the Lunar and Planetary Science Conferences**. Lunar Planetary Institute, Houston.

Masuda A., Nakamura N., Kurasawa H. and Tanaka T. (1972) Precise determination of rare-earth elements in the Apollo 14 and 15 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1307-1313.

Masuda A., Tanaka T., Nakamura N. and Kurasawa H. (1974) Possible REE anomalies of Apollo 17 REE patterns. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1247-1253.

Mathew K.J. and Marti K. (2001) Lunar nitrogen: Indigenous signature and cosmic ray production rate. *Earth Planet. Sci. Lett.* **184**, 659-669.

Mattinson J.M., Tilton G.R., Todt W. and Chen J.H. (1977) Lead isotope studies of mare basalt 70017. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1473-1487.

Maurer P., Eberhardt P., Geiss J., Grogler N., Stettler A., Brown G.M., Peckett A. and Krahenbuhl U. (1978) Pre-Imbrium craters and basins: ages, compositions and excavation depths of Apollo 16 breccias. *Geochim. Cosmochim. Acta* **42**, 1687-1720.

Maxwell J.A., Peck L.C., and Wiik H.B. (1970) Chemical composition of Apollo 11 lunar samples 10017, 10020, 10072, and 10084. *Proc. Apollo 11 Lunar Sci. Conf.* 1369-1374

Maxwell J.A. and Wiik H.B. (1971) Chemical composition of Apollo 12 lunar samples 12004, 12033, 12051, 12052 and 12065. *Earth Planet. Sci. Lett.* **10**, 285-288.

Maxwell J.A., Bouvier J.-L. and Wiik H.B. (1972) Chemical composition of some Apollo 15 lunar samples. *In The Apollo 15 Lunar Samples* (Chamberlain and Watkins, eds.), 233-238. The Lunar Science Institute, Houston.

Mayeda T.K., Shearer J. and Clayton R.N. (1975) Oxygen isotope fractionation of Apollo 17 rocks. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1799-1802.

Mayne R.G. and Taylor L.A. (2003) New insights into the origin of 14053 – The only basaltic rock returned by Apollo 14 (abs#1604). *Lunar Planet. Sci.* **XXXIV** Lunar Planetary Institute, Houston.

McCallum I.S. (1983) Formation of Mg-rich pristine rocks by crustal metasomatism (abs). *Lunar Planet. Sci.* **XIV**, 473-474. Lunar Planetary Institute, Houston.

McCallum I.S. and Charette M.P. (1977) Partitioning of Zr between crystals and coexisting high-TI mare basalt melt (abs). *Lunar Sci.* **VIII**, 637-639. Lunar Planetary Institute, Houston.

- McCallum I.S. and Charette M.P. (1978) Zr and Nb distribution coefficients: Further constraints on the genesis of high-Ti mare basalts and KREEP (abs). *Lunar Planet. Sci.* **IX**, 711-713. Lunar Planetary Institute, Houston.
- McCallum I.S., Mathez E.A., Okamura F.P. and Ghose S. (1974a) Petrology and crystal chemistry of poikilitic anorthositic gabbro 77017. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 287-302.
- McCallum I.S., Okamura F.P., Mathez E.A. and Ghose S. (1974b) Pyroxene relations in highland plutonic and high grade metamorphic rocks (abs). *Lunar Sci.* **V**, 472-474. Lunar Planetary Institute, Houston.
- McCallum I.S. and Mathez E.A. (1975) Petrology of noritic cumulates and a partial melting model for the genesis of Fra Mauro basalts. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 395-414.
- McCallum I.S., Okamura F.P., Mathez E.A. and Ghose S. (1975) Petrology of noritic cumulates: Samples 78235 and 78238 (abs). *Lunar Sci.* **VI**, 534-536. Lunar Planetary Institute, Houston.
- McCallum I.S., Okamura F.P. and Ghose S. (1975) Mineralogy and petrology of sample 67075 and the origin of lunar anorthosites. *Earth Planet. Sci. Lett.* **26**, 36-53.
- McCallum I.S. and O'Brien H.E. (1996) Stratigraphy of the lunar highland crust: Depths of burial of lunar samples from cooling-rate studies. *Am. Mineral.* **81**, 1166-1175.
- McCallum I.S. and Schwartz J.M. (2001) Lunar Mg suite: thermobarometry and petrogenesis of parental magmas. *J. Geophys. Res.* **106**, 27969-27983.
- McCallum I.S., Schwartz J.M., Camara F. and Norman M. (2002) Sample 67215: An anomalous ferroan anorthosite (abs#1830). *Lunar Planet. Sci.* **XXXIII** Lunar Planetary Institute, Houston.
- McCallum I.S. and Mullen Emily K. (2009) Mare basalt petrogenesis revisited: Rb/Sr, Sm/Nd, and Lu/Hf fractionation factors. Mantle source regions and crustal contamination (abs#2380). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- McCallum I.S., Domeneghetti M.C., Schwartz J.M., Mullen E.K., Zema M., Camara F., McCammon C. and Ganguly J. (2006) Cooling history of lunar Mg-suite gabbro-norite 76255, troctolite 76535 and Stillwater pyroxenite SC-936: The record in exsolution and ordering in pyroxenes. *Geochim. Cosmochim. Acta* **70**, 6068-6078.
- McCanta Molly, Dyar Darby, Rutherford M.J. and Delaney J.S. (2004) Iron partitioning between basaltic melts and clinopyroxene as a function of oxygen fugacity. *Amer. Mineral.* **89**, 1685-1693.
- McCauley J.F. and Scott D.H. (1972) The geologic setting of the Luna 16 landing site. *Earth Planet. Sci. Lett.* **13**, 223-224.
- McCubbin F.M., Nekvasil H., Jolliff B.L., Carpenter P.K. and Zeigler R.A. (2009) Inhomogeneous distribution of magmatic volatiles in the lunar interior: Clues from the mineral apatite (abs#2246). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- McCubbin F.M., Steele A., Nekvasil H., Schnieders A., Rose T., Fries M., Carpenter P.K. and Jolliff B.L. (2010) Detection of structurally bound hydroxyl in apatite from Apollo mare basalt 15058,128 using TOF-SIMS (abs#2468). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- McCubbin F.M., Steele A., Hauri E.H., Nekvasil H., Yamashita S. and Hemley R.J. (2010) Nominally hydrous magmatism on the Moon. *Proc. Nat. Acad. Sci.* **27**, 11223-11228.



- McCubbin F.M., Steele A., Nekvasil H., Schnieders A., Rose T., Fries M., Carpender P.K. and Jolliff B.L. (2010) Detection of structurally bound hydroxyl in fluoroapatite from Mare basalt 15085,128 using TOF-SIMS *Amer. Mineral.* **95**, 1141-1150.
- McCubbin F.M., Schearer C.K. and Sharpe Z.D. (2011) Magmatic volatiles in lunar apatite: Approaching a single solution to many unique observations (abs#2341). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- McCubbin F.M., Jolliff B.L., Nekvasil H., Carpender P.K., Zeigler R.A., Steele A., Elardo S.M. and Lindsley D.H. (2011) Fluorine and chlorine abundances in lunar apatite: Implications for heterogeneous distributions of magmatic volatiles in the lunar interior. *Geochim. Cosmochim. Acta* **75**, 5073-5093.
- McDonnell J.A.M., Flavill R.P. and Carey W.C. (1976) The micrometeoroid impact crater comminution distribution and accretionary populations on lunar rocks: Experimental measurements. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1055-1072.
- McDonnell J.A.M., Ashworth D.G., Flavill R.P., Carey W.C., Bateman D.C. and Jennison R.C. (1977) The characterization of lunar surface impact erosion and solar wind sputter processes on the lunar surface. *Phil. Trans. Roy. Soc. London* **A285**, 303-308.
- McDonough W.F., Sun S.-S., Ringwood A.E., Jagoutz E. and Hofman A.W. (1992) Potassium, rubidium and cesium in the Earth and Moon and the evolution of the mantle of the Earth. *Geochim. Cosmochim. Acta* **56**, 1001-1012.
- McDougall I. and Harrison T.M. (1999) Geochronology and Thermochronology by the  $^{40}\text{Ar}/^{39}\text{Ar}$  Method. 2<sup>nd</sup> edition, Oxford Press
- McGee J.J. (1987a) Petrology and precursors of lithic clasts from feldspathic fragmetal breccia 67975. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* E513-E525. Lunar Planetary Institute, Houston.
- McGee J.J. (1987b) Petrology of brecciated ferroan noritic anorthosite 67215. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 21-31. Lunar Planetary Institute, Houston.
- McGee J.J. (1989) Granulitic breccia clasts and feldspathic melt breccia clasts from North Ray Crater breccia 67975: Precursors and petrogenesis. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 73-84. The Lunar Planetary Institute, Houston.
- McGee J.J. (1993) Lunar ferroan anorthosites: Mineralogy, compositional variations and petrogenesis. *J. Geophys. Res.* **98**, 9089-9105.
- McGee J.J., Bence A.E., Eichhorn G. and Schaeffer O.A. (1978a) Feldspathic granulite 79215: Limitations on T-fO<sub>2</sub> conditions and time of metamorphism. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 743-772.
- McGee J.J., Bence A.E. and Schaeffer O.A. (1978b) Feldspathic granulite 79215: Conditions of metamorphism and age (abs). *Lunar Planet. Sci.* **IX**, 720-722. Lunar Planetary Institute, Houston
- McGee J.J., Nord G.L. and Wandless M.-V. (1980a) Comparative thermal histories of matrix from Apollo 17 boulder 7 fragment-laden melt rocks: An analytical transmission electron microscopy study. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 611-627.
- McGee J.J., Nord G.L., Jr. and Wandless M.-V. (1980b) Comparative thermal histories of matrix from Apollo 17 boulder 7 fragment-laden melt rocks (abs). *Lunar Planet. Sci.* **XI**, 700-702. Lunar Planetary Institute, Houston.
- McGee P.E., Warner J.L. and Simonds C.H. (1977) Introduction to the Apollo Collections. Part I: Lunar Igneous Rocks. Curators Office, JSC.

McGee P.E., Warner J.L., Simonds C.E. and Phinney W.C. (1979) Introduction to the Apollo collections. Part II: Lunar Breccias. Curator's Office. JSC

McGetchin T.R., Settle M. and Head J.W. (1973) Radial thickness variations in impact crater ejecta: Implications for lunar basin deposits. *Earth Planet. Sci. Lett.* **20**, 226-236.

McKay D.S., Greenwood W.R. and Morrison D.A. (1970) Origin of small lunar particles and breccias from the Apollo 11 site. *Proc. Apollo 11 Lunar Sci. Conf.* 673-693.

McKay D.S. and Morrison D.A. (1971) Lunar breccias. *J. Geophys. Res.* **76**, 5658-5669.

McKay D.S., Morrison D.A., Clanton U.S., Ladle G.H. and Lindsay J. (1971) Apollo 12 soil and breccias. *Proc. Second Lunar Sci. Conf.* 755-774.

McKay D.S., Clanton U.S., Morrison D.A. and Ladle G.H. (1972) Vapor phase crystallization in Apollo 14 breccia. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 739-752.

McKay D.S., Heiken G.H., Taylor R.M., Clanton U.S., Morrison D.A. and Ladle G.H. (1972) Apollo 14 soils: Size distribution and particle types. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 983-995.

McKay D.S., Clanton U.S. and Ladle G. (1973) Scanning electron microscope study of Apollo 15 green glass. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 225-238.

McKay D.S. and Heiken G.H. (1973) Petrology and scanning electron microscope study of Apollo 17 orange and black glass. *EOS Trans. AGU* **54**, 599-600.

McKay D.S., Fruland R.M. and Heiken G.H. (1974) Grain size and the evolution of lunar soils. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 887-906.

McKay D.S., Heiken G.H. and Waits G. (1978) Core 74001/2: Grain size and petrology as a key to the rate of in-situ reworking and lateral transport on the lunar surface. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 1913-1932.

McKay D.S., Basu A. and Waits G. (1978) Grain size and the evolution of Luna 24 soils. In **Mare Crisium: The view from Luna 24**. *Geochem. Cosmochim. Acta* suppl. 9, 125-136. (ed. Merrill) Pergamon Press.

McKay D.S., Basu A. and Nace G-A. (1980) Lunar core 15010/11: Grain size, petrology and implications for regolith dynamics. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1531-1550.

McKay D.S. and Wentworth S.J. (1983) A petrographic survey of regolith breccias from the Apollo 15 and 16 collection (abs). *Lunar Planet. Sci.* **XIV**, 481-482. Lunar Planetary Institute, Houston.

McKay D.S., Morris R.V. and Wentworth S.J. (1984) Maturity of regolith breccias as revealed by ferromagnetic and petrographic indices (abs). *Lunar Planet. Sci.* **XV**, 530-531. Lunar Planetary Institute, Houston.

McKay D.S., Bogard D.D., Morris R.V., Korotev R.L., Johnson P. and Wentworth S.J. (1986) Apollo 16 regolith breccias: Characterization and evidence for early formation in the megaregolith. *Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **91**, D277-D303.

McKay D.S., Wentworth S.J. and Basu A. (1988) Core 79001/2: An example of extreme mixing in the lunar regolith (abs). *Lunar Planet. Sci.* **XIX**, 758-759. Lunar Planetary Institute, Houston.

- McKay D.S., Bogard D.D., Morris R.V., Korotev R.L., Wentworth S.J. and Johnson P. (1989) Apollo 15 regolith breccias: Window to a KREEP regolith. *Proc. 19<sup>th</sup> Lunar Sci. Conf.* 19-41. Lunar Planetary Institute, Houston.
- McKay D.S. and Wentworth S.J. (1993) Morphology and composition of condensates on Apollo 17 Orange and Black Glass. In **Workshop on Geology of the Apollo 17 Landing Site** (abs). LPI Tech. Rpt. 92-09. 31-33. Lunar Planetary Institute, Houston.
- McKay D.S., Heiken G., Basu A., Blanford G., Simon S., Reedy R., French B.M. and Papike J. (1991) The Lunar Regolith. In **Lunar Sourcebook: a users guide to the moon.** (eds. Heiken et al. ) Cambridge Univ. Press
- McKay G.A., Kridelbaugh S. and Weill D. (1973a) A preliminary report on the petrology of microbreccia 66055 (abs). *Lunar Sci.* **IV**, 487-489. Lunar Planetary Institute, Houston.
- McKay G.A., Kridelbaugh S. and Weill D. (1973b) The occurrence and origin of shreibersite-kamacite intergrowths in microbreccia 66055. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 811-818.
- McKay G.A. and Weill D. (1976) The petrogenesis of KREEP. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2427-2447.
- McKay G.A. and Weill D. (1977) KREEP petrogenesis revisited. *Proc. 8<sup>th</sup> Lunar Science Conf.* 2339-2355.
- McKay G.A., Wiesmann H., Nyquist L.E., Wooden J.L. and Bansal B.M. (1978) Petrology, chemistry and chronology of 14078: Chemical constraints on the origin of KREEP. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 661-687.
- McKay G.A., Wiesmann H., Bansal B.M. and Shih C.-Y. (1979a) Petrology, chemistry, and chronology of Apollo 14 KREEP basalts. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 181-205.
- McKay G.A., Wiesmann H. and Bansal B. (1979b) The KREEP-magma ocean connection (abs). *Lunar Planet. Sci.* **X**, 804-806. Lunar Planetary Institute, Houston.
- McKinley J.P., Taylor G.J., Keil K., Ma M.-S. and Schmitt R.A. (1984) Apollo 16: Impact sheets, contrasting nature of the Cayley Plains and Descartes Mountains, and geologic history. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **89**, B513-B524.
- McSween H.Y. (1976) A new type of chondritic meteorite found in lunar soil. *Earth Planet. Sci. Lett.* **31**, 193-199.
- McSween H.Y., Taylor L.A. and Clark J.C. (1977) Luna 24 metabasalts: Possible evidence for assimilation highlands materials? In Papers Presented to the **Conference on Luna 24**, 118-120. Lunar Science Institute, Houston.
- Mehta S. and Goldstein J.I. (1979a) Analytical electron microscopy study of submicroscopic metal particles in glassy constituents of lunar breccias 15015 and 60095. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1507-1521.
- Mehta S., Goldstein J.I. and Friel J.J. (1979b) Investigations of submicron sized metal particles in glass coatings of lunar breccia 15286. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1523-1530.
- Mehta S. and Goldstein J.I. (1980a) Metallic particles in the glassy constituents of three lunar highland samples 65315, 67435, and 78235. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1713-1725.
- Mehta S. and Goldstein J.I. (1980b) Metallic particles in the glass coatings of lunar highland samples 65315, 67435 and 78235 (abs). *Lunar Planet. Sci.* **XI**, 720-722. Lunar Planetary Institute, Houston.

- Mellin M.J., Taylor L.A. and Patchen A.D. (2006) Characterization of a unique soil sample from the Apollo 17 site, 70051 (abs#2334). *Lunar Planet. Sci.* **XXXVII**, Lunar Planetary Institute, Houston.
- Megrue G.H. (1973a) Spacial distributions of  $^{40}\text{Ar}/^{39}\text{Ar}$  ages in lunar breccia 14301. *J. Geophys. Res.* **78**, 3216-3221.
- Megrue G.H. (1973b) Distribution of gases within Apollo 15 samples: Implications for the incorporation of gases within solid bodies of the Solar System. *J. Geophys. Res.* **78**, 4875-4883.
- Megrue G.H. and Steinbrunn F. (1972) Classification and source of lunar soils: clastic rocks; and individual mineral, rock and glass fragments - - *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1899-1916.
- Merle R.E., Grange M.L., Nemchin A.A. and Pidgen R.T. (2012) Comparison of zircon U-Pb ages of Apollo 14 breccias (abs#5161). *75<sup>th</sup> Meteoritical Society @ Cains*
- Merlivat L., Nief G. and Roth E. (1972) Deuterium content of lunar material. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1473-1477.
- Merlivat L., Lelu M., Nief G. and Roth E. (1974a) Deuterium, hydrogen, and water content of lunar material. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1885-1895.
- Merlivat L., Lelu M., Nief G. and Roth E. (1974b) Deuterium content of lunar material (abs). *Lunar Sci.* **V**, 498-500. Lunar Planetary Institute, Houston.
- Merlivat L., Lelu M., Nief G. and Roth E. (1976) Spallation deuterium in rock 70215. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 649-658.
- Meyer C. (1972) Mineral assemblages and the origin of non-mare lunar rock types (abs). *Lunar Sci.* **III**, 542-544. Lunar Planetary Institute, Houston.
- Meyer C. (1973) Apollo 17 Coarse Fines (4-10 mm) Sample Location, Classification and Photo Index. Curator Report. pp. 182.
- Meyer C. (1977) Petrology, mineralogy and chemistry of KREEP basalt. *Physics and Chemistry of the Earth* **10**, 239-260. (Ahrens and Runcorn, eds)
- Meyer C. (1978) Ion microprobe analyses of aluminous lunar glasses: A test of the "rock type" hypothesis. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 1551-1570.
- Meyer C. (1979) Trace elements in plagioclase from the lunar highlands. *In Papers presented to the Conference on the Lunar Highlands Crust* (abs). LPI Contr. 394, 111-113. Lunar Planetary Institute, Houston
- Meyer C. (1987) **The Lunar Petrographic Thin Section Set**. Curatorial Branch Publication No. 76. JSC. (superceded in 2003)
- Meyer C. (1994) **Catalog of Apollo 17 rocks**: Volume 4. Curator's Office JSC 26088 pp. 644
- Meyer C. (2003) The Lunar Petrographic Educational Thin Section Set (revised) – on line.
- Meyer C. (2010) Lunar Sample Compendium (abs#1016). *The 41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Meyer C. and Hubbard N.J. (1970) High potassium and high phosphorous glass as an important rock type in the Apollo 12 soils (abs). *Meteoritics* **5**, 210-211.

- Meyer C., Brett R., Hubbard N.J., Morrison D.A., McKay D.S., Aitken F.K., Takeda H. and Schonfeld E. (1971) Mineralogy, chemistry and origin of the KREEP component in soils from the Ocean of Storms. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 393-411.
- Meyer C., Anderson D.H. and Bradley J.G. (1974) Ion microprobe mass analysis of plagioclase from "non-mare" lunar samples (abs). *Lunar Sci. V*, 506-508. Lunar Planetary Institute, Houston.
- Meyer C., Anderson D.H. and Bradley J.G. (1974) Ion microprobe mass analysis of plagioclase from "non-mare" lunar samples. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 685-706.
- Meyer C., McKay D.S., Anderson D.H. and Butler P. (1975) The source of sublimates on the Apollo 15 green and Apollo 17 orange glass samples. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1673-1699.
- Meyer C. and King C.D. (1979) Breccia Guidebook #1, 14321. JSC 14753 Curators Office, Houston.
- Meyer C., Compston W. and Williams I.S. (1985) Lunar zircon and the closure age of the lunar crust (abs). *Lunar Planet. Sci. XVI*, 557-558. Lunar Planetary Institute, Houston.
- Meyer C. and Yang S.V. (1988) Tungsten-bearing yttrobetafite in lunar granophyre. *Am. Mineral.* **73**, 1420-1425.
- Meyer C., Williams I.S. and Compston W. (1989) <sup>207</sup>Pb/<sup>206</sup>Pb ages of zircon-containing rock fragments indicate continuous magmatism in the lunar crust from 4350 to 3900 million years (abs). *Lunar Planet. Sci. XX*, 691-692. Lunar Planetary Institute, Houston.
- Meyer C., Williams I.S. and Compston W. (1989) Zircon-containing rock fragments within Apollo 14 breccias indicate serial magmatism from 4350 to 4000 million years (abs). *In Workshop on Moon in Transition: Apollo 14, KREEP, and evolved lunar rocks.* LPI Tech Rpt. 89-03, 75-78. Lunar Planetary Institute, Houston.
- Meyer C., Galindo C. and Yang V. (1991) Lunar zircon (abs). *Lunar Planet. Sci. XXII*, 895-896. Lunar Planetary Institute, Houston.
- Meyer C., Williams I.S. and Compston W. (1996) Uranium-lead ages for lunar zircons: Evidence for a prolonged period of granophyre formation from 4.32 to 3.88 Ga. *Meteor. & Planet. Sci.* **31**, 370-387.
- Meyer C.E. and Wilshire H.G. (1974) "Dunite" inclusion in lunar basalt 74275 (abs). *Lunar Sci. V*, 503-505. Lunar Planetary Institute, Houston.
- Meyer H.O.A. (1973) Luna 20: mineralogy and petrology of fragments less than 125 micron size. *Geochim. Cosmochim. Acta* **37**, 943-952.
- Meyer H.O.A. and McCallister R.H. (1973) Mineralogy and petrology of Apollo 16: Rock 60215,13. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 661-665.
- Meyer H.O.A. and Boctor N.Z. (1974a) Opaque mineralogy: Apollo 17, rock 75035. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 707-716.
- Meyer H.O.A. and Boctor N.Z. (1974b) Opaque minerals in basaltic rock 75035 (abs). *Lunar Sci. V*, 512-514. Lunar Planetary Institute, Houston.
- Meyer H.O.A. and Tsai H.M. (1975) Lunar glass compositions: Apollo 16 core sections 60002 and 60004. *Earth Planet. Sci. Lett.* **28**, 2343-240.

- Meyer H.O.A., Hwang J-Y. and McCallister R.H. (1978) Luna 24: Mineral chemistry of 90-150 micron clasts. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2137-2147.
- Michel-Levy M.C. and Johan Z. (1973) An unusual basalt fragment in Luna 20 sample L2010. *Geochim. Cosmochim. Acta* **37**, 805-809.
- Michel-Levy M.C. and Johan Z. (1973) Apollo 15 lunar rocks 15555, 15565 and 15505 and their associated glasses (abs). *Lunar Sci.* **IV**, 136-137. Lunar Planetary Institute, Houston.
- Miller M.D., Pacer R.A., Ma M.-S., Hawke B.R., Lookhart G.L. and Ehmann W.D. (1974) Compositional studies of the lunar regolith at the Apollo 17 site. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1079-1086.
- Minkin J.A., Thompson C.L. and Chao E.C.T. (1977) Apollo 16 white boulder consortium samples 67455 and 67475: Petrologic investigations. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1967-1986.
- Minkin J.A., Thompson C.L. and Chao E.C.T. (1978) The Apollo 17 Station 7 boulder: Summary of study by the International Consortium. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 877-903.
- Minkin J.A., Thompson C.L. and Chao E.C.T. (1987) Allocation of subsamples of Apollo 17 lunar rocks from the boulder at station 7, for study by the International Consortium. Open-file report 78-511. United States Geological Survey.
- Misra K.C. and Taylor L.A. (1975) Characteristics of metal particles in Apollo 16 rocks. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 615-639.
- Misra K.C., Walker B.M. and Taylor L.A. (1976a) Textures and compositions of metal particles in Apollo 17, Station 6 boulder samples. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2251-2266.
- Misra K.C., Walker B.M. and Taylor L.A. (1976b) Native FeNi metal particles in Apollo 17 Station 6 boulder (abs). *Lunar Sci.* **VII**, 565-567. Lunar Planetary Institute, Houston.
- Mitchell J.K., Bromwell L.G., Carrier W.D., Costes N.C. and Scott R.F. (1971) Soil Mechanics Experiment. In Apollo 14: Preliminary Science Report NASA **SP-272**.
- Mitchell J.K., Bromwell L.G., Carrier W.D., Costes N.C., Houston W.N. and Scott R.F. (1972) 7. Soil-Mechanics Experiment. In Apollo 15 Preliminary Science Rpt. NASA SP-289. pages 7-17-28.
- Mitchell J.K., Carrier W.D., Houston W.N., Scott R.F., Bromwell L.G., Durgunoglu H.T., Hovland H.J., Treadwell D.D. and Costes N.C. (1973) 8. Soil-Mechanics. In Apollo 16 Preliminary Science Rpt. NASA SP-315. pages 8-1-29.
- Mitchell J.K., Carrier W.D., Costes N.C., Houston W.N., Scott R.F. and Hovland H.J. (1973) 8. Soil-Mechanics. In Apollo 17 Preliminary Science Rpt. NASA SP-330. pages 8-1-22.
- Mitchell J.N., Snyder G.A. and Taylor L.A. (1999) Mineral-chemical and isotopic variations in Apollo 16 impact-melt breccias. In **Planetary Petrology and Geochemistry**, 173-192. GSA Bellweather Press
- Miura Y. (1982) A new indicator of formation process based on bulk An and Or contents of terrestrial and extraterrestrial plagioclases with or without exsolution (abs). *Lunar Planet. Sci.* **XIII**, 524-525. Lunar Planetary Institute, Houston.
- Miura Y. (1988) Normal and anomalous compositions of lunar feldspars - I. Lunar plagioclases (abs). *Lunar Planet. Sci.* **XIX**, 794-795. Lunar Planetary Institute, Houston.
- Miyamoto M., Takeda H. and Ishii T. (1984) Mineralogical comparison and cooling history of Lunar and chondritic vesicular melt breccias. *J. Geophys. Res.* **89** 11581-11588.

- Mizutani H., Fujii N., Hamano Y. and Osako M. (1972) Elastic wave velocities and thermal diffusivities of Apollo 14 rocks. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2557-2564.
- Mizutani H. and Newbigging D. (1973) Elastic wave velocities of Apollo 14, 15 and 16 rocks. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2601-2609.
- Mizutani H. and Osako M. (1974a) Elastic-wave velocities and thermal diffusivities of Apollo 17 rocks and their geophysical implications. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2891-2901.
- Mizutani H. and Osako M. (1974b) Elastic wave velocities and thermal diffusivities of Apollo 17 rocks (abs). *Lunar Sci.* **V**, 518-519. Lunar Planetary Institute, Houston.
- Modzeleski J.E. and V.E., Nagy L.A. and B., Hamilton P.B., McEwan W.S. and Urey H.C. (1972) Carbon compounds in Apollo 15 lunar samples. In **The Apollo 15 Lunar Samples**, 311-315. The Lunar Science Institute, Houston.
- Moore C.B., Gibson E.K., Larimer J.W., Lewis C.F. and Nichiporuk W. (1970) Total carbon and nitrogen abundances in Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1375-1382.
- Moore C.B., Lewis C.F., Larimer J.W., Delles F.M., Gooley R.C., Nichiporuk W. and Gibson E.K. (1971) Total carbon and nitrogen abundances in Apollo 12 lunar samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1343-1350.
- Moore C.B., Lewis C.F., Cripe J., Delles F.M., Kelly W.R. and Gibson E.K. (1972) Total carbon, nitrogen and sulfur in Apollo 14 lunar samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2051-2058.
- Moore C.B., Lewis C.F., and Gibson E.K. (1972) Carbon and nitrogen in Apollo 15 lunar samples. In **The Apollo 15 Lunar Samples** (Chamberlain and Watkins, eds.), 316-318. The Lunar Science Institute, Houston.
- Moore C.B., Lewis C.F. and Gibson E.K. (1973) Total carbon contents of Apollo 15 and 16 lunar samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1613-1923.
- Moore C.B., Lewis C.F. and Cripe J.D. (1974a) Total carbon and sulfur contents of Apollo 17 lunar samples. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1897-1906.
- Moore C.B., Lewis C.F., Cripe J.D. and Volk M. (1974b) Total carbon and sulfur contents of Apollo 17 lunar samples (abs). *Lunar Sci.* **V**, 520-522. Lunar Planetary Institute, Houston.
- Moore C.B. and Lewis C.F. (1975) Total nitrogen contents of Apollo 15, 16 and 17 lunar fines samples. *Lunar Sci.* **VI**, 569-571.
- Moore C.B. and Lewis C.F. (1976) Total nitrogen contents of Apollo 15, 16 and 17 lunar rocks and breccias (abs). *Lunar Sci.* **VII**, 571-573. Lunar Planetary Institute, Houston.
- Morawski A., Vaughan D.J. and Burns R.G. (1972) Crystal chemistry of zoned clinopyroxenes from lunar rock 15058. In **The Apollo 15 Lunar Samples**, 140-142. The Lunar Science Institute, Houston.
- Morgan C.J. (1975) Exposure dating of lunar features: Lunar heavy rare gases. PhD. Thesis, Washington University, St. Louis.
- Morgan J.W. and Ehmann W.D. (1970) Lunar rock 12013: O, Si, Al and Fe abundances. *Earth Planet. Sci. Lett.* **9**, 164-176.
- Morgan J.W., Laul J.C., Ganapathy R. and Anders E. (1971) Glazed lunar rocks: Origin by impact. *Science* **172**, 556-557.

- Morgan J.W. and Petrie R.K. (1979a) Breccias 73215 and 73255: Siderophile and volatile trace elements. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 789-801.
- Morgan J.W. and Petrie R.K. (1979b) Siderophile and volatile trace elements in breccias 73215 and 73255 and in core 74001 (abs). *Lunar Planet. Sci.* **X**, 852-854. Lunar Planetary Institute, Houston.
- Morgan J.W. and Wandless G.A. (1979a) Terrestrial upper mantle: Siderophile and volatile trace element abundances (abs). *Lunar Planet. Sci.* **X**, 855-857. Lunar Planetary Institute, Houston.
- Morgan J.W. and Wandless G.A. (1979b) 74001 drive tube: Siderophile elements match IIB iron meteorite pattern. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 327-340.
- Morgan J.W. and Wandless G.A. (1984) Surface-correlated trace elements in 15426 lunar glasses (abs). *Lunar Planet. Sci.* **XV**, 562-563. Lunar Planetary Institute, Houston.
- Morgan J.W. and Wandless G.A. (1988) Lunar dunite 72415-72417: Siderophile and volatile trace elements (abs). *Lunar Planet. Sci.* **XIX**, 804-805. Lunar Planetary Institute, Houston.
- Morgan J.W., Krahenbuhl U., Ganapathy R. and Anders E. (1972a) Trace elements in Apollo 15 samples: Implications for meteorite influx and volatile depletion on the moon. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1361-1376.
- Morgan J.W., Laul J.C., Krahenbuhl U., Ganapathy R. and Anders E. (1972b) Major impacts on the moon: Characterization from trace elements in Apollo 12 and 14 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1377-1395.
- Morgan J.W., Krahenbuhl U., Ganapathy R. and Anders E. (1973a) Luna 20 soil: abundances of 17 trace elements. *Geochim. Cosmochim. Acta* **37**, 953-962.
- Morgan J.W., Krahenbuhl U., Ganapathy R., Anders E., and Marvin U.B. (1973b) Trace element abundances and petrology of separates from Apollo 15 soils. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1379-1398.
- Morgan J.W., Ganapathy R., Higuchi H., Krahenbuhl U. and Anders E. (1974a) Lunar basins: Tentative characterization of projectiles, from meteoritic elements in Apollo 17 boulders. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1703-1736.
- Morgan J.W., Ganapathy R., Higuchi H., Krahenbuhl U. and Anders E. (1974b) Lunar basins: Tentative characterization of projectiles, from meteoritic elements in Apollo 17 boulders (abs). *Lunar Sci.* **V**, 526-528. Lunar Planetary Institute, Houston.
- Morgan J.W., Ganapathy R. and Krahenbuhl U. (1975a) Meteoritic trace elements in lunar rock 14321,184. *Geochim. Cosmochim. Acta* **39**, 261-264.
- Morgan J.W., Higuchi H. and Anders E. (1975b) Meteoritic material in a boulder from the Apollo 17 site: Implications for its origin. *The Moon* **14**, 373-383.
- Morgan J.W., Gros J., Takahashi H. and Hertogen J. (1976) Lunar breccia 73215: siderophile and volatile elements. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2189-2199.
- Morgan J.W., Ganapathy R., Higuchi H. and Anders E. (1977) Meteoritic material on the Moon. In *The Soviet-American Conference on Cosmochemistry of the Moon and Planets*. NASA SP-370. 659-689.
- Morgan J.W., Hertogen J. and Anders E. (1978) The Moon: Composition determined by nebular processes. *The Moon and Planets* **18**, 465-478.



Morgan J.W., Walker R.J., Brandon A.D. and Horan M.F. (2001) Siderophile elements in Earth's upper mantle and lunar breccias: Data synthesis suggests manifestations of the same late influx. *Meteor. Planet. Sci.* **36**, 1257-1276.

Morgan Z., Lian Y. and Hess P. (2006) An experimental study of anorthosite dissolution in picritic magmas: Implications for crustal assimilation processes. *Geochim. Cosmochim. Acta* **70**, 3477-3491.

Morgeli M., Eberhardt P., Eugster O., Geiss J., Grogler N. and Jungck M. (1977) The age of Shorty Crater (abs). *Lunar Sci.* **VIII**, 679-681. Lunar Planetary Institute, Houston.

Mori H. and Takeda H. (1980) Thermal and deformational history of diogenites and a lunar norite, as determined by electron microscopy and crystallography (abs). *Lunar Planet. Sci.* **XI**, 743-745. Lunar Planetary Institute, Houston.

Mori H., Takeda H. and Miyamoto M. (1982) Comparison of orthopyroxenes in lunar norites and diogenites (abs). *Lunar Planet. Sci.* **XIII**, 540-541. Lunar Planetary Institute, Houston.

Morisset C-E., Jackson S., Williamson M-C. and Hipkin V.J. (2012) Trace element concentrations of ilmenite in samples selected from the six Apollo landed missions. 43<sup>rd</sup> *Lunar Planet. Sci. Conf.*@ The Woodlands

Morris R.V. (1976) Surface exposure indices of lunar soils: A comparative FMR study. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 315-335.

Morris R.V. (1977) Origin and evolution on the grain-size dependence of the concentration of fine-grained metal in lunar soil: The maturation of lunar soils to a steady-state stage. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3719-3747.

Morris R.V. (1978) The surface exposure (maturity) of lunar soils: Some concepts and Is/FeO compilation. *Proc. 9<sup>th</sup> Lunar Sci. Conf.* 2287-2297.

Morris R.V. (1978) FMR and magnetic studies of Luna 24 soils and >1mm soil particles. In **Mare Crisium: The view from Luna 24**. *Geochem. Cosmochim. Acta* suppl. 9, 117-124. (ed. Merrill) Pergamon Press.

Morris R.V. (1980) Origins and size distribution of metallic iron particles in the lunar regolith. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1697-1712.

Morris R.V. and Gose W.A. (1977) Depositional history of core section 74001: Depth profiles of maturity, FeO and metal. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3113-3122.

Morris R.V., Warner J.L., McKay D.S. and Brown R.W. (1977) Nearly pure Apollo 12 KREEP: Soil sample 12023. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2449-2458.

Morris R.V., Gose W.A. and Lauer H.V. (1978) Depositional and surface history of the Shorty Crater core 74001/2: FMR and magnetic studies. *Proc. 9<sup>th</sup> Lunar Planet. Sci.* 2033-2048.

Morris R.V., Lauer H.V. and Gose W.A. (1979) Characterization and depositional and evolutionary history of the Apollo 17 deep drill core. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1141-1157.

Morris R.V. and Lauer H.V. (1982a) Stratigraphy of core 12027 and section 64002 of core 64001/2: FeO and Is/FeO depth profiles (abs). *Lunar Planet. Sci.* **XIII**, 544-545. Lunar Sci. Inst., Houston.

Morris R.V. and Lauer H.V. (1982b) Stratigraphy of the Apennine Front core 15007/8 (abs). *Lunar Planet. Sci.* **XIII**, 546-547. Lunar Sci. Inst., Houston.

- Morris R.V., Score R., Dardano C. and Heiken G. (1983) Handbook of Lunar Soils. Two Parts. JSC 19069. Curator's Office, Houston.
- Morris R.V., See T.H. and Horz F. (1986) Composition of the Cayley Formation at Apollo 16 as inferred from impact melt splashes. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **90**, E21-E42.
- Morris R.V., Korotev R.L. and Lauer H.V. (1989) Maturity and geochemistry of the van Serg core (79001/2) with implications for micrometeorite compositions. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 269-284.
- Morris R.W., Taylor G.J., Newsom H.E., Keil K. and Garcia S.R. (1990) Highly evolved and ultramafic lithologies from Apollo 14 soils. *Proc. 20<sup>th</sup> Lunar Planet. Sci. Conf.* 61-75. Lunar Planetary Institute, Houston.
- Morrison D.A., McKay D.S., Heiken G.H. and Moore H.J. (1972) Microcraters on lunar rocks. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2767-2791.
- Morrison D.A., McKay D.S., Fruland R.M. and Moore H.J. (1973) Microcraters on Apollo 15 and 16 rocks. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 3235-3253.
- Morrison D.A. and Zinner E. (1975) Studies of solar flares and impact craters in partially protected crystals. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3373-3390.
- Morrison D.A. and Zinner E. (1977a) 12054 and 76215: New measurements of interplanetary dust and solar flare fluxes. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 841-863.
- Morrison D.A. and Zinner E. (1977b) Microcraters and solar cosmic ray tracks (abs). *Lunar Sci.* **VIII**, 691-693. Lunar Planetary Institute, Houston.
- Morrison D.A. and Zinner E. (1977c) Distribution and flux of micrometeoroids. *Phil. Trans. Roy. Soc. London* **A285**, 379-384.
- Morrison D.A. and Clanton U.S. (1979) Properties of microcraters and cosmic dust of less than 1000 Å dimensions. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1649-1663.
- Morrison G.H., Gerard J.T., Kashuba A.T., Gangadharam E.V., Rothenberg A.M., Potter N.M. and Miller G.B. (1970) Elemental abundances of lunar soil and rocks. *Proc. Apollo 11 Lunar Sci. Conf.* 1383-1392.
- Morrison G.H., Gerard J.T., Potter N.M., Gangadharam E.V., Rothenberg A.M. and Burdo R.A. (1971) Elemental abundances of lunar soil and rocks from Apollo 12. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1169-1185.
- Morrison G.H., Nadkarni R.A., Jaworski J., Botto R.I. and Roth J.R. (1973) Elemental abundances of Apollo 16 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1399-1405.
- Mosie Andrea B. (1985) Examination of new faces of 72255. Lunar Sample Newsletter 43, Appendix 3, pages 38-45.
- Moynier F., Albarede F. and Herzog G.F. (2006) Isotopic composition of zinc, copper, and iron in lunar samples. *Geochim. Cosmochim. Acta* **70**, 6103-6117.
- Muan A., Lofall T. and Ma C.-B. (1974) Liquid-solid equilibria in lunar rocks from Apollo 15, 16 and 17, and phase relations in parts of the system  $\text{CaMgSi}_2\text{O}_6$ - $\text{CaFeSi}_2\text{O}_6$ - $\text{Fe}_2\text{SiO}_4$ - $\text{CaAl}_2\text{Si}_2\text{O}_8$  (abs). *Lunar Sci.* **V**, 529-530. Lunar Planetary Institute, Houston.
- Muehlberger W.R. and many others (1973) Preliminary Geological Investigation of the Apollo 17 Landing Site. In Apollo 17 Preliminary Science Report. NASA SP-330.

- Muehlberger W.R. and many others (1973) Geologic exploration of Taurus-Littrow: Apollo 17 landing site. *Science* **182**, 672-680.
- Muehlberger W.R., Horz F., Seiver J.R. and Ulrich G.E. (1980) Mission objectives for geological exploration of the Apollo 16 landing site. *In Proc. Conf. on Lunar Highlands Crust*, 1-49 (eds. Papike and Merrill). Lunar Planetary Institute, Houston.
- Muhich T., Vaniman D. and Heiken G. (1990) Ilmenite in high-Ti Apollo 17 basalts: Variations in composition with degree of exsolution (abs). *Lunar Planet. Sci.* **XXI**, 817-819. Lunar Planetary Institute, Houston.
- Muller H.W., Plieninger T., James O.B. and Schaeffer O.A. (1977a) Laser probe  $^{39}\text{Ar}$ - $^{40}\text{Ar}$  dating of materials from consortium breccia 73215. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2551-2565.
- Muller H.W., Plieninger T., James O.B. and Schaeffer O.A. (1977b) Laser probe  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  dating of materials from consortium breccia 73215 (abs). *Lunar Planet. Sci.* **XVIII**, 697-699. Lunar Planetary Institute, Houston.
- Müller O. (1972) Alkali and alkaline earth elements, La, and U in Apollo 14 and Apollo 15 samples. *In The Apollo 15 Lunar Samples* (Chamberlain and Watkins, eds.), 240-243. The Lunar Science Institute, Houston.
- Müller O. (1972) Chemically bond nitrogen abundances in lunar samples, and active gases released by heating at lower temperatures. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2059-2068.
- Müller O. (1973) Chemically bond nitrogen contents of Apollo 16 and Apollo 15 Lunar fines. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1625-1634.
- Müller O. (1974a) Solar wind nitrogen and indigenous nitrogen in Apollo 17 lunar samples. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1907-1918.
- Müller O. (1974b) Solar wind and indigenous nitrogen in Apollo 17 lunar samples (abs). *Lunar Sci.* **V**, 534-536. Lunar Planetary Institute, Houston.
- Müller O. (1975) Lithophile trace and major elements in Apollo 16 and 17 lunar samples. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1303-1312.
- Müller O., Grallath E. and Tolg G. (1976a) Nitrogen in lunar igneous rocks. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1615-1622.
- Müller O., Grallath E. and Tolg G. (1976b) Nitrogen in lunar igneous rocks (abs). *Lunar Sci.* **VII**, 580-582. Lunar Planetary Institute, Houston.
- Münker Carsten (2010) A high field strength element perspective on early lunar differentiation. *Geochim. Cosmochim. Acta* **74**, 7340-7361.
- Münker C., Pfander J.A., Weyer S., Buchl A., Kleine T. and Mezger K. (2003) Evolution of Planetary Cores and the Earth-Moon system from Nb/Ta systematics. *Science* **301**, 84-87.
- Murali A.V., Ma M-S. and Schmitt R.A. (1976) Mare basalt 60639: Another eastern lunar basalt (abs). *Lunar Sci.* **VII**, 583-584. Lunar Planetary Institute, Houston.
- Murali A.V., Ma M.-S., Laul J.C. and Schmitt R.A. (1977a) Chemical composition of breccias, feldspathic basalt and anorthosites from Apollo 15 (15308, 15359, 15382, and 15362), Apollo 16 (60618 and 65785), Apollo 17 (72434, 72536, 72559, 72735, 72738, 78526, and 78527) and Luna 20 (22012 and 22013) (abs). *Lunar Sci.* **VIII**, 700-702. Lunar Planetary Institute, Houston.

- Murali A.V., Ma M.-S., Schmitt R.A., Warner R.D., Keil K. and Taylor G.J. (1977b) Chemistry of 30 Apollo 17 rake basalts; 71597 a product of partial olivine accumulation (abs). *Lunar Sci.* **VIII**, 703-705. Lunar Planetary Institute, Houston.
- Murphy R.C. (1972) Aromatic and heteroatom-containing organic compounds in the lunar samples. *Space Life Sci.* **3**, 450-454.
- Murthy V.R. (1975) The source and origin of the exotic component and KREEP-rich materials on the moon. *The Moon* **13**, 111-119.
- Murthy V.R. (1976) Rb-Sr studies of A-17 mare basalts and some general considerations early terrestrial and lunar evolution (abs). *Lunar Sci.* **VII**, 585-587. Lunar Planetary Institute, Houston.
- Murthy V.R. (1977) Lunar evolution: Is there a global radioactive crust on the Moon? *Phil. Trans. Roy. Soc. London* **A285**, 127-136.
- Murthy V.R. (1978) Considerations of lunar initial strontium ratio (abs). *Lunar Planet. Sci.* **IX**, 778-780. Lunar Planetary Institute, Houston.
- Murthy V.R., Evensen N.M. and Coscio M.R. (1970) Distribution of K, Rb, Sr, and Ba and Rb-Sr isotopic relations in Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.*, 1393-1406.
- Murthy V.R., Evensen N.M., Jahn B.-M. and Coscio M.R. (1971) Rb-Sr ages and elemental abundances of K, Rb, Sr and Ba in samples from the Ocean of Storms. *Geochim. Cosmochim. Acta* **35**, 1139-1153.
- Murthy V.R., Evensen N.M., Jahn B.-M. and Coscio M.R. (1972) Apollo 14 and 15 samples: Rb-Sr ages, trace elements, and lunar evolution. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1503-1514.
- Murthy V.R. and Banerjee S.K. (1973) Lunar evolution: How well do we know it now? *The Moon* **7**, 149-171.
- Murthy V.R. and Coscio C. (1976) Rb-Sr ages and isotopic systematics of some Serenitatis mare basalts. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1529-1544.
- Murthy V.R. and Coscio C. (1977) Rb-Sr isotopic systematics and initial Sr considerations for some lunar samples (abs). *Lunar Sci.* **VIII**, 706-708. Lunar Planetary Institute, Houston.
- Murrell M.T., Nishiizumi K. and Arnold J.R. (1979) <sup>53</sup>Mn profile 74001/2: Comments on the recent history of the core (abs). *Lunar Planet. Sci.* **X**, 881-883. Lunar Planetary Institute, Houston.
- Nagata T., Ishikawa Y., Kinoshita H., Kono M. Syono Y. and Fisher R.M. (1970) Magnetic properties and natural remanent magnetization of lunar materials. *Proc. Apollo 11 Lunar Sci. Conf.* 2325-2340.
- Nagata T., Fisher R.M. and Schwerer F.C. (1972) Lunar rock magnetism. *The Moon* **4**, 160-186.
- Nagata T., Fisher R.M., Schwerer F.C., Fuller M.D. and Dunn J.R. (1971) Magnetic properties and remanent magnetism of Apollo 12 lunar materials and Apollo 11 lunar microbreccia. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 2461-2476.
- Nagata T., Fisher R.M., Schwerer F.C., Fuller M.D. and Dunn J.R. (1972a) Rock magnetism of Apollo 14 and 15 materials. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2423-2447.
- Nagata T., Fisher R.M., Schwerer F.C., Fuller M.D. and Dunn J.R. (1972c) Rock magnetism of Apollo 14 and 15 materials. *Geochemica Cosmochim. Acta* **36**, 2423-2447??

- Nagata T., Fischer R.M., Schwerer F.C., Fuller M.D. and Dunn J.R. (1972b) Summary of rock magnetism of Apollo 15 lunar materials. In **The Apollo 15 Lunar Samples**, 442-443. The Lunar Science Institute, Houston.
- Nagata T., Fischer R.M., Schwerer F.C., Fuller M.D. and Dunn J.R. (1973) Magnetic properties and natural remanent magnetization of Apollo 15 and 16 lunar materials. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 3019-3043.
- Nagata T., Sugiura N., Fisher R.M., Schwerer F.C., Fuller M.D. and Dunn J.R. (1974a) Magnetic properties of Apollo 11-17 lunar materials with special reference to effects of meteorite impact. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2827-2839.
- Nagata T., Sugiura N., Fisher R.M., Schwerer F.C., Fuller M.D. and Dunn J.R. (1974b) Magnetic properties and natural remanent magnetization of Apollo 16 and 17 lunar samples (abs). *Lunar Sci. V*, 540-542. Lunar Planetary Institute, Houston.
- Nagata T., Fisher R.M., Schwerer F.C., Fuller M.D. and Dunn J.R. (1975a) Effects of meteorite impact on magnetic properties of Apollo lunar materials. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3111-3122.
- Nagata T., Fisher R.M., Schwerer F.C., Fuller M.D. and Dunn J.R. (1975b) Basic magnetic properties of Apollo 17 basaltic and anorthositic lunar materials (abs). *Lunar Sci. VI*, 584-586. Lunar Planetary Institute, Houston.
- Nagel K., Neukum G., Eichhorn G., Fectig H., Muller O. and Schneider E. (1975) Dependencies of microcrater formation on impact parameters. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3417-3432.
- Nagel K., Neukum G., Dohnanyi J.S., Fectig H. and Gentner W. (1976) density and chemistry of interplanetary duct particles, derived from measurements of lunar microcraters. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1021-1029.
- Nagel K., ElGoresy A. and Grogler N. (1978) Chemical investigations of impact features on sample 12001,520. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2485-2493.
- Nagle J.S. (1978a) Drive tubes 74002/74001: Dissection and description. Lunar Core Catalog. NASA Johnson Space Center, Houston.
- Nagle J.S. (1978b) A comparison of a lunar and a terrestrial volcanic section. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 1509-1526.
- Nagle J.S. (1978c) Luna 24 clast populations. In **Mare Crisium: The view from Luna 24**. *Geochem. Cosmochim. Acta* suppl. 9, 207-216. (ed. Merrill) Pergamon Press.
- Nagle J.S. (1979a) Preliminary description and interpretation of Apollo 14 cores 14210/11. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1299-1319.
- Nagle J.S. (1979b) Drive tube 76001 – continuous accumulation with complications? *Proc. 10<sup>th</sup> Lunar Sci. Conf.* 1385-1399.
- Nagle J.S. (1980a) Core 14220 and the lateral continuity of soils at Apollo 14 station G. *The Moon and the Planets* **23**, 165-183.
- Nagle J.S. (1978b) The detrital zone in the Shorty Crater cores. *The Moon* **18**, 499-517.
- Nagle J.S. (1980c) Possible rim crest deposits in cores 12027 and 15008: Some interpretations and problems for future research. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1479-1496.

- Nagle J.S. (1981a) Apollo 15 green glass: a mare margin deposit (abs). *Lunar Planet. Sci.* **XII**, 750-752. Lunar Planetary Institute, Houston.
- Nagle J.S. (1981b) Deposition history of core 15008/7: Some implications regarding slope processes. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 463-473.
- Nagle J.S. (1982a) Evidence of subcrater lithification and hot ejecta deposition in lunar polymict regolith breccias and achondrites (abs). *Lunar Planet. Sci.* **XIII**, 568-569. Lunar Planetary Institute, Houston.
- Nagle J.S. (1982b) Subcrater lithification of polymict regolith breccias. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf. in J. Geophys. Res.* **87**, A131-A146.
- Nagle J.S. and Walton W.J.A. (1977) **Luna 24: Catalog** and preliminary description. Curator's Office, NASA Johnson Space Center, Houston.
- Nagy B., Hohammed M.A.J. and Modzeleski V.E. (1972) An evaluation of pyrolytic techniques with regard to the Apollo 11, 12 and 14 lunar samples analyties. *Space Life Sci.* **3**, 323-329.
- Nakamura N., Masuda A., Tanaka T. and Kurasawa H. (1973) Chemical compositions and rare-earth features of four Apollo 16 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1407-1414.
- Nakamura N. and Tatsumoto M. (1977) The history of the Apollo 17 Station 7 boulder. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2301-2314.
- Nakamura N., Unruh D.M., Gensho R. and Tatsumoto M. (1977) Evolution history of lunar mare basalts: Apollo 15 samples revisited (abs). *Lunar Sci.* **VIII**, 712-714.
- Nakamura N., Tatsumoto M., Nunes P.D., Unruh D.M., Schwab A.P. and Wildeman T.R. (1976) 4.4 b.y.-old clast in Boulder 7, Apollo 17: A comprehensive chronological study by U-Pb, Rb-Sr, and Sm-Nd methods. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2309-2333.
- Namur O., Charlier B., Pirad C., Hermann J., Liegeois J-P. and Vander Auwera V. (2011) Anorthosite formation by floatation in ferrobasalt and implications for the lunar crust. *Geochim. Cosmochim. Acta* **75**, 4998-5018.
- Naney M.T., Crowl D.M. and Papike J.J. (1976) The Apollo 16 drill core: Statistical analysis of glass chemistry and the characterization of a high alumina-silica poor HASP glass. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 155-184.
- Nash W.P and Hausel W.D. (1973) Partial pressures of oxygen, phosphorus and fluorine in some lunar lavas. *Earth Planet. Sci. Lett.* **20**, 13-27.
- Nash W.P. and Haselton J.D. (1975) Silica activity in lunar lavas. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 119-130.
- Nautiyal C.M., Padia J.T., Rao M.N. and Venkatesan T.R. (1981a) Solar and galactic cosmic ray records of noble gases in lunar rock 79215 (abs). *Lunar Planet. Sci.* **XII**, 753-755. Lunar Planetary Institute, Houston.
- Nautiyal C.M., Padia J.T., Rao M.N. and Venkatesan T.R. (1981b) Solar flare neon: Clues from implanted noble gases in lunar soils and rocks. *Proc. 12<sup>th</sup> Lunar Sci. Conf.* 627-637.
- Nava D.F. (1974a) Chemical compositions of some soils and rock types from the Apollo 15, 16, and 17 lunar sites. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1087-1096.
- Nava D.F. (1974b) Chemistry of some rock types and soils from the Apollo 15, 16 and 17 lunar sites (abs). *Lunar Sci.* **V**, 547-549. Lunar Planetary Institute, Houston.

- Nava D.F. (1977) Rind glass and breccias: a study of lunar sample 15255 (abs). *Lunar Sci.* **VIII**, 720-722.
- Nava D.F. and Philpotts J.A. (1973) A differentiation model in light of new chemical data on Luna 20 and Apollo 16 soils. *Geochim. Cosmochim. Acta* **37**, 963-974.
- Neal C.R. (2001) Interior of the moon: The presence of garnet in the primitive deep lunar mantle. *J. Geophys. Res.* **106**, 27865-27885.
- Neal C.R. (2007) Mining the literature for “new” data: expanding the Apollo 14 high-alumina basalt isotope database (abs#2398). *Lunar Planet. Sci.* **XXXVIII**, Lunar Planetary Institute, Houston.
- Neal C.R. (2008) The Moon 35 years after Apollo: What’s left to learn? *Chemie der Erde-Geochemistry*, doi:10.1016/j.chemer.2008.07.002
- Neal C.R., Taylor L.A. and Lindstrom M.M. (1988a) Importance of lunar granite and KREEP in very high potassium (VHK) basalt petrogenesis. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 121-137. Lunar Planetary Institute, Houston.
- Neal C.R., Taylor L.A. and Lindstrom M.M. (1988b) Apollo 14 mare basalt petrogenesis: assimilation of KREEP-like components by a fractionating magma. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 139-153. Lunar Planetary Institute, Houston.
- Neal C.R. and Taylor L.A. (1989a) The nature of barium partitioning between immiscible melts: A comparison of experimental and natural systems with reference to lunar granite petrogenesis. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 209-218. Lunar Planetary Institute, Houston.
- Neal C.R. and Taylor L.A. (1989b) The barium problem in silicate liquid immiscibility: Influence of melt composition and structure on elemental partitioning (abs). *Lunar Planet. Sci.* **XX**, 770-771. Lunar Planetary Institute, Houston.
- Neal C.R. and Taylor L.A. (1989c) Metasomatism (?) products of the lunar magma ocean: The role of KREEP dissemination. *Geochim. Cosmochim. Acta* **53**, 529-541.
- Neal C.R., Taylor L.A., Schmitt R.A., Hughes S.S. and Lindstrom M.M. (1989d) High alumina (HA) and very high potassium (VHK) basalt clasts from Apollo 14 breccia, Part 1: Mineralogy and petrology: Evidence of crystallization from evolving magmas. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 137-145. Lunar Planetary Institute, Houston.
- Neal C.R., Taylor L.A., Schmitt R.A., Hughes S.S. and Lindstrom M.M. (1989d) High alumina (HA) and very high potassium (VHK) basalt clasts from Apollo 14 breccia, Part 2 – whole rock geochemistry: Further evidence for combined assimilation and fractional crystallization within the lunar crust. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 147-161. Lunar Planetary Institute, Houston.
- Neal C.R., Taylor L.A., Hughes S.S. and Schmitt R.A. (1989e) Apollo 17 high-Ti basalt petrogenesis: An integrated approach using whole-rock major and trace element analysis (abs). *Lunar Planet. Sci.* **XX**, 776-777. Lunar Planetary Institute, Houston.
- Neal C.R., Taylor L.A., Patchen A.D. and Ballington M. (1989f) Mineralogy and petrography of 28 “new” Apollo 17 basalts (abs). *Lunar Planet. Sci.* **XX**, 780-781. Lunar Planetary Institute, Houston.
- Neal C.R., Taylor L.A., Patchen A.D., Hughes S.S. and Schmitt R.A. (1990a) The significance of fractional crystallization in the petrogenesis of Apollo 17 Type A and B high-Ti basalts. *Geochim. Cosmochim. Acta* **54**, 1817-1833.

- Neal C.R., Paces J.B., Taylor L.A. and Hughes S.S. (1990b) Two new Type C basalts: Petrogenetic implications for source evolution and magma genesis at the Apollo 17 site (abs). *Lunar Planet. Sci.* **XXI**, 855-856. Lunar Planetary Institute, Houston.
- Neal C.R., Taylor L.A., Hughes S.S. and Schmitt R.A. (1990c) The importance of fractional crystallization in the petrogenesis of Apollo 17 Type A and B high-Ti basalts (abs). *Lunar Planet. Sci.* **XXI**, 857-858. Lunar Planetary Institute, Houston.
- Neal C.R., Taylor L.A. and Patchen A.D. (1990d) An Apollo 17 safari: Exciting new clast from breccia "pull apart" efforts (abs). *Lunar Planet. Sci.* **XXI**, 859-860. Lunar Planetary Institute, Houston.
- Neal C.R., Taylor L.A. and Patchen A.D. (1990e) The dichotomy between primitive highland cumulates and evolved interstitial whitlockites: The process of "REEP-fraction" metasomatism (abs). *Lunar Planet. Sci.* **XXI**, 863-864. Lunar Planetary Institute, Houston.
- Neal C.R. and Taylor L.A. (1990f) Modeling of lunar basalt petrogenesis: Sr isotopic evidence from Apollo 14 high-alumina basalts. *Proc. 20<sup>th</sup> Lunar Planet. Sci. Conf.* 101-108. Lunar Planetary Institute, Houston.
- Neal C.R. and Taylor L.A. (1991) Evidence for metasomatism of the lunar highlands and the origin of whitlockite. *Geochim. Cosmochim. Acta* **55**, 2965-2980.
- Neal C.R. and Taylor L.A. (1992) Petrogenesis of mare basalts: A record of lunar volcanism. *Geochim. Cosmochim. Acta* **56**, 2177-2211.
- Neal C.R., Taylor L.A., Schmitt R.A. and Liu Y.-G. (1992) The recognition of monomict and polymict clasts from Apollo 17 breccias (abs). *Lunar Planet. Sci.* **XXIII**, 979-980. Lunar Planetary Institute, Houston.
- Neal C.R. and Taylor L.A. (1993) Catalog of Apollo 17 rocks, central valley. Volumes 2 and 3. Curators Office #26088 JSC, Houston.
- Neal C.R., Hacker M.D., Snyder G.A., Taylor L.A., Liu Y.-G. and Schmitt R.A. (1994a) Basalt generation at the Apollo 12 site, Part 1: New data, classification and re-evaluation. *Meteoritics* **29**, 334-348.
- Neal C.R., Hacker M.D., Snyder G.A., Taylor L.A., Liu Y.-G. and Schmitt R.A. (1994b) Basalt generation at the Apollo 12 site, Part 2: Source heterogeneity, multiple melts and crustal contamination. *Meteoritics* **29**, 349-361.
- Neal C.R. and Taylor L.A. (1998) Exploring the complexities of the Serenitatis basin: Breccia clasts from Apollo 17. *International Geology Review* **40**, 945-962. (also in *Planetary Petrology and Geochemistry* 155-172. GSA)
- Neal C.R. and Kramer G.Y. (2003) The composition of KREEP: A detailed study of KREEP basalt 15386 (abs#1665). *Lunar Planet. Sci.* **XXXIV**, Lunar Planetary Institute, Houston.
- Neal C.R., Shearer C.K. and Kramer G.Y. (2005) Are the Apollo 14 high-Al basalts really impact melts? (abs#2023) *Lunar Planet. Sci.* **XXXVI**, Lunar Planetary Institute, Houston.
- Neal C.R. and Kramer G.Y. (2006) The petrogenesis of the Apollo 14 high-Al mare basalts. *Am. Mineral.* **91**, 1521-1535.
- Neal C.R., Shih C.-Y., Reese Y., Nyquist L.E. and Kramer G.Y. (2006) Derivation of Apollo 14 high-Al basalts from distinct source regions at discrete times: New constraints (abs#2003). *Lunar Planet. Sci.* **XXXVII**, Lunar Planetary Institute, Houston.



- Neal C.R. and Shervais J.W. (2008) Alkali anorthosite 14305,303: Evidence of magma mixing using trace element data from zoned plagioclase (abs#1217). *Lunar Planet. Sci.* **XXXIX**, Lunar Planetary Institute, Houston.
- Neal C.R., Fagan A.L. and Oshrin J.C. (2010) Differentiating between pristine mare basalts and impact melts using quantitative petrography (abs#1647). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Nebel O., van Westrenen W., Vroon P.Z. and Raith M.M. (2010) Storing Earth's missing niobium in the terrestrial counterpart of evolved lunar magma ocean melts (abs#1814). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Nebel O., Scherer E.E., and Mezger K. (2011) Evaluation of the  $^{87}\text{Rb}$  decay constant by age comparison against U-Pb system. *Earth Planet. Sci. Lett.* **301**, 1-8.
- Nehru C.E., Prinz M., Dowty E. and Keil K. (1973) Electron microprobe analyses of spinel group minerals and ilmenite in Apollo 15 rake samples of igneous origin. Spec. Pub. Num. 10, UNM Inst. Meteor. ABQ
- Nehru C.E., Prinz M., Dowty E. and Keil K. (1974) Spinel-group minerals and ilmenite in Apollo 15 rake samples. *Am. Mineral.* **59**, 1220-1235.
- Nehru C.E., Warner R.D., Keil K. and Taylor G.J. (1978) Metamorphism of brecciated ANT rocks: Anorthositic troctolite 72559 and norite 78527. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 773-788.
- Nelen J., Noonan A. and Fredriksson K. (1972) Lunar glasses breccias and chondrules. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 723-737.
- Nemchin A.A., Meyer C. and Pidgeon R.T. (2004) The early evolution of the Earth and Moon: comparative chronology (abs). Goldschmidt Conf.
- Nemchin A.A., Whitehouse M.J., Pidgeon R.T. and Meyer C. (2005) Isotopic composition of oxygen in lunar zircon (abs#1274). *Lunar Planet. Sci.* **XXXVI**, Lunar Planetary Institute, Houston.
- Nemchin A.A., Whitehouse M.J., Pidgeon R.T. and Meyer C. (2006) Oxygen isotopic signature of 4.4 – 3.9 Ga zircons as a monitor of differentiation processes on the Moon. *Geochim. Cosmochim. Acta* **70**, 1864-1872.
- Nemchin A.A., Pidgeon R.T., Whitehouse M.J., Vaughan J.P. and Meyer C. (2008) SIMS study of zircons from Apollo 14 and 17 breccias: Implications for the evolution of lunar KREEP. *Geochim. Cosmochim. Acta* **72**, 668-689.
- Nemchin A.A. and Pidgeon R.T. (2008) Lunar cataclysm or lunar cataclysms? (abs#1558). *Lunar Planet. Sci.* **XXXIX** Lunar Planetary Institute, Houston.
- Nemchin A.A., Timms N., Pidgeon R.T., Geisler T., Reddy S. and Meyer C. (2009a) Timing of crystallization of the lunar magma ocean constrained by the oldest zircon. *Nature Geoscience* doi 10.1038/NGEO419
- Nemchin A.A., Pidgeon R.T. and Grange M. (2009b) REE patterns in lunar zircons (abs#1509). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Nemchin A.A., Pidgeon R.T., Healy D., Grange M.L., Whitehouse M.J. and Vaughan J. (2009c) The comparative behavior of apatite-zircon U-Pb systems in Apollo 14 breccias: Implications for the thermal history of the Fra Mauro Formation. *Meteorit. & Planet. Sci.* **44**, 1717-1734.
- Nemchin A.A., Grange M.L. and Pidgeon R.T. (2010) Distribution of rare earth elements in lunar zircon. *Amer. Mineral.* **95**, 273-283.

- Nemchin A.A., Whitehouse M.J., Grange M.L. and Muhling J.R. (2010) High U-Pb ratios in the source of low-Ti volcanic glass beads from the Apollo 14 soil (abs#1836). *41<sup>st</sup> Lunar Planet. Sci. Conf. @ The Woodlands*
- Nemchin A.A., Whitehouse M.J., Grange M.L. and Muhling J.R. (2011) On the elusive isotopic composition of lunar Pb. *Geochim. Cosmochim. Acta* **75**, 2940-2964.
- Neukum G., Mehl A., Fectig H. and Zahringer J. (1970) Impact phenomena of micrometeorites on lunar surface material. *Earth Planet. Sci. Lett.* **8**, 31-35.
- Neukum G., Schneider E., Mehl A., Storzer D., Wagner G.A., Fectig H. and Bloch M.R. (1972) Lunar craters and exposure ages derived from crater statistics and solar flare tracks. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2793-2810.
- Neukum G., Horz F., Morrison D.A. and Hartung J.B. (1973) Crater populations on lunar rocks. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 3255-3276.
- Neukum G., Ivanov B.A. and Hartmann W.K. (2001) Cratering record in the inner solar system in relation to the lunar reference system. *Space Science Reviews* **96**, 55-86.
- Neukum G., Basilevsky A., Kneissel T., Michael G. and Ivanov Boris (2012) On the history of early meteoritic bombardment of the moon: Did the lunar terminal cataclysm occur (abs#4022). **Early Solar System Impact Bombardment II**. Lunar Planet. Institute, Houston.
- Newsom H.E. (1984) The abundance of molybdenum in lunar samples, new evidence for a lunar metal core (abs). *Lunar Planet. Sci.* **XV**, 605-606. Lunar Planetary Institute, Houston.
- Newton R.C., Anderson A.T. and Smith J.V. (1971) Accumulation of olivine in rock 12040 and other basaltic fragments in the light of analysis and syntheses. *Proc. Second Lunar Sci. Conf.* 575-582.
- Nguyen L-D., deSaint Simon M., Puil G. and Yokoyama Y. (1973) Rare earth elements in Luna 20 soils and their implications of cosmochemistry. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1415-1426.
- Nicholis M.G. and Rutherford M.J. (2009) Graphite oxidation in the Apollo 17 orange glass magma: Implications for the generation of a lunar volcanic gas phase. *Geochim. Cosmochim. Acta* **73**, 5905-5917.
- Niebuhr H.H., Zeira S. and Hafner S.S. (1973) Ferric iron in plagioclase crystals from anorthosite 15415. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 971-982.
- Niederer F., Wahlen M. and Geiss J. (1975) A search for energetic tritons in lunar samples. *Meteoritics* **10**, 466-467.
- Niederer F.R., Papanastassiou D.A. and Wasserburg G.J. (1980) Titanium abundances in terrestrial, lunar and meteoritic samples (abs). *Lunar Planet. Sci.* **XI**, 809-811. Lunar Planetary Institute, Houston.
- Niedermann S. and Eugster O. (1992) Noble gases in lunar anorthositic rocks 60018 and 65315: Acquisition of terrestrial krypton and xenon indicating an irreversible adsorption process. *Geochim. Cosmochim. Acta* **56**, 493-509.
- Nielsen R.J. and Drake M.J. (1978) The case for at least three mare basalt magmas at the Luna 24 landing site. In **Mare Crisium: The view from Luna 24**. (ed. Merrill and Papike) Pergamon 419-428.
- Niemeyer S. (1977a) Exposure histories of lunar rocks 71135 and 71569. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3083-3093.

- Niemeyer S. (1977b) Exposure histories of lunar rocks 71135 and 71569 (abs). *Lunar Sci.* **VIII**, 729-731. Lunar Planetary Institute, Houston.
- Niemeyer S. and Leich D.A. (1976) Atmospheric rare gases in lunar rock 60015. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 587-597.
- Niihara T., Schaffer L. and Kring D.A. (2012) Petrology of the impact melt clasts in 60016, Ancient Regolith Breccia (abs#4016). **Early Solar System Impact Bombardment II**. Lunar Planet. Institute, Houston.
- Niihara T. and Kring D.A. (2012) Petrography of impact melt clasts in Apollo 16 ancient regolith breccias. *75<sup>th</sup> Meteoritical Society @ Cains*
- Nishiizumi K., Imamura M., Honda M., Russ G.P., Kohl C.P., and Arnold J.R. (1976) <sup>53</sup>Mn in the Apollo 15 and 16 drill stems: evidence for surface mixing. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 41-54.
- Nishiizumi K., Imamura M., Kohl C.P., Murrell M.T., Arnold J.R. and Russ G.P. (1979) The extent of the lunar regolith mixing. *Earth Planet. Sci. Lett.* **44**, 409-419.
- Nishiizumi K., Kohl C.P., Arnold J.R., Finkel R.C., Chaffee M.W., Masarik J. and Reedy R.C. (1995) Final results of comogenic nuclides in lunar rock 64455 (abs). *Lunar Planet. Sci.* **XXVI**, 1055-1056. Lunar Planetary Institute, Houston.
- Nishiizumi K., Murrell M.T. and Arnold J.R. (1983) <sup>53</sup>Mn profiles in four Apollo surface cores. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **88**, B211-B219.
- Nishiizumi K., Imamura M., Kohl C.P., Nagai H., Kobayashi K., Yoshida K., Yamashita H., Reedy R.C., Honda M. and Arnold J.R. (1988) <sup>10</sup>Be profiles in lunar surface rock 68815. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 79-85. Lunar Planetary Institute, Houston.
- Nishiizumi K., Kubik P.W., Elmore D., Reedy R.C. and Arnold J.R. (1989) Cosmogenic <sup>36</sup>Cl production rates in meteorites and the lunar surface. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 305-32.
- Nishiizumi K. and Caffee M.W. (2001) Beryllium-10 from the Sun. *Science* **294**, 352-354.
- Nishiizumi K., Caffee M.W., Wieler R., Lecclere M.D. and Jull A.J.T. (2009) Exposure history of lunar meteorite Northwest Africa 5000 (abs#1476). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Noble S.K. (2010) Examining the uppermost surface of the lunar regolith (abs#1505). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Noble S.K., Pieters C.M., Taylor L.A., Morris R.V., Allen C.C., McKay D.S. and Keller L.P. (2001) The optical properties of the finest fraction of lunar soil: Implications for space weathering. *Meteor. & Planet. Sci.* **36**, 31-42.
- Noble S.K., Keller L.P. and Pieters C.M. (2005) Evidence of space weathering in regolith breccias I: Lunar regolith breccias. *Meteor. & Planet. Sci.* **40**, 397-408.
- Nord G.L. (1976) 76535: Thermal history deduced from pyroxene precipitation in anorthite. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1875-1888.
- Nord G.L. and James O.B. (1977) Aphanitic matrix, an ANT-suite clast and a feldspar clast in consortium breccia 73215: An electron petrographic study. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2495-2506.

Nord G.L. and James O.B. (1978a) Consortium breccia 73255: Thermal and deformational history of bulk breccia and clasts, as determined by electron petrography. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 821-839.

Nord G.L. and James O.B. (1978b) Consortium breccia 73255: Electron petrography of aphanitic lithologies and anorthite clasts (abs). *Lunar Planet. Sci.* **IX**, 814-816. Lunar Planetary Institute, Houston.

Nord G.L. and McGee J.J. (1979a) Thermal and mechanical history of granulated norite and pyroxene anorthosite clasts in breccia 73255. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 817-832.

Nord G.L. and McGee J.J. (1979b) Thermal and mechanical history of granulated norite and pyroxene anorthosite clasts in breccia 73255 (abs). *Lunar Planet. Sci.* **X**, 919-921. Lunar Planetary Institute, Houston.

Nord G.L. and Wandless M-V. (1983) Petrology and comparative thermal histories of clasts in breccias 62236. *Proc. 13<sup>th</sup> Lunar Planet. Sci.* A645-657.

Nord G.L., Lally J.S., Heuer A.H., Christie J.M., Radcliffe S.V., Griggs D.T. and Fisher R.M. (1973) Petrologic study of igneous and metaigneous rocks from Apollo 15 and 16 using high voltage transmission electron microscopy. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 953-970.

Nord G.L., Lally J.S., Heuer A.H., Christie J.M., Radcliffe S.V., Fisher R.M. and Griggs D.T. (1974) A mineralogical study of rock 70017, an ilmenite-rich basalt, by high voltage electron microscopy (abs). *Lunar Sci.* **V**, 556-558. Lunar Planetary Institute, Houston

Nord G.L., Heuer A.H., Lally J.S. and Christie J.M. (1975a) Substructures in lunar clinopyroxene as petrologic indicators (abs). *Lunar Sci.* **VI**, 601-603. Lunar Planetary Institute, Houston.

Nord G.L., Christie J.M., Heuer A.H. and Lally J.S. (1975b) North Ray Crater breccias: An electron petrographic study. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 779-797.

Nord G.L., Ross M. and Huebner J.S. (1976) Lunar troctolite 76535: Mineralogical investigations (abs). *Lunar Sci.* **VII**, 628-630. Lunar Planetary Institute, Houston

Nord G.L., Heubner J.S. and Ross M. (1977) Structure, composition, and significance of "G-P" zones in 76535 orthopyroxene (abs). *Lunar Planet. Sci.* **VIII**, 732-734. Lunar Planetary Institute, Houston.

Nord G.L. and James O.B. (1977) Aphanitic matrix, an ANT-suite clast and a felsites clast in consortium breccia 73215: An electron petrographic study. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2495-2506.

Nord G.L., Christie J.M., Lally J.S. and Heuer A.H. (1977) The thermal and deformational history of Apollo 15418. a partly shock-melted lunar breccia. *The Moon* **17**, 217-231.

Norman M.D. (1981) Petrology of suevitic lunar breccia 67016. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 235-252.

Norman M.D. (2005) Lunar impact breccias: petrology, crater setting and bombardment history of the moon. *Australian Journal of Earth Sciences* **52**, 711-723.

Norman M.D. (2008) The lunar cataclysm hypothesis: Status and prospects (abs#1126). *Lunar Planet. Sci.* **XXXIX**, Lunar Planetary Institute, Houston.

Norman M.D. (2009) The lunar cataclysm: Reality or mythconception? *Elements* **5**, 23-28.

Norman M., Coish R.A. and Taylor L.A. (1978) Glasses in the Luna 24 core and petrogenesis of ferrobasalts. *In Mare Crisium: The View from Luna 24* (Merrill R.B. and Papike J.J., eds.) 281-289. Pergamon.

- Norman M.D. and Ryder G. (1979) A summary of the petrology and geochemistry of pristine highland rocks. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 531-559.
- Norman M.D. and Ryder G. (1980) Luna 24 ferrobasalts as a low-Mg primary melt. *The Moon and Planets* **23**, 271-292.
- Norman M.D. and Garcia G.G. (1981) Guidebook for lunar breccia #5, 67016. Curators Office, JSC-17393.
- Norman M.D., Taylor G.J. and Keil K. (1991) New lunar rock types: Sodic anorthosites, and noritic, sulfur-rich kindred of ferroan anorthosites. *Geophys. Res. Lett.* **18**, 2081-2084.
- Norman M.D. and Taylor S.R. (1992) Geochemistry of lunar crustal rocks from breccia 67016 and the composition of the Moon. *Geochim. Cosmochim. Acta* **56**, 1013-1024.
- Norman M.D., Taylor G.L., Spudis P. and Ryder G. (1993) Lithologies contributing to the clast population in Apollo 17 LKFM basaltic impact melts. *In Workshop on Geology of the Apollo 17 Landing site*. Lunar Planetary Institute, Houston Tech. Rpt. 92-09. 42-44.
- Norman M.D., Keil K., Griffin W.L. and Ryan C.G. (1995) Fragments of ancient lunar crust: Petrology and geochemistry of ferroan anorthosites from the Descartes region of the Moon. *Geochim. Cosmochim. Acta* **59**, 831-847.
- Norman M.D., Bennett V.C. and Ryder G. (2002) Targeting the impactors: highly siderophile element signatures of lunar impact melts from Serenitatis. *Earth Planet. Sci. Lett.* **202**, 217-228.
- Norman M.D., Borg L.E., Nyquist L.E. and Bogard D.D. (2003) Chronology, geochemistry, and petrology of a ferroan noritic anorthosite from Descartes breccia 67215: Clues to the age, origin, structure and impact history of the lunar crust. *Meteor. & Planet. Sci.* **38**, 645-661.
- Norman M.D., Duncan R.A. and Huard J.J. (2006) Identifying impact events within the lunar cataclysm from <sup>40</sup>Ar-<sup>39</sup>Ar ages and compositions of Apollo 16 impact melt rocks. *Geochim. Cosmochim. Acta* **70**, 6032-6049.
- Norman M.D. and Bennett V.C. (2006) Impactor populations and lunar crustal compositions inferred from highly siderophile element compositions of Apollo 16 and 17 melt breccias (abs#1526). *Lunar Planet. Sci. XXXVII*, Lunar Planetary Institute, Houston.
- Norman M.D., Shih C.-Y., Nyquist L.E., Bogard D.D. and Taylor L.A. (2007) Early impacts on the moon: Crystallization ages of Apollo 16 melt breccias (abs#1991). *Lunar Planet. Sci. XXXVIII*, Lunar Planetary Institute, Houston.
- Norman M.D. and Duncan R.A. (2008) Age and origin of Apollo 16 feldspathic fragmental breccias (abs). *Geochem. Cosmochim. Acta* **72**, A689
- Norman M.D., Duncan R.A. and Huard J.J. (2010) Imbrium provenance for the Apollo 16 Descartes terrain: Argon ages and geochemistry of lunar breccias 67016 and 67455. *Geochim. Cosmochim. Acta* **74**, 763-783.
- Norman M.D. and Nemchik A.A. (2012a) Large impacts at 4.2 Ga from U-Pb dating of lunar melt impact breccias (abs#4013). **Early Solar System Impact Bombardment II**. Lunar Planet. Institute, Houston.
- Norman M.D. and Nemchik A.A. (2012b) Heavy bombardment of the moon at ~4.2 Ga: Evidence from ages of lunar melt breccias and zircons (abs#1368). *Lunar Planet. Sci. Conf. XLIII* Lunar Planetary Institute, The Woodlands

- Norman M.D., Zellner N.E.B. and Adena K. (2012) A new approach to dating lunar spherules using U-Th-Pb chemical ages (abs#1370) 43<sup>rd</sup> *Lunar Planet. Sci. Conf.*@ The Woodlands
- Norris J.A., Keller L.P. and McKay D.S. (1993) Impact glasses from the <20um fraction of Apollo 17 soils 72501 and 78221. *In* Workshop on **Geology of the Apollo 17 Landing Site**. Lunar Planetary Institute, Houston Tech. Rpt. 92-09. 44-45.
- Norris S.J., Swart P.K., Wright I.P., Grady M.M. and Pillinger C.T. (1983) A search for a correlatable, isotopically light carbon and nitrogen components in lunar soils and breccias. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **88**, B200-B210.
- Nunes P.D. (1975) Pb loss from Apollo 17 glassy samples and Apollo 16 revisited. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1491-1499.
- Nunes P.D. and Tatsumoto M. (1973a) Excess lead in "Rusty Rock" 66095 and implications for an early lunar differentiation. *Science* **182**, 916-920.
- Nunes P.D., Tatsumoto M., Knight R.J., Unruh D.M. and Doe B.R. (1973b) U-Th-Pb systematics of some Apollo 16 lunar samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1797-1822.
- Nunes P.D. and Tatsumoto M. (1975a) U-Th-Pb systematics of selected samples from Apollo 17, Boulder I, Station 2. *The Moon* **14**, 463-471.
- Nunes P.D. and Tatsumoto M. (1975b) Pb loss from Apollo 17 glassy samples and Apollo 16 revisited (abs). *Lunar Sci.* **VI**, 604-606. Lunar Planetary Institute, Houston
- Nunes P.D. and Tatsumoto M. (1975c) U-Th-Pb systematics of anorthositic gabbro 78155 (abs). *Lunar Sci.* **VI**, 607-609. Lunar Planetary Institute, Houston
- Nunes P.D., Tatsumoto M. and Unruh D.M. (1974a) U-Th-Pb and Rb-Sr systematics of Apollo 17 Boulder 7 from the North Massif of the Taurus-Littrow valley. *Earth Planet. Sci. Lett.* **23**, 445-452.
- Nunes P.D., Tatsumoto M. and Unruh D.M. (1974b) U-Th-Pb systematics of some Apollo 17 lunar samples and implications for a lunar basin excavation chronology. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1487-1514.
- Nunes P.D., Tasumoto M. and Unruh D.M. (1974c) U-Th-Pb systematics of some Apollo 17 samples (abs). *Lunar Sci.* **V**, 562-564. Lunar Planetary Institute, Houston.
- Nunes P.D., Tatsumoto M. and Unruh D.M. (1975a) U-Th-Pb systematics of anorthositic gabbros 78155 and 77017 - implications for early lunar evolution. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1431-1444.
- Nunes P.D., Nakamura N. and Tatsumoto M. (1976) 4.4 b.y.-old cast in Boulder 7, Apollo 17 (abs). *Lunar Sci.* **VII**, 631-632. Lunar Planetary Institute, Houston
- Nunes P.D., Unruh D.M. and Tatsumoto M. (1977) U-Th-Pb systematics of Apollo 16 samples 60018, 60025 and 64435; and the continuing problem of terrestrial Pb contamination of lunar samples. *In Lunar Sample Studies NASA SP-418*, 61. (Ed. Phinney)
- Nunn M.H. and Thiemens M.H. (2012) High precision oxygen isotopic measurements of water extracted from selected lunar samples (abs#2752). 43<sup>rd</sup> *Lunar Planet. Sci. Conf.*@ The Woodlands
- Nyquist L.E. (1977) Lunar Rb-Sr chronology. *Phys. Chem. Earth* **10**, 103-142. *A review*

- Nyquist L.E., Gast P.W., Church S.E., Wiesmann H. and Bansal B.M. (1972) Rb-Sr systematics for chemically defined Apollo 15 materials. In **The Apollo 15 Lunar Samples** (Chamberlain and Watkins eds.), 380-384. The Lunar Science Institute, Houston.
- Nyquist L.E., Hubbard N.J., Gast P.W., Church S.E., Bansal B.M. and Wiesmann H. (1972) Rb-Sr systematics for chemically defined Apollo 14 breccias. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1515-1530.
- Nyquist L.E., Hubbard N.J., Gast P.W., Bansal B.M., Wiesmann H. and Jahn B.-M. (1973) Rb-Sr systematics for chemically defined Apollo 15 and 16 materials. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1823-1846.
- Nyquist L.E., Bansal B.M., Wiesmann H. and Jahn B.-M. (1974a) Taurus-Littrow chronology: some constraints on early lunar crustal development. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1515-1539.
- Nyquist L.E., Bansal B.M., Wiesmann H. and Jahn B.-M. (1974b) Taurus-Littrow chronology: Implications for early lunar crustal development (abs). *Lunar Sci.* **V**, 565-567. Lunar Planetary Institute, Houston.
- Nyquist L.E., Bansal B.M. and Wiesmann H. (1975a) Rb-Sr ages and initial  $^{87}\text{Sr}/^{86}\text{Sr}$  for Apollo 17 basalts and KREEP basalt 15386. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1445-1465.
- Nyquist L.E., Bansal B.M. and Wiesmann H. (1975b) Rb-Sr ages and initial  $^{87}\text{Sr}/^{86}\text{Sr}$  for Apollo 17 basalts and KREEP basalt 15386 (abs). *Lunar Sci.* **VI**, 610-612. Lunar Planetary Institute, Houston.
- Nyquist L.E., Bansal B.M. and Wiesmann H. (1976) Rb-Sr systematics of agglutinate fractions from Apollo 16 soils (abs). *Lunar Sci.* **VII**, 639-641. Lunar Planetary Institute, Houston.
- Nyquist L.E., Bansal B.M. and Wiesmann H. (1976a) Sr isotopic constraints on the petrogenesis of Apollo 17 mare basalts. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1507-1528.
- Nyquist L.E., Bansal B.M. and Wiesmann H. (1976b) Sr isotopic constraints on the petrogenesis of Apollo 17 mare basalts (abs). *Lunar Sci.* **VII**, 636-638. Lunar Planetary Institute, Houston.
- Nyquist L.E., Wiesmann H., Shih C.-Y. and Bansal B.M. (1976c) 15405 quartz-monzodiorite: Super KREEP. In Wood and 27 others. Imbrium Consortium.
- Nyquist L.E., Bansal B.M., Wooden J. and Wiesmann H. (1977) Sr-isotopic constraints on the petrogenesis of Apollo 12 mare basalts. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1383-1415.
- Nyquist L.E., Wiesmann H., Bansal B., Wooden J., McKay G. and Hubbard N. (1977) Chemical and Sr-isotopic characteristics of the Luna 24 samples. In **Papers Presented to the Conference on Luna 24**, 139-142. Lunar Science Institute, Houston.
- Nyquist L.E., Wiesmann H., Bansal B., Wooden J. and McKay G. (1978) Chemical and Sr-isotopic characteristics of the Luna 24 samples. In **Mare Crisium: The view from Luna 24** (Merrill and Papike eds.) p632-656. Pergamon Press.
- Nyquist L.E., Shih C.-Y., Wooden J.L., Bansal B.M. and Wiesmann H. (1979) The Sr and Nd isotopic record of Apollo 12 basalts: Implications for lunar geochemical evolution. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 77-114.
- Nyquist L.E., Wiesmann H., Wooden J., Bansal B.M. and Shih C.-Y. (1979) Age and REE abundances of anorthositic norite from 15455 (abs). In Papers present to the Conf. on the Lunar Highlands Crust. LPI 394, 122-124.

Nyquist L.E., Reimold W.U., Wooden J.L., Bansal B.M., Wiesmann H. and Shih C.-Y. (1981a) Sr and Nd cooling ages of cumulate norite 78236 (abs). *Lunar Planet. Sci.* **XII**, 782-784. Lunar Planetary Institute, Houston.

Nyquist L.E., Reimold W.U., Bogard D.D., Wooden J.L., Bansal B.M., Wiesmann H. and Shih C.-Y. (1981b) A comparative Rb-Sr, Sm-Nd and K-Ar study of shocked norite 78236: Evidence of slow cooling in the lunar crust? *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 67-97.

Nyquist L.E., Wooden J.L., Shih C.-Y., Wiesmann H. and Bansal B.M. (1981c) Isotopic and REE studies of lunar basalt 12038: Implications for the petrogenesis of aluminous mare basalts. *Earth Planet. Sci. Lett.* **55**, 335-355.

Nyquist L.E., Shih C.-Y., Bansal B., Wiesmann H. and Wooden J. (1983) Formation of a lunar granite 4.1 AE ago (abs). *Lunar Planet. Sci.* **XIV**, 576-577. Lunar Planetary Institute, Houston.

Nyquist L., Lindstrom M., Bansal B., Mittlefehldt D., Shih C.-Y. and Wiesmann H. (1989) Chemical and isotopic constraints on the petrogenesis of the large mare basalt clast in breccia 15459. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 163-174. Lunar Planetary Institute, Houston.

Nyquist L.E., Bogard D.D., Garrison D.H., Bansal B.M., Wiesmann H. and Shih C.-Y. (1991a) Thermal resetting of radiometric ages. I: Experimental Investigations (abs). *Lunar Planet. Sci.* **XXII**, 985-986. Lunar Planetary Institute, Houston.

Nyquist L.E., Bogard D.D., Garrison D.H., Bansal B.M., Wiesmann H. and Shih C.-Y. (1991b) Thermal resetting of radiometric ages. II: Modeling and applications (abs). *Lunar Planet. Sci.* **XXII**, 987-988. Lunar Planetary Institute, Houston.

Nyquist L.E. and Shih C.-Y. (1992) The isotopic record of lunar volcanism. *Geochim. Cosmochim. Acta* **56**, 2213-2234.

Nyquist L.E., Shih C.-Y., Wiesmann H. and Bansal B.M. (1993) Formation interval for the lunar mantle and implications for lunar evolution (abs). *Lunar Planet. Sci.* **XXIV**, 1095-1096. Lunar Planetary Institute, Houston

Nyquist L.E., Wiesmann H., Bansal B., Shih C.-Y., Keith J.E. and Harper C.L. (1995) <sup>146</sup>Sm-<sup>142</sup>Nd formation interval for the lunar mantle. *Geochim. Cosmochim. Acta* **59**, 2817-2837.

Nyquist L.E., Bogard D.D. and Shih C.-Y. (2001) Radiometric chronology of the Moon and Mars. In **The Century of Space Science**, 1325-1376, Kluwer Acad. Press. (eds Bleeker, Geiss, Huber) Dordrecht, Holland

Nyquist L.E., Bogard D.D., Yamaguchi A., Shih C.-Y., Karouji Y., Ebihara M., Reese Y., Garrison D., McKay G. and Takeda H. (2006) Feldspathic clasts in Yamato-86032: Remnants of the lunar crust with implications for its formation and impact history. *Geochim. Cosmochim. Acta* **70**, 5990-6015.

Nyquist L.E., Shih C.-Y. and Reese Y.D. (2008) Sm-Nd for norite 78236 and eucrite Y980318/433: Implications for planetary and solar system processes (abs). *Lunar Planet. Sci.* **XXXIX** Lunar Planetary Institute, Houston.

Nyquist L.E. and Shih C.-Y. (2008) Chronology and provenance of lunar KREEP: A 4.0 or 4.1 Ga age for Serenitatis? (abs) **Early Solar System Impact Bombardment Workshop**. Lunar Planet. Institute, Houston.

Nyquist L.E., Shih C.-Y., Reese Y.D., Park J., Bogard D.D., Garrison D.H. and Yamaguchi A. (2010) Lunar crustal history recorded in lunar anorthosites (abs#1383). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands



- Nyquist L.E, Shih C-Y., Reese Y.D., Park J., Bogard D.D., Garrison D.H. and Yamaguchi A. (2011) Sm-Nd and Ar-Ar studies of DHO 908 and 489: Implications for lunar crustal history (abs#2368). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Nyquist L.E, Shih C-Y., Bogard D.D. and Yamaguchi A. (2011) Lunar crustal history from isotopic studies of lunar anorthosites. *Proc. Nat. Acad. China*, 1-13.
- Nyquist L.E, Shih C-Y. and Reese Y.D. (2011) Dating rock 63545 by Rb-Sr and Sm-Nd: Age of Imbrium; SPA dress rehearsal (abs#1868). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Nyquist L.E, Shih C-Y. and Reese Y.D. (2012) Redetermination of the Sm-Nd age and initial Nd of Lunar troctolite 76535: Implications for the Lunar Crust development (abs). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Oberli F., McCulloch M.T., Tera F., Papanastassiou D.A. and Wasserburg G.J. (1978) Early lunar differentiation constraints from U-Th-Pb, Sm-Nd and Rb-Sr model ages (abs). *Lunar Planet. Sci.* **IX**, 832-834. Lunar Planetary Institute, Houston.
- Oberli F., Huneke J.C. and Wasserburg G.J. (1979a) U-Pb and K-Ar systematics of cataclysm and precataclysm lunar impactites (abs). *Lunar Planet. Sci.* **X**, 940-942. Lunar Planetary Institute, Houston.
- Oberli F., Huneke J.C., McCulloch M.T., Papanastassiou D.A. and Wasserburg G.J. (1979b) Isotopic constraints for the early evolution of the moon. *Meteoritics* **14**, 502-503.
- O'Hara M.J. (2000) Flood basalts and lunar petrogenesis. *J. Petrogr.* **41**, 1121-1125.
- O'Hara M.J. (2000) Flood basalts, basalt floods or topless bushvelds? Lunar petrogenesis revisited. *J. Petrogr.* **41**, 1545-1651.
- O'Hara M.J. (2001) Flood basalts, basalt floods or topless bushvelds? Lunar petrogenesis revisited: A reply. *J. Petrogr.* **42**, 1221-1224. (see Taylor, SR)
- O'Hara M.J. and Biggar G.M. (1972) A point of phase equilibrium interpretation in connection with lavas from Apollo 12 site. *Earth Planet. Sci. Lett.* **16**, 388-390.
- O'Hara M.J., Biggar G.M., Hill P.G., Jefferies B. and Humphries D.J. (1974) Plagioclase saturation in lunar high-Titanium basalt. *Earth Planet. Sci. Lett.* **21**, 253-268.
- O'Hara M.J., Biggar G.M., Humphries D.J. and Saha P. (1974b) Experimental petrology of high titanium basalt (abs). *Lunar Sci.* **V**, 571-573. Lunar Planetary Institute, Houston.
- O'Hara M.J. and Humphries D.J. (1975) Armalcolite crystallization, phenocryst assemblages, eruption conditions and origin of eleven high titanium basalts from Taurus Littrow (abs). *Lunar Sci.* **VI**, 619-621. Lunar Planetary Institute, Houston.
- O'Hara M.J. and Humphries D.J. (1977) Gravitational separation of quenching crystals: a cause of chemical differentiation in lunar basalts. *Phil. Trans. Roy. Soc. London* **A285**, 177-192.
- Ohtake et al. (2009) The global distribution of pure anorthosite on the Moon. *Nature* **461**, 236-241.
- Ohtake and 11 others (2012) Primitive farside highland materials detected by Mg number (abs#1977). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Okamura F.P., McCallum I.S., Stroh J.M. and Ghose S. (1976) Pyroxene-spinel intergrowths in lunar and terrestrial pyroxenes. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1889-1899.

O'Keefe J.D. and Ahrens T.J. (1975) Shock effects from a large impact on the Moon. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2831-2844.

O'Keefe J.A. (1970) Tektite glass in Apollo 12 sample. *Science* **168**, 1209-1210. *not*

O'Keefe J.A. and Glass B.P. (1985) Lunar sample 14425: Characterization and resemblance to high-magnesium microtektites. *Science* **227**, 515-516.

O'Kelley G.D., Eldridge J.S., Schonfeld E. and Bell P.R. (1970) Primordial radionuclide abundances, solar proton and cosmic ray effects and ages of Apollo 11 lunar samples by non-destructive gamma-ray spectrometry. *Proc. Apollo 11 Lunar Sci. Conf.* 1407-1424.

O'Kelley G.D., Eldridge J.S., Schonfeld E. and Bell P.R. (1971a) Abundances of the primordial radionuclides K, Th, and U in Apollo 12 lunar samples by nondestructive gamma-ray spectroscopy: implications for the origin of lunar soils. *Proc. Second Lunar Sci. Conf.* 1159-1168.

O'Kelley G.D., Eldridge J.S., Schonfeld E. and Bell P.R. (1971b) Cosmogenic radionuclide concentrations and exposure ages of lunar samples from Apollo 12. *Proc. Second Lunar Sci. Conf.* 1747-1755.

O'Kelley G.D., Eldridge J.S. and Northcutt K.J. (1972a) Abundances of primordial radioelements K, Th, and U in Apollo 15 samples, as determined by non-destructive gamma-ray spectrometry. In **The Apollo 15 Lunar Samples** (Chamberlain J.W. and Watkins C., eds.), 244-246. Lunar Science Institute, Houston.

O'Kelley G.D., Eldridge J.S., Schonfeld E. and Northcutt K.J. (1972b) Primordial radionuclides and cosmogenic radionuclides in lunar samples from Apollo 15. *Science* **175**, 440-443.

O'Kelley G.D., Eldridge J.S., Northcutt K.J. and Schonfeld E. (1972c) Primordial radionuclides and cosmogenic radionuclides in lunar samples from Apollo 15. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1659-1670.

O'Kelley G.D., Eldridge J.S. and Northcutt K.J. (1973) Solar flare induced radionuclides and primordial radioelement concentrations in Apollo 17 rocks and frees preliminary results (abs). *Lunar Sci.* **IV**, 572-574. Lunar Planetary Institute, Houston.

O'Kelley G.D., Eldridge J.S. and Northcutt K.J. (1974a) Cosmogenic radionuclides in samples from Taurus-Littrow: Effects of the solar flare of August 1972. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2139-2147.

O'Kelley G.D., Eldridge J.S. and Northcutt K.J. (1974b) Concentrations of cosmogenic radionuclides in Apollo 17 samples: Effects of the solar flare of August, 1972 (abs). *Lunar Sci.* **V**, 577-579. Lunar Planetary Institute, Houston

O'Kelley G.D., Eldridge J.S., Northcutt K.J. and Schonfeld E. (1976) Radionuclide concentrations of KREEP basalt samples 15382 and 15386 (abs). *Lunar Sci.* **VII**, 651-652.

Olhoeft G.R. and Strangway D.W. (1973) Electrical and magnetic properties of Apollo 17 soils. *EOS Trans. AGU* **54**, 601.

Olhoeft G.R., Strangway D.W. and Frisillo A.L. (1973) Lunar sample electrical properties. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 3133-3149.

O'Neil J.R. and Adams L.H. (1970) Oxygen isotope analyses of selected Apollo 11 materials. *Proc. Apollo 11 Lunar Sci. Conf.* 1425-1427.

Onuma N., Clayton R.N. and Mayeda T. (1970) Apollo 11 rocks: Oxygen isotope fractionation between minerals and an estimate of the temperature of formation. *Proc. Apollo 11 Lunar Sci. Conf.* 1429-1434.

- Onorato P.I.K., Uhlmann D.R. and Simonds C.H. (1976) Heat flow in impact melts: Apollo 17 Station 6 Boulder and some applications to other breccias and xenolith laden melts. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2449-2467.
- Onorato P.I.K., Yinnon H., Uhlmann D.R. and Taylor L.A. (1979) Partitioning as a cooling rate indicator. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 479-491.
- Oro J. (1972) Extraterrestrial organic analysis. *Space Life Sci.* **3**, 507-550.
- Oro J., Upegrove W.S., Gilbert J., McReynolds J., Gil-Av E., Ibanez J., Zlatkis A., Flory D.A., Levy R.L. and Wolf C.J. (1970) Organogenic elements and compounds in type C and D lunar samples from Apollo 11. *Proc. Apollo 11 Lunar Sci. Conf.* 1901-1920.
- Osborne M.D., Parkin K.M. and Bums R.G. (1978) Temperature-dependence of Fe-Ti spectra in the visible region: implications for mapping Ti concentrations of hot planetary surfaces. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2949-2960.
- Osinski G.R., Tornabene L.L. and Grieve R.A.F. (2011) Impact ejecta emplacement on terrestrial planets. *Earth Planet. Sci. Lett.* **310**, 167-181.
- Oshrin J. and Neal C.R. (2008) Crystal size distributions and trace element profiles of plagioclase crystals in Apollo 14 high-alumina basalts (abs#1085). *Lunar Planet. Sci.* **XXXIX**, Lunar Planetary Institute, Houston.
- Oshrin J. and Neal Clive R. (2009) Crystal size distributions and basalt evolution: More from Fra Mauro (abs#1706). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- O'Sullivan K. and Neal C.R. (2008) Insights in the petrogenesis of Apollo 12 basalts from crystal size distributions and mineral geochemistry (abs#1537). *Lunar Planet. Sci.* **XXXIX**, Lunar Planetary Institute, Houston.
- O'Sullivan K. and Neal C.R. (2010) Petrogenesis of Apollo 12 basalts 12031 and 12038 (abs#2307). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- O'Sullivan K., Neal C.R. and Simonetti A. (2011) Crystal stratigraphy of Apollo 12 basalts (abs#2368). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Oyama V.J. (1972) Search for biogenic structures and viable organisms in lunar samples: A review. *Space Life Sci.* **3**, 377-382.
- Oyama V.J., Merek E.L., Silverman M.P. and Boylen C.W. (1971) Search for viable organisms in lunar samples: Further biological studies of Apollo 11 core, Apollo 12 bulk, and Apollo 12 core samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1931-1937.
- Ozima M., Seki K., Terada N., Miura Yas, Podeseck F. and Shinagawa H. (2005) Terrestrial nitrogen and noble gases in lunar soils. *Nature* **436**, 655-659.
- Paces J.B., Nakai S., Neal C.R., Taylor L.A., Halliday A.N., Lee D.-C. and McKinney M.C. (1990a) Resolution of ages and Sm-Nd isotopic characteristics in Apollo 17 high-Ti basalts (abs). *Lunar Planet. Sci.* **XXI**, 924-925. Lunar Planetary Institute, Houston.
- Paces J.B., Neal C.R., Nakai S., Taylor L.A. and Halliday A.N. (1990b) Open- and closed-system magma evolution of Apollo 17 high-Ti basalts and origin of source heterogeneities at 4.1 Ga: Sr-Nd isotopic evidence (abs). *Lunar Planet. Sci.* **XXI**, 926-927. Lunar Planetary Institute, Houston.

- Paces J.B., Nakai S., Neal C.R., Taylor L.A., Halliday A.N. and Lee D.-C. (1991) A strontium and neodymium isotopic study of Apollo 17 high-Ti mare basalts: Resolution of ages, evolution of magmas, and origin of source heterogeneities. *Geochim. Cosmochim. Acta* **55**, 2025-2043.
- Padawer G.M., Kamykowski E.A., Stanber M.C., D'Agostino M.D. and Brandt W. (1974) Concentration-versus-depth profiles of hydrogen, carbon, and fluorine in lunar rock surfaces. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1919-1937.
- Padia J.T., Rao M.N. and Venkatesan T.R. (1979) Cosmogenic and trapped rare gases in Luna 24 drill core samples. *The Moon* **20**, 423-438.
- Pahlevan K. and Stevenson D.J. (2007) Equilibration in the aftermath of the lunar-forming giant impact. *Earth Planet. Sci. Lett.* **262**, 438-449.
- Pahlevan K. and Stevenson D.J. (2009) Chemical fractionation after the Moon-forming giant impact (abs#2392). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Palme H. (1977) On the age of KREEP. *Geochim. Cosmochim. Acta* **41**, 1791-1801.
- Palme H. (1980) The meteoritic contamination of terrestrial and lunar impact melts and the problem of indigenous siderophiles in the lunar highlands. *Proc. 11<sup>th</sup> Lunar Sci. Conf.* 481-506.
- Palme H. and Wanke H. (1977) Lunar differentiation processes as characterized by trace element abundances. *Phil. Trans. Roy. Soc. London* **A285**, 199-206.
- Palme H. and Wlotzka F. (1977) Trace element fractionation during crystallization of lunar rock 75035 (abs). *Lunar Sci.* **VIII**, 747-749. Lunar Planetary Institute, Houston
- Palme H., Baddenhausen H., Blum K., Cendales M., Dreibus G., Hofmeister H., Kmse H., Palme C., Spettel B. Vilcsek E. and Wanke H. (1978) New data on lunar samples and achondrites and a comparison of the least fractionated samples from the earth, the moon, and the eucrite parent body. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 25-57.
- Palme H., Spettel B., Wanke H., Bischoff A. and Stoffler D. (1984a) The evolution of the lunar magma ocean: Evidence from trace elements in plagioclase (abs). *Lunar Planet. Sci.* **XV**, 625-626. Lunar Planetary Institute, Houston.
- Palme H., Spettel B., Wanke H., Bischoff A. and Stoffler D. (1984b) Early differentiation of the Moon: Evidence from trace elements in plagioclase. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* C3-C15.
- Palme H., Spettel K., Jochum K.P., Dreibus G., Weber H., Weckwerth G., Wanke H., Bischoff A., and Stoffler D. (1991) Lunar highland meteorites and the composition of the lunar crust. *Geochim. Cosmochim. Acta* **55**, 3105-3122.
- Papanastassiou D.A., Wasserburg G.J. and Burnett D.S. (1970a) Rb-Sr ages of lunar rocks from the Sea of Tranquillity. *Earth Planet. Sci. Lett.* **8**, 1
- Papanastassiou D.A. and Wasserburg G.J. (1970b) Rb-Sr ages from the Ocean of Storms. *Earth Planet. Sci. Lett.* **8**, 269-278.
- Papanastassiou D.A. and Wasserburg G.J. (1971a) Lunar chronology and evolution from Rb-Sr studies of Apollo 11 and 12 samples. *Earth Planet. Sci. Lett.* **11**, 37-62.
- Papanastassiou D.A. and Wasserburg G.J. (1971b) Rb-Sr ages of igneous rocks from the Apollo 14 mission and the age of the Fra Mauro Formation. *Earth Planet. Sci. Lett.* **12**, 36-48.

- Papanastassiou D.A. and Wasserburg G.J. (1972a) Rb-Sr age of a Luna 16 basalt and the model age of lunar soils. *Earth Planet. Sci. Lett.* **13**, 368-374.
- Papanastassiou D.A. and Wasserburg G.J. (1972b) Rb-Sr age of a crystalline rock from Apollo 16. *Earth Planet. Sci. Lett.* **16**, 289-298.
- Papanastassiou D.A. and Wasserburg G.J. (1972c) Rb-Sr age of Luna 20 and Apollo 16 samples. *Earth Planet. Sci. Lett.* **17**, 52-63.
- Papanastassiou D.A. and Wasserburg G.J. (1973) Rb-Sr ages and initial strontium in basalts from Apollo 15. *Earth Planet. Sci. Lett.* **17**, 324-337.
- Papanastassiou D.A. and Wasserburg G.J. (1975a) Rb-Sr study of a lunar dunite and evidence for early lunar differentiates. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1467-1489.
- Papanastassiou D.A. and Wasserburg G.J. (1975b) A Rb-Sr study of Apollo 17 boulder 3: Dunite clast, microclasts, and matrix (abs). *Lunar Sci.* **VI**, 631-633. Lunar Planetary Institute, Houston.
- Papanastassiou D.A. and Wasserburg G.J. (1976a) Rb-Sr age of troctollite 76535. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2035-2054.
- Papanastassiou D.A. and Wasserburg G.J. (1976b) Early lunar differentiates and lunar initial  $^{87}\text{Sr}/^{86}\text{Sr}$  (abs). *Lunar Sci.* **VII**, 665-667. Lunar Planetary Institute, Houston.
- Papanastassiou D.A., DePaolo D.J., Tera F. and Wasserburg G.J. (1976c) An isotopic triptych on mare basalts: Rb-Sr, Sm-Nd, U-Pb. *Lunar Science* **VIII**, 750-752. Lunar Planetary Institute, Houston.
- Papanastassiou D.A., DePaolo D.J. and Wasserburg G.J. (1977) Rb-Sr and Sm-Nd chronology and genealogy of mare basalts from the Sea of Tranquillity. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1639-1672.
- Papike J.J. (1996) Pyroxene as a recorder of cumulate formational processes in asteroids, Moon, Mars and Earth: Reading the record with the ion microprobe. *Am. Mineral.* **81**, 525-544.
- Papike J.J., Bence A.E., Brown G.E., Prewitt C.T. and Wu C.H. (1971) Apollo 12 clinopyroxenes: Exsolution and epitaxy. *Earth Planet. Sci. Lett.* **10**, 307-315.
- Papike J.J., Bence A.E. and Ward M.A. (1972) Subsolvus relations of pyroxenes from Apollo 15 basalts. In **The Apollo 15 Lunar Samples**. 144-147. Lunar Science Institute, Houston.
- Papike J.J. and Bence A.E. (1972) Apollo 14 inverted pigeonites: Possible samples of lunar plutonic rocks. *Earth Planet. Sci. Lett.* **14**, 176-182.
- Papike J.J., Bence A.E. and Lindsley D.H. (1974) Mare basalts from the Taurus-Littrow region of the moon. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 471-504.
- Papike J.J., Hodges F.N., Bence A.E., Cameron M. and Rhodes J.M. (1976) Mare basalts: Crystal chemistry, mineralogy and petrology. *Rev. Geophys. Space Phys.* **14**, 475-540.
- Papike J.J. and Bence A.E. (1978) Lunar mare vs. terrestrial mid-ocean ridge basalts: Planetary constraints on basaltic volcanism. *Geophys. Res. Lett.* **5**, 803-806.
- Papike J.J. and Vaniman D.T. (1978) The lunar mare basalt suite. *Geophys. Res. Lett.* **5**, 433-436.
- Papike J.J. and Vaniman D.T. (1978) Luna 24 ferrobasalts and the mare basalt suite: Comparative chemistry, mineralogy and petrology. In **Mare Crisium: The View from Luna 24**. (eds. Merrill and Papike) Pergamon Press, 371-401.

Papike J.J., Simon S.B., White C. and Laul J.C. (1981) The relationship of the lunar regolith <10 micron fraction and agglutinates. Part I: A model for agglutinate formation and some indirect supportive evidence. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Lett.* 409-420.

Papike J.J., Simon S.B. and Laul J.C. (1982) The lunar regolith: Chemistry, Mineralogy and Petrology. *Rev. Geophys. Space Phys.* **20**, 761-826.

Papike J.J., Taylor L.A. and Simon S.B. (1991) Lunar Minerals. In **Lunar Sourcebook: a users guide to the moon.** (eds. Heiken et al. ) Cambridge Univ. Press

Papike J.J., Fowler G.W. and Shearer C.K. (1994a) Orthopyroxene as a recorder of lunar Mg-suite norite petrogenesis: Preliminary ion microprobe studies of Apollo 17 fragments (abs). *Lunar Planet. Sci.* **XXV**, 1045-1046. Lunar Planetary Institute, Houston.

Papike J.J., Fowler G.W. and Shearer C.K. (1994b) Orthopyroxene as a recorder of lunar crust evolution: An ion microprobe investigation of Mg-suite norites. *Am. Mineral.* **79**, 796-800.

Papike J.J., Fowler G.W., Shearer C.K. and Layne G.D. (1996) Ion microprobe investigation of plagioclase and orthopyroxene from lunar Mg-suite norites: Implications for calculating parental melt REE concentrations and for assessing postcrystallization REE redistribution. *Geochim. Cosmochim. Acta* **60**, 3967-3978.

Papike J.J., Fowler G.W. and Shearer C.K. (1997) Evolution of the lunar crust: SIMS study of plagioclase from ferroan anorthosites. *Geochim. Cosmochim. Acta* **61**, 2343-2350.

Papike J.J., Ryder G. and Shearer C.K. (1998) Lunar Samples. In **Planetary Materials.** (ed. Papike) Reviews in Mineralogy, vol 36. 5-01-5-189. Min. Soc. Am.

Papike J.J., Fowler G.W., Adcock C.T. and Shearer C.K. (1999) Systematics of Ni and Co in olivine from planetary melt systems: Lunar mare basalts. *Am. Mineral.* **84**, 392-399.

Papike J.J., Karner J.M. and Shearer C.K. (2003) Determination of planetary basalt parentage: A simple technique using the electron microprobe. *Am. Mineral.* **88**, 469-472.

Papike J.J., Karner J.M. and Shearer C.K. (2004) comparative planetary mineralogy: V/Cr + Al systematic in chromite as an indicator of relative oxygen fugacity. *Amer. Mineral.* **89**, 1557-1560.

Papike J.J., Burger P.V., Shearer Chip, Sutton Steve, Newville M., Choi Y. and Lanzirrti A. (2011) Sulfides from martian and Lunar basalts: Comparative chemistry fro Ni, Co, Cu and Se. *Amer. Mineral.* **96**, 932-935.

Papp H.A., Steele I.M. and Smith J.V. (1978) Luna 24: Mineralogy of the 90-150 micrometer fraction: Implications for remote sampling of regolith. In **Mare Crisium: The view from Luna 24.** Geochem. Cosmochim. Act suppl. 9, 245-264. (ed. Merrill) Pergamon Press.

Parker M., Agee C.B. and Westrenen W. (2009) Density of molten "Apollo 17 orange glass"(abs#1722). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.

Parmentier E.M. (2009) On the scale of lunar –mantle overturn following magma ocean fractional solidification: The role for multiple scales of convective motion (abs#1781). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.

Patchen A.P. and Taylor L.A. (2004) The most reduced rock from the moon – Apollo 14 basalt 14053: Extreme reduction entirely from a re-heating event (abs#1762). *Lunar Planet. Sci.* **XXXV**, Lunar Planetary Institute, Houston.

- Pearce G.W., Strangway D.W. and Larson E.E. (1971) Magnetism of two Apollo 12 igneous rocks. *Proc. Second Lunar Sci. Conf.* 2451-2460.
- Pearce G.W., Strangway D.W. and Gose W.A. (1972) Remanent magnetism of the lunar surface. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2449-2464.
- Pearce G.W., Gose W.A. and Strangway D.W. (1973) Magnetic studies on Apollo 15 and 16 lunar samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 3045-3076.
- Pearce G.W. and Simonds C.H. (1974) Magnetic properties of Apollo 16 samples and implications for their mode of formation. *J. Geophys. Res.* **79**, 2953-2959.
- Pearce G.W., Strangway D.W. and Gose W.A. (1974a) Magnetic properties of Apollo samples and implications for regolith formation. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2815-2826.
- Pearce G.W., Gose W.A. and Strangway D.W. (1974b) Magnetism of the Apollo 17 samples (abs). *Lunar Sci.* **V**, 590-592. Lunar Planetary Institute, Houston.
- Pearce G.W., Hoye G.S., Strangway D.W., Walker B.M. and Taylor L.A. (1976) Some complexities in the determination of lunar paleointensities. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 3271-3297.
- Pearce G.W. and Chou C.-L. (1976) Relationships between siderophile elements and metallic iron contents of Apollo 16 and 17 lunar soils (abs). *Lunar Sci.* **VII**, 673-675. Lunar Planetary Institute, Houston.
- Pearce G.W. and Chou C.-L. (1977) On the origin of sample 70019 and its suitability for lunar magnetic field intensity studies. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 669-677.
- Pearce G.W., Chou C.-L. and Wu Y. (1977) Chemical compositions and magnetic properties in separated glass and breccia fractions of 70019 (abs). *Lunar Sci.* **VIII**, 759-761. Lunar Planetary Institute, Houston.
- Pearce T.H. and Timms C. (1992) Interference imaging of plagioclase in lunar materials (abs). *Lunar Planet. Sci.* **XXIII**, 1045. Lunar Planetary Institute, Houston.
- Peckett A., Phillips R. and Brown G.M. (1972) New zirconium-rich minerals from Apollo 14 and 15 lunar rocks. *Nature* **236**, 215-217.
- Peckett A. and Brown G.M. (1973) Plutonic or metamorphic equilibration in Apollo 16 lunar pyroxenes. *Nature* **242**, 252-255.
- Pepin R.O., Nyquist L.E., Phinney D. and Black D.C. (1970) Rare gases in Apollo 11 lunar material. *Proc. Apollo 11 Lunar Sci. Conf.* 1435-1454.
- Pepin R.O., Bradley J.G., Dragon J.C. and Nyquist L.E. (1972) K-Ar dating of lunar fines: Apollo 12, Apollo 14 and Luna 16. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1569-1588.
- Pepin R.O., Basford J.R., Dragon J.C., Johnson N.L., Coscio M.R. and Murthy V.R. (1974) Rare gases and trace elements in Apollo 15 drill fines: Depositional chronologies and K-Ar ages and production rates of spallation-produced <sup>3</sup>He, <sup>22</sup>Ne and <sup>38</sup>Ar vrs depth. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2149-2184.
- Pepin R.O., Dragon J.C., Johnson N.L., Bates A., Coscio M.R. and Murthy V.R. (1975) Rare gases and Ca, Sr and Ba in Apollo 17 drill-core fines. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2027-2056.
- Pepin R.O., Becker R.H. and Schlutter D.J. (1983) Irradiation records in regolith materials I: isotopic compositions of solar wind neon and argon in single lunar mineral grains. *Geochim. Cosmochim. Acta* **63**, 2145-2162.

- Perkins R.W., Rancitelli L.A., Cooper J.A., Kaye J.H. and Wogman N.A. (1970) Cosmogenic and primordial radionuclide measurements in Apollo 11 lunar samples by nondestructive analysis. *Proc. Apollo 11 Lunar Sci. Conf.* 1455-1469.
- Perry C.H., Agrawal D.K., Anastassakis E., Lowndes R.P. and Tornberg N.E. (1972) Far infrared and Raman spectra A15. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 3077-3095.
- Petro N.E. and Pieters C.M. (2004) Surviving the heavy bombardment: Ancient material at the surface of South Pole-Aitken Basin. *J. Geophys. Res.* **109** E06004.
- Petro N.E. and Pieters C.M. (2004) Comparison of the geologic setting of the South Pole-Aitken basin interior with Apollo 16: Implications for regolith components (abs#1345). *Lunar Planet. Sci.* **XXXV**, Lunar Planetary Institute, Houston.
- Petro N.E. and Pieters C.M. (2005) The lunar wide effects of the formation of basins on the megaregolith (abs#1209). *Lunar Planet. Sci.* **XXXVI**, Lunar Planetary Institute, Houston.
- Petro N.E. and Pieters C.M. (2006) The effects of basin formation on the lunar geochemical terranes (abs#1868). *Lunar Planet. Sci.* **XXXVII**, Lunar Planetary Institute, Houston.
- Petro N.E. and Pieters C.M. (2006) Modelling the provenance of the Apollo 16 regolith. *J. Geophys. Res.* **111**, E09005.
- Petro N.E. and Pieters C.M. (2008) The Lunar-wide effects of basin ejecta distribution on the early megaregolith. *Meteor. & Planet. Sci.* **43**, 1517-1529.
- Petrowski C., Kerridge J.F. and Kaplan I.R. (1974) Light element geochemistry of the Apollo 17 site. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1939-1948.
- Phakey P.P., Hutcheon I.D., Rajan R.S. and Price B. (1972) Radiation effects in soils from five lunar missions. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2905-2915.
- Phakey P.P. and Price B. (1972) Extreme radiation damage in soil from Mare Fecunditatis. *Earth Planet. Sci. Lett.* **13**, 410-418.
- Phakey P.P. and Price P.B. (1973) Radiation damage in Luna 20 soil. *Geochim. Cosmochim. Acta* **37**, 975-978.
- Philpotts J.A. and Schnetzler C.C. (1970a) Potassium, rubidium, strontium, barium and rare-earth concentrations in lunar rocks and separated phases. *Science* **167**, 493-495.
- Philpotts J.A. and Schnetzler C.C. (1970b) Apollo 11 lunar samples: K, Rb, Sr, Ba and rare-earth concentrations in some rocks and separated phases. *Proc. Apollo 11 Lunar Science Conf.* 1471-1486.
- Philpotts J.A., Schnetzler C.C., Bottino M.L., Schumann S. and Thomas H.H. (1972) Luna 16: Some Li, K, Rb, Sr Ba, rare-earth, Zr and Hf concentrations. *Earth Planet. Sci. Lett.* **13**, 429-435.
- Philpotts J.A., Schumann S., Bickel A.L. and Lum R.K.L. (1972) Luna 20 and Apollo 16 core fines: Large-ion lithophile trace-element abundances. *Earth Planet. Sci. Lett.* **17**, 13-18.
- Philpotts J.A., Schnetzler C.C., Nava D.F., Bottino M.L., Fullagar P.D., Thomas H.H., Schumann S. and Koons C.W. (1972) Apollo 14: Some geochemical aspects. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1293-1305.



- Philpotts J.A., Schuhmann S., Schnetzler C.C., Kouns C.W., Doan A.S., Wood F.M., Bickel A.L. and Lum R.K.L. (1973a) Apollo 17: Geochemical aspects of some soils, basalts, and breccia (abs). *EOS Trans. AGU* **54**, 603-604. Amer. Geophys. Union.
- Philpotts J.A., Schumann S., Kouns C.W., Lum-Staab R.K.L. and Schnetzler C.C. (1973b) Apollo 16 returned lunar samples – lithophile trace-element abundances. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1427-1436.
- Philpotts J.A., Schuhmann S., Kouns C.W., Lum R.K.L. and Winzer S. (1974a) Origin of Apollo 17 rocks and soils. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1255-1267.
- Philpotts J.A., Schuhmann S., Kouns C.W. and Lum R.K.L. (1974b) Lithophile trace elements in Apollo 17 soils (abs). *Lunar Sci.* **V**, 599-601. Lunar Planetary Institute, Houston.
- Phinney D., Kahl S.B. and Reynolds J.H. (1975) <sup>40</sup>Ar-<sup>39</sup>Ar dating of Apollo 16 and 17 rocks. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1593-1608.
- Phinney W.C. (1981) Guidebook for the Boulders at Station 6, Apollo 17. Curatorial Branch Publication 55, JSC- 17243 pp. 125.
- Phinney W.C. (1991) Lunar anorthosites, their equilibrium melts and the bulk moon. *Proc. 21<sup>st</sup> Lunar Planet. Sci. Conf.* 29-49. Lunar Planetary Institute, Houston.
- Phinney W.C. (1992) Partition coefficients for iron between plagioclase and basalt as a function of oxygen fugacity: Implications for Archean and lunar anorthosites. *Geochim. Cosmochim. Acta* **56**, 1885-1895.
- Phinney W.C., Warner J., Simonds C.H. and Lofgren G.E. (1972) Classification and distribution of rock types at Spur Crater. In **The Apollo 15 Lunar Samples**, 149-153. (ed. Watkins and Chaimberlain) The Lunar Science Institute, Houston.
- Phinney W.C., Consortium Leader (1974) Progress report: Apollo 17, station 6 boulder consortium (abs). *Lunar Sci.* **V**, Suppl. A. The Lunar Science Institute, Houston.
- Phinney W. and Lofgren G. (1973) Description, classification and inventory of Apollo 16 rake samples from stations 1, 4 and 13. Curators Office.
- Phinney W.C., Simonds C.H. and Warner J. (1974) Description, Classification and Inventory of Apollo 17 Rake Samples from Station 6. Curator's Catalog, pp. 46.
- Phinney W.C., Simonds C.H. and Warner J. (1975) Description, Classification and Inventory of the Comprehensive sample from Apollo 14. Curator's Catalog, pp. 46.
- Phinney W.C., McKay D.S., Simonds C.H. and Warner J.L. (1976a) Lithification of vitric- and clastic-matrix breccias: SEM photography. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2469-2492.
- Phinney W.C., McKay D.S., Warner J.L. and Simonds C.H. (1976b) Lithification of fragmental and vitric matrix breccias (abs). *Lunar Sci.* **VII**, 694-696. Lunar Planetary Institute, Houston.
- Phinney W.C., Warner J.L. and Simonds C.H. (1977) Petrologic evidence for formation and solidification of impact melts (abs). *Lunar Sci.* **VIII**, 770-772. Lunar Planetary Institute, Houston.
- Pidgeon R.T., Nemchin A.A. and Meyer C. (2005) A further investigation of the exceptional zircon aggregate in lunar thin section 73235,82 (abs#1275). *Lunar Planet. Sci.* **XXXVI**, Lunar Planetary Institute, Houston.

Pidgeon R.T., Nemchin A.A. and Meyer C. (2006) Complex histories of two lunar zircons as evidenced by their internal structures and U-Pb ages (abs#1548). *Lunar Planet. Sci.* **XXXVII**, Lunar Planetary Institute, Houston.

Pidgeon R.T., Nemchin A.A., vanBronswijk W., Geisler T., Meyer C., Compston W. and Williams I.S. (2007) Complex history of a zircon aggregate from lunar breccia. *Geochim. Cosmochim Acta* **71**, 1370-1381.

Pidgeon R.T., Nemchin A.A., Grange M.L. and Meyer C. (2010) Evidence for a lunar "Cataclysm" at 4.34 Ga from zircon U-Pb systematics (abs#1126). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands

Pidgeon R.T., Nemchin A.A. and Grange M.L. (2012) The development of lunar zircon/apatite U-Pb geochronology at Curtin Univ. (abs#5167). *75<sup>th</sup> Meteoritical Society @ Cains*

Pieters C.M. (1998) Lunar materials from visible to mid-infrared: The effects of space weathering. *International Geology Review* **40**, 981-989.

Pieters C.M., Hawke B.R., Butler P., Waltz S. and Nagle S. (1980) Multispectral imaging of the lunar regolith core samples: Preliminary results for 74002. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1593-1608.

Pieters C.M., Meloy A., Nagle S. and Hawke B.R. (1981) Core segment 15008: Regolith stratigraphy at Apennine Front Station 2 using multispectral imaging. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 451-461.

Pieters C.M. and Taylor G.J. (1989) Millimeter petrology and kilometer mineral exploration of the Moon. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 115-125. Lunar Planetary Institute, Houston.

Pieters C.M., Pratt S.F. and Sunshine J.M. (1990) Petrology of the olivine mountains at Copernicus (abs). *Lunar Planet. Sci.* **XXI**, 962-963. Lunar Planetary Institute, Houston.

Pieters C.M., Fischer E.M., Rode O. and Basu A. (1993) Optical effects of space weathering: The role of the finest fraction. *J. Geophys. Res.* **98**, 20,817-20,824.

Pieters C.M., Taylor L.A., McKay D., Wentworth S., Morris R. and Keller L. (2000) Spectral characterization of lunar mare soil (abs#1865). *Lunar Planet. Sci.* **XXXI**, Lunar Planetary Institute, Houston.

Pieters C.M., Taylor L.A., Noble S.K., Keller L.P., Hapke B., Morris R.V., Allen C.C., McKay D.S. and Wentworth S. (2000) Space weathering on airless bodies: Resolving a mystery with lunar samples. *Meteorit. & Planet. Sci.* **35**, 1101-1107.

Pieters C.M., Head J.W., Gaddis L., Jollif B. and Duke M. (2001) Rock types of South Pole-Aitken basin and extent of basaltic volcanism. *J. Geophys. Res.* **106**, 28001-28022.

Pieters C.M., Stankevich D., Shkuratov Y. and Taylor L.A. (2002) Statistical analysis of the links among Lunar mare soil mineralogy, chemistry and reflectance spectra. *Icarus* **155**, 285-298.

Pieters C.M. and Taylor L.A. (2003) Systematic global mixing and melting in lunar soil evolution. *Geophys. Res. Lett.* **30**, doi:10.1029/2003GL019212

Pieters C.M., Shkuratov Y., Kaydash V., Stankevich D. and Taylor L.A. (2006) Lunar soil characterization consortium analyses: Pyroxene and maturity estimates derived from Clementine image data. *Icarus* **184**, 83-101.

Pillinger C.T., Eglinton G., Gowar A.P., Jull A.J.T. and Maxwell J.R. (1977) The exposure history of the Apollo 16 site: An assessment based on methane and hydrolysable carbon. In **Soviet-American Conf. on Cosmochemistry of the Moon and Planets**, 541-551. NASA-SP370.

- Pillinger C.T., Batts B.D., Eglinton G., Gowar A.P., Jull A.J.T. and Maxwell J.R. (1973) Foramtion of lunar carbide from lunar iron silicates. *Nature Phys. Sci.* **245**, 3-5.
- Pillinger C.T. and seven (1974) The association between carbide and finely divided metallic iron in lunar fines. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1949-1961.
- Pillinger C.T., Gardiner L.R., Jull A.J.T., Woodcock M.R. and Stephenson A. (1978) Magnetic properties and carbon chemistry studies pertinent to the evolution of the regolith at the Luna 24 site. *In Mare Crisium: The view from Luna 24*. *Geochem. Cosmochim. Acta suppl.* 9, 217-228. (ed. Merrill) Pergamon Press.
- Pillinger C.T. and Eglinton G. (1977) The chemistry of carbon in the lunar regolith. *Phil. Trans. Roy. Soc. London* **A285**, 369-378.
- Pinson W.H. and Hurley P.M. (1971) Rb-Sr ages on density and size fractions of Apollo 11 fine soil sample 10084. *Earth Planet. Sci. Lett.* **13**, 130-133.
- Plieninger T. and Schaeffer O.A. (1976) Laser probe Ar ages in individual mineral grains in lunar baslt 15607 and lunar breccias 15465. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2055-2066.
- Podosek F.A., Huneke J.C., Burnett D.S. and Wasserburg G.J. (1971) Isotopic composition of xenon and krypton in the lunar soil and in the solar wind. *Earth Planet. Sci. Lett.* **10**, 199-216.
- Podosek F.A., Huneke J.C. and Wasserburg G.J. (1972) Gas retention and cosmic ray exposure ages of lunar rock 15555. *Science* **175**, 423-425.
- Podosek F.A. and Huneke J.C. (1973) Argon in Apollo 15 green glass spherules (15426): <sup>40</sup>Ar-<sup>39</sup>Ar age and trapped argon. *Earth Planet. Sci. Lett.* **19**, 413-421.
- Podosek F.A., Huneke J.C., Gancarz A.J. and Wasserburg G. Jos. (1973) The age and petrology of two Luna 20 fragments and inferences for widespread lunar metamorphism. *Geochim. Cosmochim. Acta* **37**, 887-904.
- Podosek F.A. and Walker R.M. (1976) Rare gas and fission track analysis. *In Imbrium Consortium* (see Wood and 27 others).
- Poitrasson F., Halliday A.N., Lee D-C., Levasseur Sylvain, Teutsch N. (2004) Iron isotope differences between the Earth, Moon, Mars and Vesta as possible records of conrtsted accretion mechanisms. *Earth Planet. Sci. Lett.* **223**, 253-266.
- Ponnamperuma C. (1972) Lunar organic analysis: Implications for chemical evolution. *Space Life Sci.* **3**, 493-496.
- Poupeau G., Pellas P., Lorin J.C., Chetrit G.C. and Berdot J.L. (1972) Track analysis of rocks 15058, 15555, 15641 and 14307. *In The Apollo 15 Lunar Samples*. 385-387. Lunar Planetary Institute, Houston.
- Poupeau G., Walker R.M., Zinner E. and Morrison D.A. (1975) Surface exposure history of individual crystals in the lunar regolith. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3433-3448.
- Poupeau G., Michel-Levy M.C., Mandeville J.C., Johnson J. and Romary Ph. (1978) Microcrater and solar flare tracks maturation of the lunar regolith. *In Mare Crisium: The view from Luna 24*. *Geochem. Cosmochim. Acta suppl.* 9, 137-156. (ed. Merrill) Pergamon Press.

Powell B.N. (1972) Apollo 15 Coarse Fines (4-10mm): Sample classification, description and inventory. MSC 03228 Curator's Office JSC

Powell B.N. and Weiblen P.W. (1972) Petrology and origin of lithic fragments in the Apollo 14 regolith. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 837-852.

Powell B.N., Aitken F.K. and Weiblen P.W. (1973) Classification, distribution and origin of lithic fragments from the Hadley-Apennine region. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 445-460.

Powell B.N., Duncan M.A. and Weiblen P.W. (1974) Apollo 16 feldspathic melt rocks: Clues to the magmatic history of the lunar crust. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 445-460.

Pratt D.D., Moore C.B. and Parsons M.L. (1978) Apollo 17 Mare basalt regression and classification studies. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 487-494.

Premo W.R. (1991) Rb-Sr and Sm-Nd ages for lunar norite 78235/78236: Implications on the U-Pb isotopic systematics in this high-Mg rock (abs). *Lunar Planet. Sci. XXII*, 1089-1090. Lunar Planetary Institute, Houston.

Premo W.R. (1993) U-Pb isotopic ages and characteristics of ancient (>4.0 Ga) lunar highland rocks (abs). *Lunar Planet. Sci. XXIV*, 1169-1170. Lunar Planetary Institute, Houston.

Premo W.R. and Tatsumoto M. (1989) Pb isotopes in anorthosite breccias 67075, revisited: Evidence of a mare basalt-age component (abs). *Lunar Planet. Sci. XX*, 866-867. Lunar Planetary Institute, Houston.

Premo W.R., Tatsumoto M. and Wang J-W. (1988) Pb isotopes in anorthositic breccias 67075 and 62237: A search for primitive lunar lead (abs). *Lunar Planet. Sci. XIX*, 945-946. Lunar Planetary Institute, Houston.

Premo W.R. and Tatsumoto M. (1990) Pb isotopes in norite 78235 (abs). *Lunar Planet. Sci. XXI*, 977-978. Lunar Planetary Institute, Houston.

Premo W.R. and Tatsumoto M. (1991a) Pb isotopes in troctolite 76535 (abs). *Lunar Planet. Sci. XXII*, 1093-1094. Lunar Planetary Institute, Houston.

Premo W.R. and Tatsumoto M. (1991b) U-Th-Pb isotopic systematics of lunar norite 78235. *Proc. 21<sup>st</sup> Lunar Planet. Sci. Conf.* 89-100. Lunar Planetary Institute, Houston.

Premo W.R. and Tatsumoto M. (1992a) U-Th-Pb, Rb-Sr, and Sm-Nd isotopic systematics of lunar troctolite cumulate 76535: Implications on the age and origin of this early lunar, deep-seated cumulate. *Proc. 22<sup>nd</sup> Lunar Planet. Sci. Conf.* 381-397. Lunar Planetary Institute, Houston.

Premo W.R. and Tatsumoto M. (1992b) Acid leaching of apatite: Implications for U-Th-Pb systematics of lunar highland plutonic rocks (abs). *Lunar Planet. Sci. XXIII*, 1101-1102. Lunar Planetary Institute, Houston.

Premo W.R. and Tatsumoto M. (1992c) U-Pb isotopes in dunite 72415 (abs). *Lunar Planet. Sci. XXIII*, 1103-1104. Lunar Planetary Institute, Houston.

Premo W.R. and Tatsumoto M. (1993a) Isotopic ages and characteristics of ancient (pre-Serenitatis) crustal rocks at Apollo 17. *In Workshop on Geology of the Apollo 17 Landing Site*. LPI Tech. Rpt. 92-09. 45-48. Lunar Planetary Institute, Houston.

Premo W.R. and Tatsumoto M. (1993b) U-Pb isotopic systematics of ferroan anorthosite 60025 (abs). *Lunar Planet. Sci. XXIV*, 1173-1174. Lunar Planetary Institute, Houston.

- Premo W.R., Tatsumoto M., Misawa K., Nakamura N. and Kita N.I. (1999) Pb-isotopic systematics of lunar highland rocks (>3.9 b.y.): Constraints on early lunar evolution. In **Taylor Volume 207-240**. GSA Bellweather Press (Snyder et al. eds.)
- Premo W.R. and Tatsumoto M. (2000) Contrasting U-Th-Pb, Rb-Sr and Sm-Nd isotopic systematics of lunar ferroan anorthosite 60025 and 62237. Implications on the age and origin of the moon. unpublished?
- Prettyman T.H. et al. (2006) Elemental composition of the lunar surface: Analysis of gamma ray spectroscopy data from Lunar Prospector. *J. Geophys. Res.* **111**, E12007
- Price P.B. and O'Sullivan D. (1970) Lunar erosion rate and solar flare paleontology. *Proc. Apollo 11 Lunar Sci. Conf.* 2351-2359.
- Price P.B., Hutcheon I.D., Cowsik R. and Barber D.J. (1971) Enhanced emission of Fe nuclei in solar flares. *Phys. Rev. Lett.* **26**, 916-919.
- Price P.B., Chan J.H., Hutcheon I.D., MacDougall D., Rajan R.S., Shirk E. and Sullivan J.D. (1973) Low energy heavy ions in the solar system. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2347-2362.
- Prinz M., Bunch T.E. and Keil K. (1971) Composition and origin of lithic fragments and glasses in Apollo 11 samples. *Cont. Mineral. Petrol.* **32**, 211-230.
- Prinz M., Dowty E., Keil K. and Bunch T.E. (1973a) Spinel troctolite and anorthosite in Apollo 16 samples. *Science* **179**, 74-76.
- Prinz M., Dowty E. and Keil K. (1973b) A model for the formation of orange and green glass and the filling of mare basins. *EOS Trans. AGU* **54**, 605.
- Prinz M., Dowty E., Keil K. and Bunch T.E. (1973c) Mineralogy, petrology and chemistry of lithic fragments from Luna 20 fines: Origin of the cumulate ANT suite and its relationship to high-alumina basalts. *Geochim. Cosmochim. Acta* **37**, 979-1006.
- Prinz M. and Keil K. (1977) Mineralogy, petrology and chemistry of ANT-suite rocks from the lunar highlands. *Phys. Chem. Earth* **10**, 215-237.
- Provost A. and Bottinga Y. (1972) Rates of solidification of Apollo 11 Basalt. *Earth Planet. Sci. Lett.* **15**, 325-337.
- Puchtel I.S., Walker R.J. and James O.B. (2005)  $^{187}\text{Os}/^{188}\text{Os}$  and highly siderophile element systematic of Apollo 17 aphanitic melt rocks (abs#1707). *Lunar Planet. Sci.* **XXXVI**, Lunar Planetary Institute, Houston.
- Puchtel I.S., Walker R.J. and James O.B. (2006) Further study of  $^{187}\text{Os}/^{188}\text{Os}$  and high siderophile element systematic of Apollo 14 & 17 impact melt rocks (abs#1428). *Lunar Planet. Sci.* **XXXVII**, Lunar Planetary Institute, Houston.
- Puchtel I.S., Walker R.J., Kring D.A. and James O.B. (2007) Further study of  $^{187}\text{Os}/^{188}\text{Os}$  and highly siderophile element systematics of lunar impact melt rocks (abs#2040). *Lunar Planet. Sci.* **XXXVIII**, Lunar Planetary Institute, Houston.
- Puchtel I.S., Walker R.J., James O.B. and Kring D.A. (2008) Osmium isotope and highly siderophile element systematics of lunar impact melt breccias: Implications for the late accretion history of the Moon and Earth. *Geochim. Cosmochim. Acta* **72**, 3022-3042.
- Quick J.E., Albee A.L., Ma M.-S., Murali A.V. and Schmitt R.A. (1977) Chemical compositions and possible immiscibility of two silicate melts in 12013. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2153-2189.

- Quick J.E., Brock B.S. and Albee A.L. (1978) Petrology of Apollo 16 breccia 66075. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 921-939.
- Quick J.E., James O.B. and Albee A.L. (1981a) Petrology and petrogenesis of lunar breccias 12013. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 117-172.
- Quick J.E., James O.B. and Albee A.L. (1981b) A reexamination of the Rb-Sr isotopic systematic of lunar breccias 12013. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 173-184.
- Quaide W. and Bunch Ted (1970) Impact metamorphism of lunar surface materials. *Proc. Apollo 11 Lunar Sci. Conf.* 711-729.
- Quaide W., Overbeck V.R., Bunch T. and Polkowski G. (1971) Investigations of the natural history of the regolith at the Apollo 12 site. *Proc. Second Lunar. Sci. Conf.* 701-718.
- Quaide W. and Wrigley R. (1972) Mineralogy and origin of Fra Mauro fines and breccias. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 771-784.
- Quaide W. and Overbeck V.R. (1975) Development of the mare regolith: some model considerations. *The Moon* **13**, 27-55.
- Radcliffe S.V., Heuer A.H., Fisher R.M., Christie J.M. and Griggs D.T. (1970) High voltage (800 kV) electron petrography of type B rock from Apollo 11. *Proc. Apollo 11 Lunar Sci. Conf.* 731-748.
- Radcliffe S.V., Christie J.M., Nord G.L., Lally J.S., Heuer A.H., Griggs D.T. and Fisher R.M. (1974) Electron petrographic evidence concerning the origin and lithification of the lunar breccias (abs). *Lunar Sci.* **V**, 613-615. Lunar Planetary Institute, Houston.
- Rajan R.S., Brownlee D.E. and Horz F. (1974) The ancient meteorite flux (abs). *Lunar Sci.* **V**, 616-617.
- Ramdohr P. (1972) Lunar pentlandite and sulfidization reactions in microbreccia 14315,9. *Earth Planet. Sci. Lett.* **15**, 113-115.
- Rancitelli L.A., Perkins R.W., Felix W.D. and Wogman N.A. (1971) Erosion and mixing of the lunar surface from cosmogenic and primordial radionuclide measurement in Apollo 12 lunar samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1757-1772.
- Rancitelli L.A., Perkins R.W., Felix W.D. and Wogman N.A. (1972) Lunar surface processes and cosmic ray characterization from Apollo 12-15 lunar samples analyses. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1681-1691.
- Rancitelli L.A., Perkins R.W., Felix W.D. and Wogman N.A. (1973) Lunar surface and solar process analyses from cosmogenic radionuclide measurements at the Apollo 16 site (abs). *Lunar Sci.* **IV**, 609-612. Lunar Planetary Institute, Houston.
- Rancitelli L.A., Perkins R.W., Felix W.D. and Wogman N.A. (1973a) Preliminary analysis of cosmogenic and primordial radionuclides in Apollo 17 samples (abs). *Lunar Sci.* **IV**, 612-614. Lunar Planetary Institute, Houston.
- Rancitelli L.A., Perkins R.W., Felix W.D. and Wogman N.A. (1973b) Primordial radiouclides in soils and rocks from the Apollo 16 site(abs). *Lunar Sci.* **IV**, 615-617. Lunar Planetary Institute, Houston.
- Rancitelli L.A., Perkins R.W., Felix W.D. and Wogman N.A. (1974a) Solar flare and lunar surface process characterization at the Apollo 17 site. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2185-2203.

- Rancitelli L.A., Perkins R.W., Felix W.D. and Wogman N.A. (1974b) Anisotropy of the August 4-7, 1972 solar flares at the Apollo 17 site (abs). *Lunar Sci.* V, 618-620. Lunar Planetary Institute, Houston.
- Rankenburg K., Brandon A.D. and Neal C.R. (2006) Neodymium isotope evidence for a chondritic composition of the Moon. *Science* **312**, 1369-1372.
- Rao M.N. and Venkatesan T.R. (1980) Solar-flare produced  $^3\text{He}$  in lunar samples. *Nature* **286**, 788-790.
- Rao M.N., Garrison D.H., Bogard D.D. and Reedy R.C. (1993) Solar-flare-implanted  $^4\text{He}/^3\text{He}$  and solar-proton-produced Ne and Ar concentration profiles preserved in lunar rock 61016. *J. Geophys. Res.* **98**, 7827-7835.
- Rao M.N., Garrison D.H., Bogard D.D. and Reedy R.C. (1994) Determination of the flux and energy distribution of energetic solar protons in the past 2 Myr using lunar rocks 68815. *Geochim. Cosmochim. Acta* **58**, 4231-4245.
- Rapp J.F. and Draper D.S. (2012) Experimental fractional crystallization of the lunar magma ocean (abs#2048). 43<sup>rd</sup> *Lunar Planet. Sci. Conf.* @ The Woodlands
- Rasmussen B., Fletcher I.R. and Janet R. Muhling (2008) Pb/Pb geochronology, petrography and chemistry of Zr-rich accessory minerals (zirconolite, tranquillityite and baddeleyite) in mare basalt 10047. *Geochim. Cosmochim. Acta* **72**, 5799-5818.
- Reed S.J.B. and Taylor S.R. (1974) Meteoritical metal in Apollo 16 samples. *Meteoritics* **9**, 23-24.
- Reed G.W. and Jovanovic S. (1970) Halogens, mercury, lithium and osmium in Apollo 11 samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1487-1492.
- Reed G.W. and Jovanovic S. (1971) The halogens and other trace elements in Apollo 12 samples and the implications of halides, platinum metals, and mercury on surfaces. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1261-1276.
- Reed G.W., Jovanovic S. and Fuchs L.H. (1971) Fluorine and other trace elements in lunar plagioclase concentrates. *Earth Planet. Sci. Lett.* **11**, 354-358.
- Reed G.W. and Jovanovic S. (1972) Trace element comparisons between mare and Apennine-Front nonmare samples. In **The Apollo 15 Lunar Samples** (Chamberlain J.W. and Watkins C., eds.), 247-249. Lunar Science Institute, Houston.
- Reed G.W. and Jovanovic S. (1973) Lunar bulk sample trace element contents and KREEP. *The Moon* **8**, 176-181.
- Reed G.W. and Jovanovic S. (1973) The halogens in Luna 16 and Luna 20 soil. *Geochim. Cosmochim. Acta* **37**, 1007-1010.
- Reed G.W., Jovanovic S. and Fuchs L. (1973) Trace element relations between Apollo 14 and 15 and other lunar samples, and the implications of a moon-wide Cl-KREE coherence and Pt-metal coherence. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1989-2001.
- Reed G.W., Allen R.O. and Jovanovic S. (1977) Volatile metal deposits on lunar soils - relation to volcanism. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3917-3930.
- Reed V.S. and Wolfe E.W. (1975) Origin of the Taurus-Littrow massifs. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2443-2461.
- Reedy R.C. and Arnold J.R. (1972) Interaction of solar and galactic cosmic ray particles with the moon. *J. Geophys. Res.* **77**, 537-555.

- Reedy R.C. (1977) Solar flare fluxes since 1956. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 825-839.
- Reedy R.C. (1980) Lunar radionuclide records of average solar-cosmic-ray fluxes over the last ten million years. In **Proc. Conf. Ancient Sun**, *Geochim Cosmochim. Acta Suppl.* 13 (eds, Pepin et al. ) Lunar Planet. Institute, Houston.
- Reedy R.C. (1987) Nuclide production by primary cosmic-ray protons. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* E697-E702. *J. Geophys. Res.*
- Reedy R.C. and Arnold J.R. (1977) Interaction of solar and galactic cosmic-ray particles with the Moon. *J. Geophys. Res.* **77**, 537-555.
- Rees C.E. and Thode H.G. (1972) Sulphur concentrations and isotope ratios in lunar samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1479-1485.
- Rees C.E. and Thode H.G. (1974a) Sulfur concentrations and isotope ratios in Apollo 16 and 17 samples. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1963-1973.
- Rees C.E. and Thode H.G. (1974b) Sulfur concentrations and isotope ratios in Apollo 16 and 17 samples (abs). *Lunar Sci.* **V**, 621-623. Lunar Planetary Institute, Houston.
- Regnier S., Hohenberg C.M., Marti K. and Reedy R.C. (1979) Predicted vrs. observed cosmic-ray-produced noble gases in lunar samples: Improved Kr production ratios. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1565-1586.
- Reid A.M. (1974) Rock types present in lunar highland soils. *The Moon* **9**, 141-146.
- Reid A.M., Frazer J.Z., Fujita H. and Everson J.E. (1970a) Apollo 11 samples: Major mineral chemistry. *Proc. Apollo 11 Lunar Sci. Conf.* 749-761.
- Reid A.M., Frazer J.Z., Fujita H. and Everson J.E. (1970b) Chemical composition of the major phases in Apollo 11 lunar samples. SIO ref. 70-4 Univ. Calif. San Diego
- Reid A.M., Meyer C., Harmon R.S. and Brett R. (1970c) Metal grains in Apollo 12 igneous rocks. *Earth Planet. Sci. Lett.* **9**, 1-5.
- Reid A.M., Ridley W.I., Jakes P. and Warner J.L. (1971) Microprobe analyses of glasses from Apollo 14 sample 14156. NASA TMX 58081 JSC, Houston.
- Reid A.M., Warner J., Ridley W.I., Johnston D.A., Harman R.S., Jakes P. and Brown R.W. (1972a) The major element compositions of lunar rocks inferred from glass compositions in lunar soils. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 363-379.
- Reid A.M., Warner J., Ridley W.I. and Brown R.W. (1972b) Major element composition of glasses in three Apollo 15 soils. *Meteoritics* **7**, 395-415.
- Reid A.M., Ridley W.I., Harman R.S., Warner J., Brett R., Jakes P. and Brown R.W. (1972c) Highly aluminous glasses in lunar soils and the nature of the lunar highlands. *Geochim. Cosmochim. Acta* **36**, 903-912.
- Reid A.M., Ridley W.I., Harman R.S. and Jakes P. (1973a) Major element chemistry of glasses in Apollo soil 14156. *Geochim. Cosmochim. Acta* **37**, 695-699.
- Reid A.M., Warner J., Ridley W.I. and Brown R.W. (1973b) Luna 20 soil: Abundances and composition of phases in the 45-125 micron fraction. *Geochim. Cosmochim. Acta* **37**, 1011-1030.



- Reid A.M., Lofgren G.E., Heiken G.H., Brown R.W. and Moreland G. (1973c) Apollo 17 orange glass, Apollo 15 green glass and Hawaiian lava fountain glass. *EOS Trans. AGU* **54**, 606-607.
- Reid A.M., Ridley W.I., Donaldson C. and Brown R.W. (1973d) Glass compositions in the orange and gray soils from Shorty Crater, Apollo 17. *EOS Trans. AGU* **54**, 607-608.
- Reid A.M. and Jakes P. (1974) Luna 16 revisited: The case for aluminous mare basalts (abs). *Lunar Sci.* **V**, 627-629. Lunar Planetary Institute, Houston.
- Reid A.M., Duncan A.R. and Richardson S.H. (1977) In search of LKFM. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2321-2338.
- Reid J.B. (1971) Apollo 12 spinels as petrogenetic indicators. *Earth Planet. Sci. Lett.* **10**, 351-356.
- Reid J.B. (1972) Olivine-rich, true spinel-bearing anorthosites from Apollo 15 and Luna 20 soils – possible fragments of the earliest formed lunar crust. In **The Apollo 15 Lunar Samples**, 154-156.
- Reid J.B., Taylor G.J., Marvin U.B. and Wood J.A. (1972) Luna 16: Relative proportions and petrologic significance of particles in the soil from Mare Fecunditatis. *Earth Planet. Sci. Lett.* **13**, 286-298.
- Reid M.J., Gancarz A.J. and Albee A.L. (1973) Constrained least-squares analysis of petrologic problems with application to lunar sample 12040. *Earth Planet. Sci. Lett.* **17**, 433-445.
- Reimold W.U. and Borchardt R. (1984) Subophitic lithologies in KREEP-rich poikilitic impact melt rocks from Cayley Plains, Apollo 16 – remnants of a volcanic Highland crust? *Earth Planet. Sci. Lett.* **67**, 9-18.
- Reimold W.U. and Reimold J.N. (1984) The mineralogical, chemical and chronological characteristics of the crystalline Apollo 16 impact melt rocks. *Forsch. Mineral.* **62**, 269-301.
- Reimold W.U., Nyquist L.E., Bansal B.M., Wooden J.L., Shih C.-Y., Wiesmann H. and Mackinnon I.D.R. (1985) Isotope analysis of crystalline impact-melt rocks from Apollo 16 stations 11 and 13. North Ray Crater. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **90**, C431-C448.
- Reynolds J.H., Alexander E.C., Davis P.K. and Srinivasan B. (1974) Studies of K-Ar dating and xenon extinct radionuclides in breccia 14318: implications for early lunar history. *Geochim. Cosmochim. Acta* **38**, 401-417.
- Rho J.H., Bauman A.J., Cohen E.A., Yen T.F. and Bonner J. (1972) Analyses of the returned lunar surface fines for porphyryns. *Space Life Sci.* **3**, 415-418.
- Rhodes J.M. (1973) Major and trace element analyses of Apollo 17 samples (abs). *EOS Trans. AGU* **54**, 609-610. AGU.
- Rhodes J.M. (1977) Some compositional aspects of lunar regolith evolution. *Phil. Trans. Roy. Soc. London* **A285**, 293-303.
- Rhodes J.M. and Hubbard N.J. (1973) Chemistry, classification, and petrogenesis of Apollo 15 mare basalts. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1127-1148.
- Rhodes J.M. and Blanchard D.P. (1980) Chemistry of Apollo 11 low-K mare basalts. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 49-66.
- Rhodes J.M. and Blanchard D.P. (1981) Apollo 11 breccias and soils: Aluminous mare basalts or multi-component mixtures? *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 607-620.

Rhodes J.M. and Blanchard D.P. (1983) New analyses of mare basalts (abs). *Lunar Planet. Sci.* **XIV**, 640-641. Lunar Planetary Institute, Houston.

Rhodes J.M. and Rodgers K.V. (1975) Major element chemistry, classification and fractionation of Apollo 17 mare basalts. In Papers presented to the **Conference on Origins of Mare Basalts** and their Implications for Lunar Evolution (Lunar Science Institute, Houston), 140-143.

Rhodes J.M., Rodgers K.V., Shih C., Bansal B.M., Nyquist L.E., Wiesmann H. and Hubbard N.J. (1974a) The relationships between geology and soil chemistry at the Apollo 17 landing site. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1097-1117.

Rhodes J.M., Rodgers K.V., Shih C., Bansal B.M., Nyquist L.E. Wiesmann H. (1974b) The relationship between geology and soil chemistry at the Apollo 17 landing site (abs). *Lunar Sci.* **V**, 630-632. Lunar Planetary Institute, Houston.

Rhodes J.M., Adams J.B., Blanchard D.P., Charette M.P., Rodgers K.V., Jacobs J.W., Brannon J.C. and Haskin L.A. (1975) Chemistry of agglutinate fractions in lunar soils. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2291-2308.

Rhodes J.M., Hubbard N.J., Wiesmann H., Rodgers K.V., Brannon J.C. and Bansal B.M. (1976a) Chemistry, classification, and petrogenesis of Apollo 17 mare basalts. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1467-1489.

Rhodes J.M., Hubbard N.J., Wiesmann H., Rodgers K.V. and Bansal B.M. (1976b) Chemistry, classification and petrogenesis of Apollo 17 mare basalts (abs). *Lunar Sci.* **VII**, 730-732. Lunar Planetary Institute, Houston.

Rhodes J.M., Blanchard D.P., Adams J.B., Charette M.B., Brannon J.C. and Rodgers K.V. (1976c) The Chemistry of agglutinate fractions in lunar soils (abs). *Lunar Sci.* **VII**, 733-734. Lunar Planetary Institute, Houston.

Rhodes J.M., Blanchard D.P., Dungan M.A., Brannon J.C. and Rodgers K.V. (1977) Chemistry of Apollo 12 mare basalts: Magma types and fractionation processes. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1305-1338.

Richter D., Simmons G. and Siegfried R. (1976a) Microcracks, micropores, and their petrologic interpretation for 72415 and 15418. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1901-1923.

Richter D., Siegfried R. and Simmons G. (1976b) Unusual cracks and pores in breccia 15418 and lunar dunite 72415 (abs). *Lunar Sci.* **VII**, 736-738. Lunar Planetary Institute, Houston.

Ridley W.I. (1973) Petrogenesis of basalt 70035: A multi-stage cooling history (abs). *EOS Trans. AGU* **54**, 611-612. Am. Geophys. Union.

Ridley W.I. (1975a) Petrology of Apollo 15 breccia 15459 (abs). *Lunar Sci.* **VI**, 671-673. Lunar Planetary Institute, Houston.

Ridley W.I. (1975b) On high-alumina mare basalts. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 131-145.

Ridley W.I. (1977) Some petrologic aspects of Imbrium stratigraphy. *Philos. Trans. R. Soc. London* **A285**, 105-114.

Ridley W.I., Reid A.M., Warner J.L. and Brown R.W. (1973a) Apollo 15 green glasses. *Phys. Earth Planet. Interiors* **7**, 133-136.

Ridley W.I., Hubbard N.J., Rhodes J.M., Wiesmann H. and Bansal B. (1973b) The petrology of lunar breccia 15445 and petrogenetic implications. *J. Geol.* **81**, 621-631.

- Ridley W.I., Reid A.M., Warner J.L., Brown R.W., Gooley R. and Donaldson C. (1973c) Glass compositions in Apollo 16 soils 60501 and 61221. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 309-321.
- Ridley W.I. and Adams M.-L. (1976) Petrologic studies of poikiloblastic textured rocks (abs). *Lunar Sci. VII*, 739-740. Lunar Science Institute, Houston.
- Righter K. and Shearer C.K. (2003) Magmatic fractionation of Hf and W: Constraints on the timing of core formation and differentiation in the moon and Mars. *Geochim. Cosmochim. Acta* **67**, 2497-2507.
- Ringwood A.E. (1970) Petrogenesis of Apollo 11 basalts and implications for a lunar origin. *J. Geophys. Res.* **75**, 6453-6479.
- Ringwood A.E. (1975) Some aspects of the minor element chemistry of lunar mare basalts. *The Moon* **12**, 127-157.
- Ringwood A.E. (1977a) Basaltic magmatism and the bulk composition of the moon. *The Moon* **16**, 389-423.
- Ringwood A.E. (1977b) Mare basalt petrogenesis and the composition of the lunar interior. *Phil. Trans. Roy. Soc. London* **A285**, 577-586.
- Ringwood A.E. (1989) Flaws in the giant impact hypothesis of lunar origin. *Earth Planet. Sci. Lett.* **95**, 208-214.
- Ringwood A.E. (1992) Volatile and siderophile element geochemistry of the moon. *Earth Planet. Sci. Lett.* **111**, 537-555.
- Ringwood A.E. and Essene E. (1970) Petrogenesis of Apollo 11 basalts, internal constitution and origin of the moon. *Proc. Apollo 11 Lunar Sci. Conf.* 769-799.
- Ringwood A.E. and Green D.H. (1972) Crystallization of plagioclase in lunar basalts and its significance. *Earth Planet. Sci. Lett.* **14**, 14-18.
- Ringwood A.E. and Kesson S.E. (1977a) A dynamic model for mare basalt petrogenesis. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1697-1722.
- Ringwood A.E. and Kesson S.E. (1977b) Basaltic magmatism and the bulk composition of the Moon: II Siderophile and volatile elements in Moon, Earth and Chondrites: Implications for lunar origin. *The Moon* **16**, 425-464.
- Ringwood A.E., Seifert S. and Wänke H. (1987) A komatiite composition in Apollo 16 highlands breccias; implications for the nickel-cobalt systematics and bulk composition of the Moon. *Earth Planet. Sci. Lett.* **81**, 105-117.
- Ringwood A.E. and Wänke H. (1990) Cobalt and nickel concentration in the "komatiite" component of Apollo 16 polymict samples – reply to R.L. Korotev. *Earth Planet. Sci. Lett.* **96**, 490-498.
- Robens E., Bischoff A., Schreiber A., Dabrowski A. and Unger K.K. (2007) Investigations of surface properties of Lunar regolith – Part I. *Applied Surface Science* **235**, 5709-5714.
- Robens E., Bischoff A., Schreiber A. and Unger K.K. (2008) Investigation of surface properties of Lunar Regolith – Part II. *J. of Thermal Analysis & Calorimetry* **94**, 627-631.
- Robinson K.L. and Taylor G.J. (2011) Intrusive and extrusive lunar felsites (abs#1257). *42<sup>nd</sup> Lunar Planet Sci. Conf.* @ The Woodlands.

- Robie R.A. and Hemingway B.S. (1971) Specific heats of the lunar breccia 10021. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 2361-2366.
- Rochette P., Gattacceca J., Ivanov A.V., Nazarov M.A. and Bezaeva N.S. (2010) Magnetic properties of lunar materials: Meteorites, Luna and Apollo returned samples. *Earth Planet. Sci. Lett.* **292**, 383-391.
- Roedder E. (1979a) Melt inclusions in 75075 and 78505 - the problem of anomalous low-K inclusions in ilmenite revisited. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 249-257.
- Roedder E. (1979b) Melt inclusions in 75075 - the problem of anomalous low-K inclusions in ilmenite revisited (abs). *Lunar Planet. Sci.* **X**, 1033-1035. Lunar Planetary Institute, Houston.
- Roedder E. and Weiblen P.W. (1970) Lunar petrology of silicate melt inclusions, Apollo 11 rocks. *Proc. Apollo 11 Lunar Sample Conf.* 801-837.
- Roedder E. and Weiblen P.W. (1971) Petrology of silicate melt inclusions, Apollo 11 and Apollo 12 and terrestrial equivalents. *Proc. Second Lunar Sci. Conf.* 507-528.
- Roedder E. and Weiblen P.W. (1972a) Petrographic features and petrologic significance of melt inclusions in Apollo 14 and 15 rocks. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 251-279.
- Roedder E. and Weiblen P.W. (1972b) Occurrence of chromian, hercynitic spinel (Pleonaste) in Apollo 14 samples and its petrologic significance. *Earth Planet. Sci. Lett.* **15**, 376-379.
- Roedder E. and Weiblen P.W. (1972c) Silicate melt inclusions and glasses in lunar soil fragments from the Luna 16 core samples. *Earth Planet. Sci. Lett.* **13**, 272-285.
- Roedder E. and Weiblen P.W. (1973a) Origin of orange glass spherules in Apollo 17 sample 74220. *EOS Trans. AGU* **54**, 612-613.
- Roedder E. and Weiblen P.W. (1973b) Apollo 17 "orange glass" and meteoritic impact on liquid lava. *Nature* **244**, 210-212.
- Roedder and Weiblen P.W. (1973c) Petrology of some lithic fragments from Luna 20. *Geochim. Cosmochim. Acta* **37**, 1031-1052.
- Roedder E. and Weiblen P.W. (1974) Petrology of clasts in lunar breccia 67915. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 303-318.
- Roedder E. and Weiblen P.W. (1975a) Anomalous low-K silicate melt inclusions in ilmenite from Apollo 17 basalts. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 147-164.
- Roedder E. and Weiblen P.W. (1975b) Anomalous low-K silicate melt inclusions in ilmenite from Apollo 17 basalts (abs). *Lunar Sci.* **VI**, 683-685. Lunar Planetary Institute, Houston.
- Roedder E. and Weiblen P.W. (1977a) Compositional variation in late-stage differentiates in mare lavas, as indicated by silicate melt inclusions. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1767-1783.
- Roedder E. and Weiblen P.W. (1977b) Shock glass veins in some lunar and meteoritic samples – Their nature and possible origin. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2593-2615.
- Roedder E. and Weiblen P.W. (1977c) High-silica glass inclusions in olivine of Luna 24 samples. *Geophys. Res. Lett.* **4**, 485-490.

- Roedder E. and Weiblen P.W. (1977d) Barred olivine “chondrules” in lunar spinel troctolite 62295. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2641-2654.
- Roedder E. and Weiblen P.W. (1978) Melt inclusions in Luna 24 soil fragments. *In Mare Crisium: The view from Luna 24*. *Geochem. Cosmochim. Acta* suppl. 9, 495-522. (ed. Merrill) Pergamon Press.
- Rose H.J., Cuttitta F., Dwornik E.J., Carron M.K., Christian R.P., Lindsay J.R., Ligon D.T. and Larson R.R. (1970a) Semimicro chemical and X-ray fluorescence analysis of lunar samples. *Science* **167**, 520-521.
- Rose H.J., Cuttitta F., Dwornik E.J., Carron M.K., Christian R.P., Lindsay J.R., Ligon D.T. and Larson R.R. (1970b) Semimicro X-ray fluorescence analysis of lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1493-1497.
- Rose H.J., Cuttitta F., Ansell C.S., Carron M.K., Christian R.P., Dwornik E.J., Greenland L.P. and Ligon D.T. (1972) Compositional data for twenty-one Fra Mauro lunar materials. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1215-1229.
- Rose H.J., Cuttitta F., Berman S., Carron M.K., Christian R.P., Dwornik E.J., Greenland L.P. and Ligon D.T. (1973) Compositional data for twenty-two Apollo 16 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1149-1158.
- Rose H.J., Cuttitta F., Berman S., Brown F.W., Carron M.K., Christian R.P., Dwornik E.J. and Greenland L.P. (1974a) Chemical composition of rocks and soils at Taurus-Littrow. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1119-1133.
- Rose H.J., Brown F.W., Carron M.K., Christian R.P., Cuttitta F., Dwornik E.J. and Ligon D.T. (1974b) Composition of some Apollo 17 samples (abs). *Lunar Sci.* **V**, 645-647. Lunar Science Institute, Houston.
- Rose H.J., Baedeker P.A., Berman S., Christian R.P., Dwornik E.J., Finkelman R.B. and Schnepfe M.M. (1975a) Chemical composition of rocks and soils returned by the Apollo 15, 16, and 17 missions. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1363-1373.
- Rose H.J., Christian R.P., Dwornik E.J. and Schnepfe M.M. (1975b) Major elemental analysis of some Apollo 15, 16, and 17 samples (abs). *Lunar Sci.* **VI**, 686-688. Lunar Planetary Institute, Houston.
- Rosholt J.N. and Tatsumoto M. (1970) Isotopic composition of uranium and thorium in Apollo 11 samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1499-1502.
- Rosholt J.N. and Tatsumoto M. (1971) Isotopic composition of thorium and uranium in Apollo 12 samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1577-1584.
- Ross M., Bence A.E., Dwornik E.J., Clark J.R. and Papike J.J. (1970) Mineralogy of the lunar clinopyroxenes, augite and pigeonite. *Proc. Apollo 11 Lunar Sample Conf.* 839-848.
- Ross M., Huebner J.S. and Dowty E. (1973) Delineation of the one atmosphere augite-pigeonite miscibility gap for pyroxenes from lunar basalt 12021. *Am. Mineral.* **58**, 619-635.
- Runcorn S.K., Collinson D.W., O'Reilly W., Batty M.H., Stephenson A., Jones J.M., Manson A.J. and Readman P.W. (1970) Magnetic properties of Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 2369-2387.
- Runcorn S.K., Collinson D.W., O'Reilly W., Stephenson A., Batty M.H., Manson A.J. and Readman P.W. (1971) Magnetic properties of Apollo 12 lunar samples. *Proc. Roy. Soc. London* **A325**, 157-174.
- Runcorn S.K., Collinson D.W., and Stephenson A. (1974) Magnetic properties of Apollo 16 and 17 rocks – interim report (abs). *Lunar Sci.* **V**, 653-654. Lunar Planetary Institute, Houston.

- Russell W.A., Papanastassiou D.A., Tombrello T.A. and Epstein S. (1977a) Ca isotope fractionation on the Moon. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3791-3805.
- Russell W.A., Papanastassiou D.A., Tombrello T.A. and Epstein S. (1977b) Search for Ca isotopic fractionation and correlation of Ca and O effects (abs). *Lunar Sci.* **VIII**, 823-825. Lunar Planetary Institute, Houston.
- Russ G.P. (1972) Neutron capture on Gd and Sm in the Luna 16, G-2 soil. *Earth Planet. Sci. Lett.* **13**, 384-386.
- Russ G.P. (1973) Apollo 16 neutron stratigraphy. *Earth Planet. Sci. Lett.* **17**, 275-289.
- Russ G.P., Burnett D.S., Lingenfelter R.E. and Wasserburg G.W. (1971) Neutron capture on Sm149 in lunar samples. *Earth Planet. Sci. Lett.* **13**, 53-57.
- Russ G.P., Burnett D.S. and Wasserburg G.W. (1972) Lunar neutron stratigraphy. *Earth Planet. Sci. Lett.* **15**, 172-186.
- Rutherford M.J. and Hess P.C. (1975) Origin of lunar granites as immiscible liquids (abs). *Lunar Sci.* **VI**, 696-698. Lunar Planetary Institute, Houston.
- Rutherford M.J., Hess P.C. and Daniel G.H. (1974a) Experimental liquid line of descent and liquid immiscibility for basalt 70017. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 569-583.
- Rutherford M.J., Hess P.C. and Daniel G.H. (1974b) Liquid lines of descent and liquid immiscibility in high Ti lunar basalt (abs). *Lunar Sci.* **V**, 657-659. Lunar Planetary Institute, Houston.
- Rutherford M.J. and Hess P.C. (1978) Immiscible silicate melts in 12013? (abs) *Lunar Planet. Sci.* **IX**, 987-989. Lunar Sci. Institute, Houston.
- Ruzicka A., Snyder G.A. and Taylor L.A. (1999) Giant impact and fission hypotheses for the origin of the Moon: A critical review of some geochemical evidence. *In Planetary Petrology and Geochemistry* 121-134. GSA
- Ruzicka A., Snyder G.A. and Taylor L.A. (2000) Crystal-bearing lunar spherules: Impact melting of the Moon's crust and implications for the origin of meteoritic chondrules. *Meteor. & Planet. Sci.* **35**, 173-192.
- Ruzicka A., Snyder G.A. and Taylor L.A. (2001) Comparative geochemistry of basalts from the Moon, Earth, HED asteroid and Mars: Implications for the origin of the Moon. *Geochim. Cosmochim. Acta* **65**, 979-997.
- Ryder G. (1976) Lunar sample 15405: Remnant of a KREEP basalt-granite differentiated pluton. *Earth Planet. Sci. Lett.* **29**, 255-268.
- Ryder G. (1982a) Apollo 17 ol-plag vitrophyres, 76035, and the Serenitatis melt sheet: Another brick in the wall (abs). *Lunar Planet. Sci.* **XIII**, 669-670. Lunar Planetary Institute, Houston.
- Ryder G. (1982b) Lunar anorthosite 60025, the petrogenesis of lunar anorthosites and the composition of the Moon. *Geochim. Cosmochim. Acta* **46**, 1591-1601.
- Ryder G. (1982c) Why lunar sample studies are not yet finished. *EOS Trans AGU* **63**, 785-787.
- Ryder G. (1983) Nickel in olivines and parent magmas of lunar pristine rocks. *In Workshop on Pristine Highlands Rocks and the Early History of the Moon* (Longhi and Ryder, eds.) LPI Tech Rept. 83-02. The Lunar and Planetary Institute, Houston, 66-68.

- Ryder G. (1984a) Most olivine in the lunar highlands is of shallow origin (abs). *Lunar Planet. Sci.* **XV**, 707-708. Lunar Planetary Institute, Houston.
- Ryder G. (1984b) Olivine in lunar dunite 72415, a rather shallow-origin cumulate (abs). *Lunar Planet. Sci.* **XV**, 709-710. Lunar Planetary Institute, Houston.
- Ryder G. (1985) Catalog of Apollo 15 Rocks (three volumes). Curatorial Branch Pub. # 72, JSC#20787
- Ryder G. (1986) Analysis of Apollo 15 green glasses: Groupings and their spatial relationships (abs). *Lunar Planet. Sci.* **XVII**, 738-739. Lunar Planetary Institute, Houston.
- Ryder G. (1987) Petrographic evidence for nonlinear cooling rates and a volcanic origin for Apollo 15 KREEP basalt. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **92**, E331-E339.
- Ryder G. (1988) Quenching and disruption of lunar KREEP lava flows by impacts. *Nature* **336**, 751-754.
- Ryder G. (1989) Mare basalts on the Apennine Front and the Mare stratigraphy of the Apollo 15 landing site. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 43-50. Lunar Planetary Institute, Houston.
- Ryder G. (1990a) Lunar samples, lunar accretion and the early bombardment of the moon. *EOS Trans. AGU* **71**, 313-323.
- Ryder G. (1990b) A distant variant of high-titanium mare basalt from the Van Serg Core, Apollo 17 landing site. *Meteoritics* **25**, 249-258.
- Ryder G. (1991) Lunar ferroan anorthosites and mare basalt sources: The mixed connection. *Geophys. Res. Lett.* **18**, 2065-2068.
- Ryder G. (1992a) Chemical variation and zoning of olivine in lunar dunite 72415: Near-surface accumulation. *Proc. 22<sup>nd</sup> Lunar Planet. Sci. Conf.* 373-380. Lunar Planetary Institute, Houston.
- Ryder G. (1992b) Lunar highlands totality from bits and pieces: A whole-rock-chemistry-free characterization of an evolved hypabyssal igneous gabbro schlieren from the Apollo 17 landing site (abs). *Lunar Planet. Sci.* **XXIII**, 1195-1196. Lunar Planetary Institute, Houston.
- Ryder G. (1992c) A distinct poikilitic impact melt rock from the Apollo 17 landing site that is not from the Serenitatis melt sheet (abs). *Meteoritics* **27**, 284.
- Ryder G. (1993a) The Apollo 17 samples: The massifs and landslide. *In Workshop on **Geology of the Apollo 17 Landing Site***. LPI Tech. Rpt. 92-09, 48-49. Lunar Planetary Institute, Houston.
- Ryder G. (1993b) Impact melt breccias at the Apollo 17 landing site. *In Workshop on **Geology of the Apollo 17 Landing Site***. LPI Tech. Rpt. 92-09, 49-50. Lunar Planetary Institute, Houston.
- Ryder G. (1993c) Catalog of Apollo 17 rocks: Stations 2 and 3. Vol. 1. Curators Office, JSC#26088.
- Ryder G. (1993d) Lunar highlands totality from bits and pieces: A whole-rock-geochemistry-free characterization of an evolved hypabyssal igneous gabbro schlieren from the Apollo 17 landing site (abs). *Lunar Planet. Sci.* **XXIII**, 1195-1196. Lunar Planetary Institute, Houston.
- Ryder G. (1994) Coincidence in time of the Imbrium basin impact and Apollo 15 KREEP volcanic flows: The case for impact-induced melting. *In **Large Meteorite Impacts***. GSA Special Paper 293. (eds. Dressler et al.) pp 11-18.
- Ryder G. (2000) Glass beads tell a tale of lunar bombardment. *Science* **287**, 1768-1769.

- Ryder G. (2002) Mass flux in the ancient Earth-moon system and benign implications for the origin of life on Earth. *J. Geophys. Res.* **107**, E4 (10.1029/2001JE001583)
- Ryder G. and 27 authors (1976) Interdisciplinary studies by the Imbrium Consortium: Samples 14064, 14082, 14312, 14318, 15405, 15445 and 15455. 2 vol. Harvard U. (pink and green literature)
- Ryder G., Stoesser D.B., Marvin U.B. and Bower J.F. (1975a) Lunar granites with unique ternary feldspars. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 435-449.
- Ryder G., Stoesser D.B., Marvin U.B., Bower J.F. and Wood J.A. (1975b) Boulder 1, Station 2, Apollo 17: Petrology and petrogenesis. *The Moon* **14**, 327-357.
- Ryder G. and Bower J.F. (1976) Poikilitic KREEP impact melts in the Apollo 14 white rocks. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1925-1948.
- Ryder G. and Taylor G.J. (1976) Did mare-type volcanism commence early in lunar history? *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1741-1755.
- Ryder G. and Bower J.F. (1977) Petrology of Apollo 15 black-and-white rocks 15445 and 15455: Fragments of the Imbrium impact melt sheet? *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1895-1923.
- Ryder G. and Wood J.A. (1977) Serenitatis and Imbrium impact melts: Implications for large-scale layering in the lunar crust. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 655-688.
- Ryder G., Stoesser D.B. and Wood J.A. (1977a) Apollo 17 KREEPy basalt: A rock type intermediate between mare and KREEP basalts. *Earth Planet. Sci. Lett.* **35**, 1-13.
- Ryder G., McSween H.Y. and Marvin U.B. (1977b) Basalts from Mare Crisium. *The Moon* **17**, 263-287.
- Ryder G., McSween H.Y. and Marvin U.B. (1977c) Luna 24 VLT basalt: Character and origin. *In Papers Presented to the Conference on Luna 24*, 160-163. Lunar Science Institute, Houston.
- Ryder G. and Marvin U.B. (1978) On the origin of Luna 24 basalts and soils. *In Mare Crisium: The view from Luna 24*. (ed. Merrill and Papike) Pergamon 339-355.
- Ryder G. and Norman M.D. (1979a) Catalog of pristine non-mare materials Part 1. Non-anorthosites, revised. NASA-JSC Curatorial Facility Publ. JSC 14565, Houston. 147 pp.
- Ryder G. and Norman M.D. (1979b) Catalog of pristine non-mare materials Part 2. Anorthosites. Revised. Curators Office JSC #14603
- Ryder G. and Norman M.D. (1980) Catalog of Apollo 16 rocks (3 vol.). Curator's Office pub. #52, JSC #16904
- Ryder G. and Spudis P. (1980) Volcanic rocks in the lunar highlands. *in Proc. Conf. Lunar Highlands Crust*, 353-375. Geo. Chem. Acta 12, Lunar Planetary Institute, Houston.
- Ryder G., Norman M.D. and Score R.A. (1980a) The distinction of pristine from meteorite-contaminated highlands rocks using metal compositions. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 471-479.
- Ryder G., Norman M.D. and Score R.A. (1980b) Ni, Co content of metal grains for the identification of indigenous rocks (abs). *Lunar Planet. Sci.* **XI**, 968-970. Lunar Planetary Institute, Houston.



- Ryder G. and Seymour R. (1982) Chemistry of Apollo 16 impact melts: Numerous melt sheets, lunar cratering history and the Cayley-Descartes distinction (abs). *Lunar Planet. Sci.* **XIII**, 673-674. Lunny Institute in Houston.
- Ryder G. and Blair E. (1982) KREEP glass and the exotic provenance and formation of polymict breccia 66055. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **87**, A147-A158.
- Ryder G. and Spudis P. (1987) Chemical composition and origin of Apollo 15 impact melts. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **92**, E432-446.
- Ryder G. and Steele A. (1988) Chemical dispersion among Apollo 15 olivine-normative mare basalts. *Proc. 18<sup>th</sup> Lunar Planet. Sci.* 273-282. Lunar Planetary Institute, Houston.
- Ryder G., Lindstrom M.M. and Willis K. (1988) The reliability of macroscopic identification of lunar coarse fines particles and the petrogenesis of 2-4 mm particles in Apennine Front sample 15243. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 219-232. Lunar Planetary Institute, Houston.
- Ryder G. and Sherman S.B. (1989) The Apollo 15 Coarse Fines. Curators Office #81, JSC#24035
- Ryder G. and Martinez R.R. (1991) Evolved hyperbyssal rocks from Station 7, Apennine Front, Apollo 15. *Proc. 21<sup>st</sup> Lunar Planet. Sci. Conf.* 137-150. Lunar Planetary Institute, Houston.
- Ryder G., Bogard D.D. and Garrison D. (1991) Probable age of Autolycus and calibration of lunar stratigraphy. *Geology* **19**, 143-146.
- Ryder G., Delano J.W., Warren P.H., Kallymeyn G.W. and Dalrymple G.B. (1996) A glass spherule of questionable impact origin from the Apollo 15 landing site: Unique target mare basalt. *Geochim. Cosmochim. Acta* **60**, 693-710.
- Ryder G. and Burling T.C. (1996) An Apollo 15 mare basalt fragment and lunar mare provinces. *Meteor. & Planet. Sci.* **31**, 50-59.
- Ryder G., Norman M.D. and Taylor G.J. (1997) The complex stratigraphy of the highland crust in the Serenitatis region of the Moon inferred from mineral fragment chemistry. *Geochim. Cosmochim. Acta* **61**, 1083-1105.
- Ryder G. and Schuraytz B.C. (2001) Chemical variations of the large Apollo 15 olivine-normative mare basalt rock samples. *J. Geophys. Res.* **106**, E1, 1435-1451.
- Saal A.E., Hauri E.H., Rutherford M. and Cooper R.F. (2007) The volatile contents (CO<sub>2</sub>, H<sub>2</sub>O, F, S, Cl) of the lunar picritic glasses (abs#2148). *Lunar Planet. Sci.* **XXXVIII**, Lunar Planetary Institute, Houston.
- Saal A.E., Hauri E.H., Lo Cascio M., VanOrman J.A., Rutherford M.C. and Cooper R.F. (2008) Volatile content of lunar volcanic glasses and the presence of water in the Moon's interior. *Nature* **454**, 192-195.
- Saal A.E., Hauri E.H., VanOrman J.A. and Rutherford M.C. (2012) D/H ratios of the lunar volcanic glasses (abs#1327). 43<sup>rd</sup> *Lunar Planet. Sci. Conf.* @ The Woodlands
- Sagan C. (1972) The search for indigenous lunar organic matter. *Space Life Sci.* **3**, 484-489.
- Saito K. and Alexander E.C. (1979) <sup>40</sup>Ar-<sup>39</sup>Ar studies of lunar soil 74001 (abs). *Lunar Sci.* **X**, 1049. Lunar Planetary Institute, Houston.
- Salpas P.A. and Taylor L.A. (1985) Basalt clasts in breccia 72275: Examples of pre-mare volcanism (abs). *Lunar Planet. Sci.* **XVI**, 728-729. Lunar Planetary Institute, Houston.

- Salpas P.A., Willis K.J. and Taylor L.A. (1985) Breccia Guidebook No. 8, 72275. Curatorial Branch Publication 71, JSC 20416 pp. 43.
- Salpas P.A., Taylor L.A. and Lindstrom M.M. (1986a) Apollo 17 KREEPy basalts: Pristine basaltic breccias (abs). *Lunar Planet. Sci. XVII*, 748-749. Lunar Planetary Institute, Houston.
- Salpas P.A., Taylor L.A. and Lindstrom M.M. (1986b) The first Apollo 17 ferroan anorthosite: Its significance relative to Mg-suite highland clasts (abs). *Lunar Planet. Sci. XVII*, 752-753. Lunar Planetary Institute, Houston.
- Salpas P.A., Lindstrom M.M. and Taylor L.A. (1987) Highland materials at Apollo 17: Contributions from 72275. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 11-19. Lunar Planetary Institute, Houston.
- Salpas P.A., Taylor L.A. and Lindstrom M.M. (1987) Apollo 17 KREEPy basalts: Evidence for Nonuniformity of KREEP. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* in J. Geophys. Res. 89 E340-E348.
- Sanchez A.G. (1981) Geology of Stone Mountain. In **Geology of Apollo 16**. (eds. Ulrich et al. ) U.S.G.S. Prof. Paper 1048
- Sands D.G., Rosman K.J.R. and de Laeter J.R. (2001) A preliminary study of cadmium mass fractionation in lunar soils. *Earth Planet. Sci. Lett.* **186**, 103-111.
- Sands D.G., de Laeter J.R. and Rosman K.J.R. (2001) Measurement of neutron capture effects on Cd, Sm and Gd in lunar samples with implications for the neutron energy spectrum. *Earth Planet. Sci. Lett.* **186**, 335-346.
- Sanford R.F. and Huebner J.S. (1979) Reexamination of diffusion processes in 77115 and 77215 (abs). *Lunar Planet. Sci. X*, 1052-1054. Lunar Planetary Institute, Houston.
- Sanford R.F. and Heubner J.S. (1980) Model thermal history of 77115 and implications for the origin of fragment-laden basalts. In Proc. Conf. **Lunar Highlands Crust**, 253-269. Lunar Planetary Institute, Houston.
- Sato M. (1976a) Oxygen fugacity and other thermochemical parameters of Apollo 17 high-Ti basalts and their implications on the reduction mechanism. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1323-1344.
- Sato M. (1976b) Oxygen fugacity values of some Apollo 16 and 17 rocks (abs). *Lunar Sci. VII*, 758-760. Lunar Planetary Institute, Houston.
- Sato M. (1979) The driving mechanism of lunar pyroclastic eruptions inferred from the oxygen fugacity behavior of Apollo 17 orange glass. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 311-325.
- Sato M., Hicklin N.L. and McLane J.E. (1973) Oxygen fugacity values of lunar samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1061-1079.
- Saxena S.K. and Walter L.S. (1974) A statistical-chemical and thermodynamic approach to the study of lunar mineralogy. *Geochim. Cosmochim. Acta* **38**, 79-95.
- Scarlett B., Buxton R.E. and Faulkner R.G. (1977) Formation of glass spheres on the lunar surface. *Phil. Trans. Roy. Soc. London* **A285**, 279-284.
- Schaal R.B., Horz F. and Gibbons R.V. (1976) Shock metamorphic effects in lunar microcraters. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1039-1054.
- Schaal R.B. and Hörz F. (1977a) Shock metamorphism of lunar and terrestrial basalts. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1697-1729.

Schaal R.B. and Hörz F. (1977b) Shock effects in some lunar basalts (abs). *Lunar Planet. Sci.* **VIII**, 832-834. Lunar Planetary Institute, Houston.

Schaal R.B., Hörz F. and Bauer J.F. (1978) Shock experiments on particulate lunar basalt - a regolith analogue (abs). *Lunar Planet. Sci.* **IX**, 999-1001. Lunar Planetary Institute, Houston.

Schaal R.B., Hörz F., Thompson T.D. and Bauer J.F. (1979a) Shock metamorphism of granulated lunar basalt. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 2547-2571.

Schaal R.B., Fryer K.H. and Hörz F. (1979c) Petrography and composition of large lunar glass objects. In Paper Presented to the **Conf. on Lunar Highlands Crust**. 135-137. Lunar Planetary Institute, Houston.

Schaal R.B., Thompson T.D., Hörz F. and Bauer J.F. (1979b) Experimentally shocked lunar basalt: Massive and particulate (abs). *Lunar Planet. Sci.* **X**, 1055-1057. Lunar Planetary Institute, Houston.

Schaal R.B. and Horz F. (1980) Experimental shock metamorphism of lunar soil. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1679-1695.

Schaeffer J. (1974) An electron microprobe analysis of Apollo 16 breccia 60255,78. B.A. Thesis, Princeton Univ.

Schaeffer J. and Hollister L.S. (1974) The petrology of two coarse-grained clasts in breccia sample 60255 (abs). *Lunar Sci.* **VI**, 705-706. Lunar Planetary Institute, Houston.

Schaeffer O.A. (1977) Lunar chronology as determined from the radiometric ages of returned lunar samples. *Phil. Trans. Roy. Soc. London* **A285**, 137-144.

Schaeffer O.A., Funkhouser J.G., Bogard D.D. and Zahringer J. (1970) Potassium-argon ages of lunar rocks from Mare Tranquillitatis and Oceanus Procellarum. *Science* **167**, 161-162.

Schaeffer O.A. and Husain L. (1973a) Isotopic ages of Apollo 17 lunar material (abs). *EOS Trans. AGU* **54**, 614.

Schaeffer O.A. and Husain L. (1973b) Early lunar history: Ages of 2 to 4 mm soil fragments from the lunar highlands. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1847-1863.

Schaeffer O.A. and Husain L. (1974a) Chronology of lunar basin formation and ages of lunar anorthositic rocks (abs). *Lunar Sci.* **V**, 663-665. Lunar Planetary Institute, Houston.

Schaeffer O.A. and Husain L. (1974b) Chronology of lunar basin formation. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1541-1555.

Schaeffer O.A., Husain L. and Schaeffer G.A. (1976) Ages of highland rocks: The chronology of lunar basin formation revisited. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2067-2092.

Schaeffer G.A., Husain L. and Schaeffer O.A. (1976) The duration of volcanism in Mare Serenitatis. *Earth Planet. Sci. Lett.* **31**, 358-368.

Schaeffer G.A. and Schaeffer O.A. (1977a) <sup>39</sup>Ar/<sup>40</sup>Ar ages of lunar rocks. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2253-2300.

Schaeffer G.A. and Schaeffer O.A. (1977b) <sup>39</sup>Ar/<sup>40</sup>Ar ages of lunar rocks (abs). *Lunar Sci.* **VIII**, 840-842. Lunar Planetary Institute, Houston.

Schaeffer O.A., Muller H.W. and Grove T.L. (1977a) Laser  $^{39}\text{Ar}$ - $^{40}\text{Ar}$  study of Apollo 17 basalts. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1489-1499.

Schaeffer O.A., Muller H.W. and Grove T.L. (1977b) Laser  $^{39}\text{Ar}$ - $^{40}\text{Ar}$  study of Apollo 17 basalts (abs). *Lunar Planet. Sci.* **VIII**, 837-839. Lunar Planetary Institute, Houston.

Schaeffer O.A., Bence A.E., Eichhorn G., Papike J.J. and Vaniman D.T. (1978a)  $^{39}\text{Ar}$ - $^{40}\text{Ar}$  and petrologic study of Mare Crisium: Age and petrology of Luna 24 samples 24007 (abs). *Lunar Planet. Sci.* **IX**, 1007-1009. Lunar Planetary Institute, Houston

Schaeffer O.A., Bence A.E., Eichhorn G., Papike J.J. and Vaniman D.T. (1978b)  $^{39}\text{Ar}$ - $^{40}\text{Ar}$  and petrologic study of Luna 24 samples 24077,13 and 24077,63. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2363-2373.

Schaeffer O.A., Warasila R. and Labotka T.C. (1982a) Ages of Serenitatis breccias: Lunar breccias and soils and their meteoritic analogs. LPI Tech. Rept. 82-02, 123-125. Lunar Planetary Institute, Houston.

Schaeffer O.A., Warasila R. and Labotka T.C. (1982b) Ages of Serenitatis breccias (abs). *Lunar Planet. Sci.* **XIII**, 685-686. Lunar Planetary Institute, Houston.

Schediwy S., Rosman K.J.R. and de Laeter J.R. (2006) Isotope fractionation of cadmium in lunar material. *Earth Planet. Sci. Lett.* **243**, 326-335.

Schmitt H.H. (1973) Apollo 17 report on the valley of Taurus-Littrow. *Science* **182**, 681-690.

Schmitt H.H. (1975) Geological model for Boulder 1 at Station 2, South Massif, Valley of Taurus-Littrow. *The Moon* **14**, 491-504.

Schmitt H.H. (2005) **Return to the Moon.** *a book about the  $^3\text{He}$  economy*

Schmitt H.H., Lofgren G., Swann G.A. and Simmons G. (1970) The Apollo 11 samples: Introduction. *Proc. Apollo 11 Lunar Science Conf.* 1-54.

Schmitt H.H. and Cernan E.A. (1973) A geological investigation of the Taurus-Littrow Valley. *In Apollo 17 Preliminary Science Report.* NASA SP-330.

Schmitt R.A. and Laul J.C. (1973) A survey of the selenochemistry of major and minor and trace elements. *The Moon* **8**, 182-209.

Schnabel C., Xue S., Ma P., Herzog G.F., Figield K., Cresswell R.G., Tada M.L., Hauslaned P. and Reedy R.C. (2000) Nickel-59 in surface layers of lunar basalt 74275: Implications for the solar alpha particle flux (abs#1778). *Lunar Planet. Sci.* **XXXI**, Lunar Planetary Institute, Houston.

Schnare D.W., Norman M.D. and Day J.M.D and Taylor L.A. (2005) LAP 02-224 (abs2212). *Lunar Planet. Sci.* **XXXVI**, Lunar Planetary Institute, Houston.

Schnare D.W., Taylor L.A., Norman M.D. and Day J.M.D. (2007) Single source origin for Apollo 15 olivine- and quartz- normative basalts (abs#1379). *Lunar Planet. Sci.* **XXXVIII**, Lunar Planetary Institute, Houston.

Schnare D.W., Day J.M.D., Norman M.D., Liu Y. and Taylor L.A. (2008) A laser-ablation ICP-MS study of Apollo 15 low-titanium olivine-normative and quartz-normative mare basalts. *Geochim. Cosmochim. Acta* **72**, 2556-2572.

Schneider E., Storzer D. and Fechtig H. (1972) Exposure ages of Apollo 15 samples by means of microcrater statistics and solar flare particle tracks. *In The Apollo 15 Lunar Samples* 415-417.

- Schneider E. and Hörz F. (1974) Microcrater populations on Apollo 17 rocks. *Icarus* **22**, 459-473.
- Schneider E., Storzer D., Hartung J.B., Fechtig H. and Genter W. (1973) Microcraters on Apollo 15 and 16 samples and corresponding cosmic dust fluxes. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 3277-3290.
- Schnetzler C.C., Philpotts J.A. and Bottino M.L. (1970) Li, K, Rb, Sr, Ba and rare-earth concentrations and Rb-Sr age of lunar rock 12013. *Earth Planet. Sci. Lett.* **9**, 185-192.
- Schnetzler C.C. and Philpotts J.A. (1971) Alkali, alkaline earth, and rare earth element concentrations in some Apollo 12 soils, rocks, and separated phases. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1101-1122.
- Schnetzler C.C. and Nava D.F. (1971) Chemical composition of Apollo 14 soils 14163 and 14259. *Earth Planet. Sci. Lett.* **11**, 345.
- Schnetzler C.C., Philpotts J.A., Nava D.F., Schuhmann S. and Thomas H.H. (1972) Geochemistry of Apollo 15 basalt 15555 and soil 15531. *Science* **175**, 426-428.
- Schonfeld E. (1972) K, U, and Th concentrations in rake sample 15382 by non-destructive gamma-ray spectroscopy. *In The Apollo 15 Lunar Samples*, 253-254.
- Schonfeld E. (1973) Determination by non-destructive gamma-ray counting of radionuclides produced by the August 1972 solar flare (abs). *Lunar Sci.* **IV**, 659. Lunar Planetary Institute, Houston.
- Schonfeld E. (1974) The contamination of lunar highland rocks by KREEP: Interpretations by mixing models. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1269-1286.
- Schonfeld E. (1975) Component abundances in Apollo 15 soils and breccias by the mixing model technique (abs). *Lunar Sci.* **VI**, 712-714. Lunar Planetary Institute, Houston.
- Schonfeld E. and Meyer C. (1972) The abundances of components of the lunar soils by a least-squares mixing model and the formation age of KREEP. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1397-1420.
- Schonfeld E., O'Kelley G.D., Eldridge J.S. and Northcutt K.J. (1972) K, U, and Th concentrations in rake sample 15382 by non-destructive gamma-ray spectroscopy. *In The Apollo 15 Lunar Samples* (Chamberlain and Watkins eds.), 253-254. Lunar Science Institute, Houston.
- Schreiber E. (1977) The Moon and Q. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1201-1208.
- Schultz P.H. and Spudis P.D. (1983) Beginning and end of lunar mare volcanism. *Nature* **302**, 233-236.
- Schurmann K. and Hafner S.S. (1972) On the amount of ferric iron in plagioclases from lunar igneous rocks. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 615-621.
- Schwaller H., Eberhardt P., Geiss J., Graf H. and Grogler N. (1971) The  $^{78}\text{Kr}/^{83}\text{Kr} - ^{131}\text{Xe}/^{126}\text{Xe}$  correlation in Apollo 12 rocks. *Earth Planet. Sci. Lett.* **12**, 167-169.
- Schwartz J.M. and McCallum I.S. (1999) Inferred depths of formation of spinel cataclases and troctolitic granulite, 76535 using new thermodynamic data for Cr-spinel (abs1308). *Lunar Planet. Sci.* **XXX**, Lunar Planetary Institute, Houston.
- Schwerer F.C., Huffman G.P., Fisher R.M. and Nagata T. (1972) Electrical conductivity and Mossbauer study of Apollo lunar samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 3173-3185.
- Schwerer F.C., Huffman G.P., Fisher R.M. and Nagata T. (1973) Electrical conductivity of lunar surface rocks at elevated temperatures. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 3151-3166.

- Schwerer F.C., Huffman G.P., Fisher R.M. and Nagata T. (1974) Electrical conductivity of lunar surface rocks: Laboratory measurements and implications for lunar interior temperatures. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2673-2687.
- Schwerer F.C. and Nagata T. (1976) Ferromagnetic-superparamagnetic granulometry of lunar surface materials. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 759-778.
- Sclar C.B. (1970) Shock metamorphism of lunar rocks and fines from tranquillity base. *Proc. Apollo 11 Lunar Sci. Conf.* 849-864.
- Sclar C.B. (1971) Shock induced features of Apollo 12 microbreccias. *Proc. Second Lunar Sci. Conf.* 817-832.
- Sclar C.B. and Bauer J.F. (1975a) Shock-induced subsolidus reduction-decomposition of orthopyroxene and shock-induced melting of norite 78235. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 799-820.
- Sclar C.B. and Bauer J.F. (1975b) Shock-induced subsolidus reduction-decomposition of orthopyroxene and shock-induced melting in norite 78235 (abs). *Lunar Sci.* **VI**, 730-731. Lunar Planetary Institute, Houston.
- Sclar C.B. and Bauer J.F. (1976a) Subsidiary reduction phenomena in lunar norite 78235: Observations and interpretations. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2493-2508.
- Sclar C.B. and Bauer J.F. (1976b) Redox reactions involving nonvolatile ionic species as a mechanism of shock-induced subsolidus reduction of Fe<sup>+2</sup> in plagioclase and orthopyroxene: Indications from lunar norite 78235 (abs). *Lunar Sci.* **VII**, 791-793. Lunar Planetary Institute, Houston.
- Scoon J.H. (1971) Chemical analyses of lunar samples 12040 and 12064. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1259-1260.
- Scoon J.H. (1972a) Chemical analysis of lunar samples 15101,65 and 15211,6. In **The Apollo 15 Lunar Samples**, 255-256. Lunar Planetary Institute, Houston.
- Scoon J.H. (1972b) Chemical analysis of lunar samples 14003, 14311 and 14321. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1335-1336.
- Scoon J.H. (1974) Chemical analysis of lunar samples from the Apollo 16 and 17 collections (abs). *Lunar Sci.* **V**, 690-692. Lunar Planetary Institute, Houston.
- Seddio S.M., Korotev R.L., Jolliff B.L. and Zeigler R.A. (2009a) Petrographic diversity in Apollo 12 regolith rock particles (abs#2415). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Seddio S.M., Korotev R.L., Jolliff B.L. and Zeigler R.A. (2009b) A newly characterized granite from the Apollo 12 regolith (abs#2285). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Seddio S.M., Korotev R.L., Jolliff B.L. and Zeigler R.A. (2010) Comparing the bulk compositions of lunar granites, with petrologic implications (abs#2688). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ the Woodlands.
- Seddio S.M., Jolliff B.L., Korotev R.L. and Zeigler R.A. (2011) Fragments of granite in Apollo 12 regolith: Pieces of 12013(abs#2381)? *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Seddio S.M., Korotev R.L. and Jolliff B.L. (2012) Two Apollo 12 granite rock fragments: Evidence for the proximal coexistence of high-Ti impact melt breccias and granite (abs#1006). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.

See T.H., Horz F. and Morris R.V. (1986) Apollo 16 impact-melt splashes: Petrography and major-element composition. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **91**, E3-E20.

Seitz H-M., Brey G.P, Weyer S., Durali S., Ott U. and Munker C. (2005) Lithium isotopic compositions of Martian and Lunar reservoirs (abs#5102). *Meteor. & Planet. Sci.* **40**, A138.

Seitz H-M., Brey G.P, Weyer S., Durali S., Ott U., Munker C. and Mezger K. (2006) Lithium isotopic compositions of Martian and Lunar reservoirs. *Earth Planet. Sci. Lett.* **245**, 6-18.

Sellers G.A., Woo C.C., Bird M.L and Duke M.B. (1971) Composition and grain-size characteristics of fines from the Apollo 12 double-core tube. *Proc. Second Lunar Sci. Conf.* 665-678.

Senftle F.E., Thorpe A.N., Alexander C.C. and Briggs C.L. (1973) Comparison of the magnetic properties of glass from Luna 20 with similar properties of glass from the Apollo missions. *Geochim. Cosmochim. Acta* **37**, 1053-1062.

Settle M., Cintala M.J. and Head J.W. (1979) Emplacement of Fahrenheit Crater ejecta at the Luna-24 site. *The Moon* **20**, 281-300.

Sha L.-K. (2000) Whitlockite solubility in silicate melts: Some insights into lunar and planetary evolution. *Geochim. Cosmochim. Acta* **64**, 3217-3236.

Sharp Z.D., Shearer C.K. and Barnes J.D. (2009) The chlorine isotope composition of the Moon (abs#2351). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.

Sharp Z.D., Shearer C.K., McKeegan K.D., Barnes J.D. and Wang Y.Q. (2010) The chlorine isotope composition of the Moon and implications for an anhydrous mantle. *Science* **329**, 1050-1053.

Sharp Z.D., McCubbin F.M. and Shearer Chip (2012) A unifying theory for H-bearing volatiles on the Moon (abs#2751). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.

Shaw D.M. and Middleton T.A. (1987) Lunar boron: A preliminary study (abs). *Lunar Planet. Sci.* **XVIII**, 912-913. Lunar Planetary Institute, Houston.

Shaffer E., Brophy J.G. and Basu A. (1990) La/Sm ratios in mare basalts as a consequence of mafic cumulate fractionation from an initial lunar magma (abs). *Lunar Planet. Sci.* **XXI**, 1130-1131. Lunar Planetary Institute, Houston.

Shearer C.K. (2008) Differentiation of the terrestrial planets. Past, present and future perspectives from the Moon (abs#1814). *Lunar Planet. Sci.* **XXXIX** Lunar Planetary Institute, Houston.

Shearer C.K., Papike J.J., Simon S.B. and Shimizu N. (1989) An ion microprobe study of the intracrystalline behavior of REE and selected trace elements in pyroxene from mare basalts with different cooling and crystallization histories. *Geochim. Cosmochim. Acta* **53**, 1041-1054.

Shearer C.K., Papike J.J., Simon S.B., Shimizu N., Yurimoto Y. and Sueno S. (1990a) Ion microprobe studies of trace elements in Apollo 14 volcanic glass beads: Comparisons to Apollo 14 mare basalts and petrogenesis of picritic magmas. *Geochim. Cosmochim. Acta* **54**, 851-867.

Shearer C.K., Papike J.J., Galbreath K.C., Wentworth S.J. and Shimizu N. (1990b) A SIMS study of lunar "komatiitic glasses". Trace element characteristics and possible origin. *Geochim. Cosmochim. Acta* **54**, 1851-1857.

Shearer C.K., Papike J.J., Galbreath K.C. and Shimizu N. (1991) Exploring the lunar mantle with secondary ion mass spectrometry: A comparison of lunar picritic glass beads from the Apollo 14 and Apollo 17 sites. *Earth Planet. Sci. Lett.* **102**, 134-147.

Shearer and 15 authors (1991) Thermal and magmatic evolution of the moon. *In New Views of the Moon* (eds Jolliff et al). Reviews in Mineralogy and Geochemistry. Vol **60** MSA and Geo. Soc.

Shearer C.K. and Papike J.J. (1993) Basaltic magmatism on the Moon: A perspective from volcanic picritic glass beads. *Geochim. Cosmochim. Acta* **57**, 4785-4812.

Shearer C.K., Layne G.D. and Papike J.J. (1994) The systematics of light lithophile elements (Li, Be, and B) in lunar picritic glasses: Implications for basaltic magmatism on the Moon and the origin of the Moon. *Geochim. Cosmochim. Acta* **58**, 5349-5362.

Shearer C.K., Papike J.J. and Layne G.D. (1996a) Deciphering basaltic magmatism on the Moon from the compositional variations in Apollo 15 very low-Ti picritic magmas. *Geochim. Cosmochim. Acta* **60**, 509-528.

Shearer C.K., Papike J.J. and Layne G.D. (1996b) The role of ilmenite in the source region for mare basalts: Evidence from niobium, zirconium and cerium in picritic glasses. *Geochim. Cosmochim. Acta* **60**, 3521-3530.

Shearer C.K. and Papike J.J. (1999) Magmatic evolution of the Moon. *Am. Mineral.* **84**, 1469-1494.

Shearer C.K. and Newsom H.E. (2000) W-Hf isotope abundances and the early origin and evolution of the Earth-Moon system. *Geochim. Cosmochim. Acta* **64**, 3599-3613.

Shearer C.K., Papike J.J. and Spilde M.N. (2001) Trace element partitioning between immiscible lunar melts: An example from naturally occurring lunar melt inclusions. *Amer. Mineral.* **84**, 1469-1494.

Shearer C.K. and Papike J.J. (2005) Early crustal building processes on the moon: Models for the petrogenesis of the magnesian suite. *Geochim. Cosmochim. Acta* **69**, 3445-3461.

Shearer C.K. and Borg L.E. (2006) Big returns on small samples: Lessons learned from the analysis of small lunar samples and implications for the future scientific exploration of the Moon. *Chemie der Erde – Geochemistry* **66**, 163-185.

Shearer C.K. and 15 authors (2006a) Thermal and magmatic evolution of the Moon. *In New Views of the Moon*, Reviews of Mineralogy and Geochemistry 60, 365-518. Min. Soc. America (ed. Jolliff et al.) ISSN 1529-6466

Shearer C.K., Papike J.J. and Karner J.M. (2006b) Pyroxene europium valance oxybarometer: Effects of pyroxene composition, melt composition, and crystallization kinetics. *Amer. Mineral.* **91**, 1565-1573.

Shearer C.K., McKay G., Papike J.J. and Karner J.M. (2006c) Valance state partitioning of vanadium between olivine-liquid: Estimates of the oxygen fugacity of Y980459 and application to other olivine-phyric martian basalts. *Amer. Mineral.* **91**, 1657-1663.

Shearer C.K., Burger P.V. and Guan Y. (2009) Vapor element transport in the lunar crust and implications for lunar ore deposits (abs#1299). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.

Shearer C.K., Papike J.J., Burger P.V., Sutton S.R., McCubbin F.M. and Newville M. (2011a) Direct determination of europium valance state by XANES in extraterrestrial merrillite: Implications for REE crystal chemistry and martian magmatism. *Amer. Mineral.* **96**, 1418-1421.

Shearer C.K., Burger P.V., Guan Y., Papike J.J. and Sutton S.R. (2011b) Vapor element transport in the lunar crust: Open system transport of elements in the shallow lunar crust by hydrous, isotopically light S-rich vapor (abs#1141). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.



Shearer C.K., Borg L.E., Burger P.V., Connelly J.N. and Bizarro M. (2012a) Timing and duration of Mg-suite episode of lunar crustal building. Part 1: Petrography and mineralogy of a norite clast in 15445 (abs#1421). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.

Shearer C.K., Sharp Z.D., McCubbin F.M., Steele A., Burger P.V., Provincio P.P. and (yes, of course) Jim Papike (2012b) Chlorine distribution and its isotopic composition, alteration mineralogy, and micro-textural analysis of “rusty rock” 66095. Implications for the petrogenesis of “rusty rock”, origin of rusty alteration and volatile element behavior on the Moon (abs#1416). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.

Shearer C.K., Burger P.V., Guan Y., Papike J.J., Sutton S.R. and Atudorei N-V. (2012c) Origin of sulfide replacement textures in lunar breccias. Implications for vapor element transport in the lunar crust. *Geochim. Cosmochim. Acta* **83**, 138-158. (please note that the authors have set a new precedent – titles with two sentences)

Shedlovsky and 10 others (1970) Pattern of bombardment-produced radionuclides in rock 10017 and in lunar soil. *Proc. Apollo 11 Lunar Science Conf.* 1503-1532,

Shervais J.W. (1994) Ion microprobe studies of lunar highland cumulate rocks: Preliminary results (abs). *Lunar Planet. Sci.* **XXV**, 1265-1266. Lunar Planetary Institute, Houston.

Shervais J.W. (1999) Surfing the Fra Mauro shoreline: Highlands crust at the Apollo 14 site. In **Taylor** Volume pp. 194-206. GSA Bellweather Publishing

Shervais J.W., Taylor L.A. and Laul J.C. (1983) Ancient crustal components in the Fra Mauro breccias. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **88**, 77-92.

Shervais J.W. and Taylor L.A. (1983) Breccia Guidebook No.5 14305. JSC 19267. Houston.

Shervais J.W., Knapp S. and Taylor L.A. (1984) Breccia Guidebook No.7 14321. JSC 19492. Houston.

Shervais J.W., Taylor L.A., Laul J.C. and Smith M.R. (1985a) Pristine highland clasts in consortium breccia 14305: Petrology and Geochemistry. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **89**, C25-40.

Shervais J.W., Taylor L.A. and Lindstrom M.M. (1985b) Apollo 14 mare basalts: petrology and geochemistry of clasts from consortium breccia 14321. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **89**, C375-395.

Shervais J.W., Taylor L.A., Laul J.C., Shih C.-Y. and Nyquist L.E. (1985c) Very high potassium (VHK) basalt: Complications in lunar mare petrogenesis. *Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **90**, D3-D18.

Shervais J.W., Taylor L.A. and Lindstrom M.M. (1988) Olivine vitrophyres: A nonpristine high-Mg component in Lunar breccia 14321. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 45-57. Lunar Planetary Institute, Houston.

Shervais J.W., Vetter S.K. and Lindstrom M.M. (1990) Chemical differences between small subsamples of Apollo 15 olivine-normative basalts. *Proc. 20<sup>th</sup> Lunar Planet. Sci. Conf.* 109-126. Lunar Planetary Institute, Houston.

Shervais J.W. and Stuart J.B. (1995) Ion microprobe studies of lunar highland cumulate rocks: New results (abs). *Lunar Planet. Sci.* **XXVI**, 1285-1286. Lunar Planetary Institute, Houston.

Shervais J.W. and McGee J.J. (1997) KREEP in the western lunar highlands: An ion microprobe study of alkali and Mg suite cumulates from the Apollo 12 and 14 sites (abs). *Lunar Planet. Sci.* **XXVIII**, 1301-1302. Lunar Planetary Institute, Houston.

Shervais J.W. and McGee J.J. (1998) Ion and electron microprobe study of troctolites, norites and anorthosites from Apollo 14: Evidence for urKREEP assimilation during petrogenesis of Apollo 14 Mg-suite rocks. *Geochim. Cosmochim. Acta* **62**, 3009-3023.

Shervais J.W. and McGee J.J. (1999a) KREEP cumulates in the western lunar highlands: ion and electron microprobe study of alkali-suite anorthosites and norites from Apollo 12 and 14. *Am. Min.* **84**, 806-820

Shervais J.W. and McGee J.J. (1999b) Petrology of the Western Highland Province: Ancient crust formation at the Apollo 14 site. *J. Geophys. Res.* **104**, 5891-5920.

SHRELLDALFFF (1970 ) see Shedlovsky J.P.

Shedlovsky J.P., Honda M., Reedy R.C., Evans J.C., Lal D., Lindstrom R.M., Delany A.C., Arnold J.R., Loosli H.H., Fruchter J.S., Finkel R.C. and Kirschner Florence (1970) Pattern of bombardment-produced radionuclides in rock 10017 and in lunar soil. *Proc. Apollo 11 Lunar Sci. Conf.* 1503-1532.

Shih C.-Y. (1977) Origins of KREEP basalts. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2375-2401.

Shih C.-Y., Nyquist L.E., Bogard D.D. and Wiesmann H. (1973) K-Ca and Rb-Sr dating of two lunar granites: Relative chronometer resetting. *Geochim. Cosmochim. Acta* **58**, 3101-3116.

Shih C.-Y., Haskin L.A., Wiesmann H., Bansal B.M. and Brannon J.C. (1975a) On the origin of high-Ti mare basalts. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1255-1285.

Shih C.-Y., Wiesmann H. and Haskin L.A. (1975b) On the origin of high-Ti mare basalts (abs). *Lunar Sci.* **VI**, 735-737. Lunar Planetary Institute, Houston.

Shih C.-Y., Nyquist L.E., Bogard D.D., Wooden J.L., Bansal B.M. and Wiesmann H. (1985) Chronology and petrogenesis of a 1.8 g lunar granite clast: 14321,1062. *Geochim. Cosmochim. Acta* **49**, 411-426.

Shih C.-Y., Nyquist L.E., Bogard D.D., Bansal B.M., Wiesmann H., Johnson P., Shervais J.W. and Taylor L.A. (1986) Geochronology and petrogenesis of Apollo 14 very high potassium mare basalts. *Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **91**, D214-D228.

Shih C.-Y., Nyquist L.E., Bogard D.D., Dash E.J., Bansal B.M. and Wiesmann H. (1987) Geochronology of high-K aluminous mare basalt clasts from Apollo 14 breccia 14304. *Geochim. Cosmochim. Acta* **51**, 3255-3271.

Shih C.-Y., Nyquist L.E., Dasch E.J., Bansal B.M. and Wiesmann H. (1989) Ages of pristine lunar plutonic rocks and their petrogenetic implications (abs). *Lunar Planet. Sci.* **XX**, 1004-1005. Lunar Planetary Institute, Houston.

Shih C.-Y., Bansal B.M., Wiesmann H. and Nyquist L.E. (1990a) Rb-Sr and Sm-Nd isotopic studies of an Apollo 17 KREEPy basalt (abs). *Lunar Planet. Sci.* **XXI**, 1148-1149. Lunar Planetary Institute, Houston.

Shih C.-Y., Nyquist L.E., Bansal B.M. and Wiesmann H. (1992) Rb-Sr and Sm-Nd chronology of an Apollo 17 KREEP basalt. *Earth Planet. Sci. Lett.* **108**, 203-215.

Shih C.-Y., Nyquist L.E., Dash E.J., Bogard D.D., Bansal B.M. and Wiesmann H. (1993) Ages of pristine noritic clasts from lunar breccias 15445 and 15455. *Geochim. Cosmochim. Acta* **57**, 915-931.

Shih C.-Y., Nyquist L.E. and Wiesmann H. (1993) K-Ca chronology of lunar granites. *Geochim. Cosmochim. Acta* **57**, 4827-4841.

- Shih C.-Y., Nyquist L.E., Bogard D.D., Reese Y., Wiesmann H. and Garrison D. (1999) Rb-Sr, Sm-Nd and  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  isotopic studies of an Apollo 11 group D basalt (abs#1787). *Lunar Planet. Sci.* **XXX**, Lunar Planetary Institute, Houston.
- Shih C.-Y., Nyquist L.E., Reese Y., Wiesmann H. and Schwandt C. (2001) Rb-Sr and Sm-Nd isotopic constraints on the genesis of lunar green and orange glasses (abs#1401). *Lunar Planet. Sci.* **XXXII**, Lunar Planetary Institute, Houston.
- Shih C.-Y., Nyquist L.E., Reese Y., Yamaguchi A. and Takeda H. (2005) Rb-Sr and Sm – Nd isotopic studies of lunar highland meteorites Y-86032 and lunar ferroan anorthosites 60025 and 67075 (abs#1433). *Lunar Planet. Sci.* **XXXVI**, Lunar Planetary Institute, Houston.
- Shih C.-Y., Nyquist L.E., Reese Y. and Bischoff A. (2008) Sm-Nd and Rb-Sr isotopic studies of meteorite Kalahari 009: An old VLT Mare basalt (abs#2165). *Lunar Planet. Sci.* **XXXIX**, Lunar Planetary Institute, Houston.
- Shih C.Y., Nyquist L.E., and Reese Y. (2012) Rb-Sr and Sm-Nd isotopic studies of lunar green and orange glasses (abs#1606). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Shirley D.N. (1983) A partially molten magma ocean model. *J. Geophys. Res.* **88**, A519-27.
- Shoemaker E.M. and 11 others (1969) Geologic setting of the lunar samples returned by the Apollo 11 mission. *In Apollo 11 Preliminary Science Rpt.* NASA Spec Publ. 214
- Shoemaker E.M. and 8 others (1970a) Origin of the regolith at Tranquillity Base. *Proc. Apollo 11 Lunar Science Conf.* 2399-2412.
- Shoemaker E.M. and 12 others (1970b) 10. Preliminary geologic investigation of the Apollo 12 landing site. *In Apollo 12 Preliminary Science Rpt.* NASA SP-235 page 113-156.
- Short N.M. and Forman M.L. (1972) Impact crater ejecta on the lunar surface. *Modern Geol.* **3**, 69-91.
- Shuster D.L., Balco G., Cassata W.S., Fernandes V.A., Garrick-Bethel I. and Weiss B.J. (2010) A record of impacts preserved in the lunar regolith. *Earth Planet. Sci. Lett.* **290**, 155-165.
- Sievers R.E., Eisentraut K.J., Griest D.J., Richardson M.F., Wolf W.R., Ross W.D., Frew N.M. and Isenhour T.L. (1971) Variations in beryllium and chromium contents in lunar fines compared with crystalline rocks. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1451-1459.
- Signer P., Baur H., Derksen Uwe, Etique P., Funk H., Horn P. and Wieler R. (1977) He, Ne and Ar records of lunar soil evolution. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3657-3683.
- Signer P., Baur H., Etique P., Frick U. and Funk H. (1977) On the question of the  $^{40}\text{Ar}$  excess in lunar soils. *Phil. Trans. Roy. Soc. London* **A285**, 385-390.
- Sill G.T., Nagy B., Nagy L.A., Hamilton P.B., McEwan W.S. and Urey H.C. (1974) Carbon compounds in Apollo 17 lunar samples: Indications of cometary contribution to breccia 78155? (abs) *Lunar Sci.* **V**, 703-705. Lunar Planetary Institute, Houston.
- Silver L.T. (1970) Uranium-thorium-lead isotopes in some Tranquillity Base samples and their implications for lunar history. *Proc. Apollo 11 Lunar Sci. Conf.* 1533-1574.
- Silver L.T. (1971) U-Th-Pb isotope systems in Apollo 11 and 12 regolith materials and a possible age for the Copernican impact (abs). *EOS Trans. AGU* **52**, 534.

- Silver L.T. (1972) Uranium-thorium-lead isotopes and the nature of the mare surface debris at Hadley-Apennine. In **The Apollo 15 Lunar Samples**, 388-390.
- Silver L.T. (1972) U-Th-Pb abundances and isotopic characteristics in some Apollo 14 rocks and soils (abs). *Lunar Sci.* **III**, 704-706. Lunar Planetary Institute, Houston.
- Silver L.T. (1973a) Uranium-Thorium-Lead isotopic relations in the remarkable debris blanket at Hadley-Apennine (abs). *Lunar Sci.* **IV**, 670-671. Lunar Planetary Institute, Houston.
- Silver L.T. (1973b) Uranium-Thorium-Lead isotopic characteristics in some regolithic materials from the Descartes Region (abs). *Lunar Sci.* **IV**, 672. Lunar Planetary Institute, Houston.
- Silver L.T. (1974a) Patterns for U, Th, Pb distributions and isotopic relationships in Apollo 17 soils (abs). *Lunar Sci.* **V**, 706-708. Lunar Planetary Institute, Houston.
- Silver L.T. (1974b) Implications of volatile leads in orange, grey, and green lunar soils for an Earth-like Moon (abs). *EOS Trans. AGU* **55**, 681.
- Skinner B.J. (1970) High crystallization temperatures indicated for igneous rocks from Tranquillity Base. *Proc. Apollo 11 Lunar Sci. Conf.* 891-895.
- Simkin T., Noonan A.F., Switzer G.S., Mason B., Nelen J.A. and Thomson G. (1973) Composition of Apollo 16 fines 60051, 60052, 64811, 64812, 67711, 67712, 68821 and 68822. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 279-289.
- Simmons G., Siegfried R. and Richter Dorthy (1975a) Characteristics of microcracks in lunar samples. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3227-3254.
- Simmons G., Richter D. and Siegfried R. (1975b) Characterization of microcracks in lunar igneous rocks (abs). *Lunar Sci.* **VI**, 741-743. Lunar Planetary Institute, Houston.
- Simmons S.T. and Lapan T.J. (2012) Trace element geochemistry of Apollo samples 78235: Potential connections with other Mg-suite norites (abs#2622). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Simon J.I., Shih C-Y., and Nyquist L.E. (2011) K-Ca and Rb-Sr dating of lunar granite 14321 revisited (abs#2754). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Simon S.B., Papike J.J. and Laul J.C. (1981) The lunar regolith: Comparative studies of the Apollo and Luna sites. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 371-388.
- Simon S.B., Papike J.J. and Laul J.C. (1982) The Apollo 14 regolith: Petrology of cores 14210/14211 and 14220 and soils 14141, 14148 and 14149. *Proc. 13<sup>th</sup> Lunar Sci. Conf.* in *J. Geophys. Res.* **87**, A232-246.
- Simon S.B., Papike J.J., Shearer C.K. and Laul J.C. (1983) Petrology of the Apollo 11 highland component. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **88**, B103-138.
- Simon S.B., Papike J.J. and Shearer C.K. (1984) Petrology of Apollo 11 regolith breccias. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **89**, C109-132.
- Simon S.B. and Papike J.J. (1985) Petrology of the Apollo 12 highland component. *Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf.* D47-D60.
- Simon S.B., Papike J.J., Gosselin D.C. and Laul J.C. (1986) Petrology of the Apollo 15 regolith breccias. *Geochim. Cosmochim. Acta* **50**, 2675-2691.

Simon S.B., Papike J.J., Laul J.C., Hughes S.S. and Schmitt R.A. (1988) Apollo 16 regolith breccias and soils: Recorders of exotic component addition to the Descartes region of the moon. *Earth Planet. Sci. Lett.* **89**, 147-162.

Simon S.B., Papike J.J. and Laul J.C. (1988) Chemistry and petrology of the Apennine Front, Apollo 15, Part I: KREEP basalts and plutonic rocks. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 187-201. Lunar Planetary Institute, Houston.

Simon S.B., Papike J.J., Shearer C.K., Hughes S.S. and Schmitt R.A. (1989) Petrology of Apollo 14 regolith breccias and ion microprobe studies of glass beads. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 1-17. Lunar Planetary Institute, Houston.

Simon S.B., Papike J.J., Laul J.C., Hughes S.S. and Schmitt R. A. (1989) Comparative petrology and chemistry of Apollo 17 regolith breccias and soils (abs). *Lunar Planet. Sci.* **XX**, 1014-1015. Lunar Planetary Institute, Houston.

Simon S.B., Papike J.J., Gosselin D.C., Laul J.C., Hughes S.S. and Schmitt R.A. (1990) Petrology and chemistry of Apollo 17 regolith breccias: A history of mixing of highland and mare regolith. *Proc. 20<sup>th</sup> Lunar Planet. Sci.* 219-230. Lunar Planetary Institute, Houston.

Simoneit B.R., Wszolek P.C. and Burlingame A.L. (1972) Apollo 15 lunar samples: LM exhaust products in the SESC 15013. In **The Apollo 15 Lunar Samples**, 286-288.

Simoneit B.R., Christiansen P.C. and Burlingame A.L. (1973) Volatile element chemistry of selected lunar, meteoritic and terrestrial samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1635-1650.

Simoneit B.R., Wszolek P.C., Christiansen P., Jackson R.F. and Burlingame A.L. (1973) Carbon chemistry of Luna 16 and Luna 20 samples. *Geochim. Cosmochim. Acta* **37**, 1063-1074.

Simonds C.H. (1973) Sintering and hot pressing of Fra Mauro composition glass and the lithification of lunar breccias. *Am. J. Sci.* **273**, 428-439.

Simonds C.H. (1975) Thermal regimes in impact melts and the petrology of the Apollo 17 Station 6 boulder. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 641-672.

Simonds C.H. and Warner J.L. (1981) Petrochemistry of Apollo 16 and 17 samples (abs). *Lunar Planet. Sci.* **XII**, 993-995. Lunar Planetary Institute, Houston.

Simonds C.H., Warner J.L. and Phinney W.C. (1973) Petrology of Apollo 16 poikilitic rocks. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 613-632.

Simonds C.H., Phinney W.C. and Warner J.L. (1974) Petrography and classification of Apollo 17 non-mare rocks with emphasis on samples from the Station 6 boulder. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 337-353.

Simonds C.H., Phinney W.C., Warner J.L. and Heiken G.H. (1975a) Thermal regimes in crater debris as deduced from the petrology of the Apollo 17 Station 6 boulder and rake samples (abs). *Lunar Sci.* **VI**, 747-749. Lunar Planetary Institute, Houston.

Simonds C.H., Warner J.L. and Phinney W.C. (1975b) The petrology of the Apennine Front revisited. *Lunar Sci.* **VI**, 744-746.

Simonds C.H., Warner J.L. and Phinney W.C. (1976a) Thermal regimes in cratered terrain with emphasis on the role of impact melt. *Am. Mineral.* **61**, 569-577.

Simonds C.H., Warner J.L., Phinney W.C. and McGee P.E. (1976) Thermal model for impact breccia lithification: Manicouagan and the moon. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2509-2528.

- Simonds C.H., Warner J.L. and Phinney W.C. (1976c) Clast-melt interactions in lunar and terrestrial impact melts (abs). *Lunar Sci.* **VII**, 812-814. Lunar Planetary Institute, Houston.
- Simonds C.H., Phinney W.C., Warner J.L., McGee P.E., Geeslin J., Brown R.W. and Rhodes M.J. (1977) Apollo 14 revisited, or breccias aren't so bad after all. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1869-1893.
- Simmons G., Siegfried R. and Richter D. (1975) Characteristics of microcracks in lunar samples. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3227-3254.
- Simpson P.R. and Bowie S.H.U. (1970) Quantitative optical and electron-probe studies of opaque phases in Apollo 11 samples. *Proc. Apollo 11 Lunar Sci. Conf.* 873-890.
- Simpson P.R. and Bowie S.H.U. (1971) Opaque phases in Apollo 12 samples. *Proc. Second Lunar Sci. Conf.* 207-218.
- Singer K.L., Riches A.J.V., Patchen A., Liu Y. and Taylor L.A. (2010) Insights into the petrogenesis of Apollo 17 high-Ti mare basalts (abs#2694). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ the Woodlands
- Singletary S. and Grove T. (2008) Origin of lunar high-titanium ultramafic glasses: A hybridized source? *Earth Planet. Sci. Lett.* **268**, 182-189.
- Sisterson J.M and Reedy R.C. (1997) Revised estimates for SCR-produced <sup>22</sup>Na in lunar rock 74275 using new cross section measurements (abs). *Lunar Planet. Sci.* **XVIII**. Lunar Planetary Institute, Houston.
- Smales A.A., Mapper D., Webb M.S.W., Webster R.K., Wilson J.D., and Hislop J.S. (1971) Elemental composition of lunar surface material (part 2). *Proc. Second Lunar Sci. Conf.* 1253-1258.
- Smith J.M., Meyer C., Compston W. and Williams I.S. (1986) 73235,82 (pomegranate): An assemblage of lunar zircon with unique overgrowth (abs). *Lunar Planet. Sci.* **XVII**, 805-806. Lunar Planetary Institute, Houston.
- Smith J.V. (1974) Lunar mineralogy: A heavenly detective story. Pres. Address. *Am. Mineral.* **59**, 231-243.
- Smith J.V., Anderson A.T., Newton R.C., Olsen E.J. and Wyllie P.J. (1970) A petrologic model for the moon based on petrogenesis, experimental petrology and physical properties. *J. Geol.* **78**, 381-405.
- Smith J.V., Anderson A.T., Newton R.C., Olsen E.J., Wyllie P.J., Crewe A.V., Isaacson M.S. and Johnson D. (1970) Petrologic history of the moon inferred from petrography, mineralogy and petrogenesis of Apollo 11 rocks. *Proc. Apollo 11 Lunar Sci. Conf.* 897-925.
- Smith J.V. and Steele I.M. (1972) Apollo 16 rake samples 67515 to 68537: Sample classification, description and inventory. Curator's Catalog. JSC
- Smith J.V. and Steele I.M. (1974) Intergrowths in lunar and terrestrial anorthosites with implications for lunar differentiates. *Am. Mineral.* **59**, 673-680.
- Smith J.V. and Steele I.M. (1976) Lunar mineralogy. *Am. Mineral.* **61**, 1059-1116.
- Smith J.V., Hansen E.C. and Steele I.M. (1980) Lunar highland rocks: Element partitioning among minerals II: Electron microprobe analyses of Al, P, Ca, Ti, Cr, Mn and Fe in olivine. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 555-569.
- Smith M.R., Schmitt R.A., Warren P.H., Taylor G.J. and Keil K. (1983) Far-eastern nonmare samples: New data from Luna 20 and 16 (abs). *Lunar Planet. Sci.* **XIV** 716-717. Lunar Planet. Institute, Houston.

- Smith M.R., Laul J.C., Simon S.B. and Papike J.J. (1985) Chemistry and petrology of Apollo 12 drive tube 12027. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* C507-C516.
- Smyth J.R. (1974) Low orthopyroxene from a lunar deep crustal rock: A new pyroxene polymorph of space group P21ca. *Geophys. Res. Lett.* **1**, 27-29
- Smyth J.R. (1974) The crystal structure of armalcolites from Apollo 17. *Earth Planet. Sci. Lett.* **24**, 262-270.
- Smyth J.R. (1975) Intracrystalline cation order in a lunar crustal troctolite. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 821-832.
- Smyth J.R. (1986) Crystal structure refinement of a lunar anorthite, An<sub>94</sub>. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **91**, E91-97.
- Snape J.F., Crawford I.A., Joy K.H. and Burgess R. (2011) A petrographic study of basaltic fragments in Apollo regolith sample 12003 (abs#2020). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Snee L.W. and Ahrens T.J. (1975a) Shock-induced deformation features in terrestrial peridot and lunar dunite. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 833-842.
- Snee L.W. and Ahrens T.J. (1975b) Shock-induced deformation features in terrestrial olivine and lunar dunite (abs). *Lunar Sci.* **VI**, 759-761. Lunar Planetary Institute, Houston.
- Snyder G.A., Taylor L.A., Liu Y.-G. and Schmit R.A. (1992a) Petrogenesis of the western highlands of the Moon: Evidence from a diverse group of whitlockite-rich rocks from the Fra Mauro formation. *Proc. 22<sup>nd</sup> Lunar Planet. Sci.* 399-416. Lunar Planetary Institute, Houston.
- Snyder G.A., Taylor L.A. and Neal C.R. (1992b) A chemical model for generating the sources of mare basalts: Combined equilibrium and fractional crystallization of the lunar magmasphere. *Geochim. Cosmochim. Acta* **56**, 3809-3823.
- Snyder G.A., Taylor L.A. and Crozaz G. (1993) Rare earth element selenochemistry of immiscible liquids and zircon at Apollo 14: An ion probe study of evolved rocks on the moon. *Geochim. Cosmochim. Acta* **57**, 1143-1149.
- Snyder G.A., Jerde E.A., Taylor L.A., Lee D.-C. and Halliday A.N. (1994a) A sortie for pristine rocks at Mare Tranquillitatis: A ferroan anorthosite, a new Group D basalt, and the isotopic composition of Group D high-Ti basalts (abs). *Lunar Planet. Sci.* **XXV**, 1299-130. Lunar Planetary Institute, Houston.
- Snyder G.A., Lee D.-C., Taylor L.A., Halliday A.N. and Jerde E.A. (1994b) Evolution of the upper mantle of the Earth's moon: Neodymium and strontium isotopic constraints from high-Ti mare basalts. *Geochim. Cosmochim. Acta* **58**, 4795-4808.
- Snyder G.A., Taylor L.A. and Halliday A.N. (1995a) Chronology and petrogenesis of the lunar highlands alkali suite: Cumulates from KREEP basalt crystallization. *Geochim. Cosmochim. Acta* **59**, 1185-1203.
- Snyder G.A., Neal C.R., Taylor L.A. and Halliday A.N. (1995b) Processes involved in the formation of magnesian-suite plutonic rocks from the highlands of the Earth's moon. *J. Geophys. Res.* **100**, 9365-9388.
- Snyder G.A., Hall C.M., Lee D.C., Taylor L.A. and Halliday A.N. (1996) Earliest high-Ti volcanism on the Moon: <sup>40</sup>Ar-<sup>39</sup>Ar, Sm-Nd and Rb-Sr isotopic studies of group D basalts from the Apollo 11 landing site. *Meteor. & Planet. Sci.* **31**, 328-334.

Snyder G.A., Neal C.R., Taylor L.A. and Halliday A.N. (1997a) Anataxis of lunar cumulate mantle in time and space: Clues from trace-element, strontium and neodymium isotopic chemistry of parental Apollo 12 basalts. *Geochim. Cosmochim. Acta* **61**, 2731-2747.

Snyder G.A., Borg L.E., Lee D.C., Taylor L.A., Nyquist L.E. and Halliday A.N. (1997b) Nd-Sr-Hf isotopic and geochronologic studies of Apollo 15 basalts (abs#1505). *Lunar Planet. Sci.* **XXVIII**, 1347-1348. Lunar Planetary Institute, Houston.

Snyder G.A., Neal C.R., Jain J. and Taylor L.A. (1997c) A sortie for pristine rocks in lunar soils: 1. Trace-element compositions of basalts and impact melts from Apollo 12 (abs#1502). *Lunar Planet. Sci.* **XXVIII**, Lunar Planetary Institute, Houston.

Snyder G.A., Taylor L.A. and Jerde E.A. (1997) "New" basalts at Mare Tranquilitatis: A sortie for pristine rocks in soil 10085 (abs#1498). *Lunar Planet. Sci.* **XXVIII**, Lunar Planetary Institute, Houston.

Snyder G.A., Borg L.E., Taylor L.A., Nyquist L.E. and Halliday A.N. (1998) Volcanism in the Hadley-Apennine region of the Moon: Geochronology, Nd-Sr isotopic systematics and depths of melting (abs#1141). *Lunar Planet. Sci.* **XXIX**, Lunar Planetary Institute, Houston.

Snyder G.A., Borg L.E., Lee D.C., Nyquist L.E., Taylor L.A. and Halliday A.N. (1999a) Volcanism in the Hadley-Apennine region of the Moon: Chronology, Nd-Sr-Hf isotopic systematics and petrogenesis of Apollo 15 mare basalts. *Geochim. Cosmochim. Acta* (say what?)

Snyder G.A., Lee D.C., Taylor L.A. and Halliday A.N. (1999b) Earliest lunar volcanism: An alternative interpretation of the Apollo 14 high-Al basalts from Nd-Sr-Hf isotopic studies. *Meteor. & Planet. Sci.* (say what?)

Snyder G.A., Borg L.E., Nyquist L.E. and Taylor L.A. (2000) Chronology and isotopic constraints on lunar evolution. In **Origin of the Earth and Moon**. 361-396. (ed. Canup and Righter) U. Arizona Press.

Snyder G.A. and Taylor L.A. (2001) Oldest mare basalts or Impact melts? The role of differential melting of plagioclase in Apollo 14 high-Al basalts (abs). *Meteoritics & Planet. Sci.* **36**, A194.

Snyder G.A., Lee D.C., Ruzicka A., Prinz M., Halliday A.N. and Taylor L.A. (2001) Hf-W, Sm-Nd, and Rb-Sr isotopic evidence of late impact fractionation and mixing of silicates on iron meteorite parent bodies. *Earth Planet. Sci. Lett.* **186**, 311-324.

Sobolev A.V., Dmitriev L.V., Barsukov V.L., Nevsorov V.N. and Slutsky A.B. (1980) The formation conditions of the high-magnesium olivines from the monomineralic fraction of Luna 24 regolith. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 106-116.

Sokol A.K and 12 authors (2008) Kalahari 008 and 009: New constraints on early lunar evolution. *Geochim. Cosmochim. Acta* **72**, 4845-4873.

Soloman S.C. and Longhi J. (1977) Magma oceanography: Thermal evolution. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 583-599.

Space Studies Board (2007) The Scientific Context for the Exploration of the Moon: Final Rpt. Nat. Acad. Press.

Spangler R.R. and Delano J.W. (1984) History of the Apollo 15 yellow impact glass and samples 15426 and 15427. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **89**, B478-B486.

Spangler R.R., Warasila R. and Delano J.W. (1984) <sup>39</sup>Ar-<sup>40</sup>Ar ages for the Apollo 15 green and yellow volcanic glasses. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **89**, B487-497.



- Spera F.J. (1992) Lunar magma transport phenomena. *Geochim. Cosmochim. Acta* **56**, 2253-2265.
- Spicuzza M.J., Day J.M.D., Taylor L.A. and Valley J.W. (2007) Oxygen isotope constraints on the origin and differentiation of the Moon. *Earth Planet. Sci. Lett.* **253**, 254-265.
- Spicuzza M.J., Valley J.W., Kitajima K. and Ushikubo T. (2011) Oxygen isotope ratios and trace element concentrations in zircons from lunar rocks and regolith (abs#2445). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Spicuzza M.J., Valley J.W., Fournelle J., Huberty J.M. and Trieman A. (2011) Native silicon and Fe-silicides from the Apollo 16 lunar regolith: Extreme reduction, metal-silicate immiscibility and shock melting (abs#2231). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Spudis P.D. and Head J.W. (1977) Geology of the Imbrium Basin Apennine Mountains and relation to the Apollo 15 landing site. *Proc. 8<sup>th</sup> Lunar Planet. Sci. Conf.* 2785-2797.
- Spudis P.D. (1978) Composition and origin of the Apennine Bench Formation. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 3379-3394.
- Spudis P.D. (1993) **The Geology of Multi-Ring Impact Basins: The Moon and Other Planets.** Cambridge Univ. Press, pp. 263.
- Spudis P.D. and Ryder G. (1981) Apollo 17 impact melts and their relation to the Serenitatis basin. *In Proc. of the Conf. on Multi-Ring Basins. Proc. Lunar Planet. Sci. 12A - Geochim. Cosmochim. Acta, Suppl. 15.* Pergamon Press. 133-148.
- Spudis P.D. and Ryder G. (1985) Geology and petrology of the Apollo 15 landing site: Past, present, and future understanding. *EOS Trans. AGU* **66**, 721-726.
- Spudis P.D. and Davis P.A. (1986) A chemical and petrological model of the lunar crust and implications for lunar crustal origin. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf. in J. Geophys. Res.* **91**, E84-E90.
- Spudis P.D., Ryder G., Taylor G.J., McCormick K.A., Keil K. and Grieve R.A.F. (1991) Sources of mineral fragments in impact melts, 15445 and 15455: Toward the origin of low-K Fra Mauro basalt. *Proc. 21<sup>st</sup> Lunar Planet. Sci. Conf.* 151-165. Lunar Planetary Institute, Houston.
- Spudis Paul and Taylor GeeJeff (2009) A major KREEP-basalt – Mare basalt unconformity on the Moon (abs#1039). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute @ The Woodlands.
- Spudis P., Wilhelms D. and Robinson Mark (2011) The Sculptured Hills of the Tarasus Highlands: Implications for the relative age of Serenitatis, basin chronology and cratering history of the Moon. *J. Geophys. Res.* **116**, E00H03
- Srinivasan B. (1973) Variation in the isotopic composition of trapped rare gases in lunar sample 14318. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2049-2064.
- Srinivasan B. (1974) Lunar breccia 14066: <sup>81-83</sup>Kr exposure age, evidence for fissionogenic xenon from <sup>244</sup>Pu and rate of production of spallogenic <sup>126</sup>Xe. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2033-2044.
- Stadermann F.J., Heusser E., Jessberger E.K., Lingner S. and Stoffler D. (1991) The case for a younger Imbrium basin: New <sup>40</sup>Ar-<sup>39</sup>Ar ages of Apollo 14 rocks. *Geochim. Cosmochim. Acta* **55**, 2339-2349.
- Stanin F.T. and Taylor L.A. (1979a) Armalcolite/ilmenite: Mineral chemistry, paragenesis, and origin of textures. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 383-405.

- Stanin F.T. and Taylor L.A. (1979b) Ilmenite/armalcolite: Effects of rock composition, oxygen fugacity, and cooling rate (abs). *Lunar Planet. Sci.* **X**, 1160-1162. Lunar Planetary Institute, Houston.
- Stanin F.T. and Taylor L.A. (1980a) Armalcolite: an oxygen fugacity indicator. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 117-124.
- Stanin F.T. and Taylor L.A. (1980b) An oxygen geobarometer for lunar high-titanium basalts (abs). *Lunar Planet. Sci.* **XI**, 1079-1081. Lunar Planetary Institute, Houston.
- Staudacher T., Jessberger E.K. and Kirsten Till (1977)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  age systematics of consortium breccia 73215 (abs). *Lunar Sci.* **VIII**, 896-898. Lunar Planetary Institute, Houston.
- Staudacher T., Dominik B., Jessberger E.K. and Kirsten T. (1978) Consortium breccia 73255:  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  dating (abs). *Lunar Planet. Sci.* **IX**, 1098-1100. Lunar Planetary Institute, Houston.
- Staudacher T., Jessberger E.K., Flohs I. and Kirsten T. (1979a)  $^{40}\text{Ar}$ / $^{39}\text{Ar}$  age systematics of consortium breccia 73255. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 745-762.
- Staudacher T., Dominik B., Flohs I., Jessberger E.K. and Kirsten T. (1979b) New  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  ages for aphanites and clasts of consortium breccia 73255 (abs). *Lunar Planet. Sci.* **X**, 1163-1165. Lunar Planetary Institute, Houston.
- Steiger R.H. and Jaeger E. (1977) Subcommittee on geochronology: Convention on the use of decay constants in geo- and cosmochemistry. *Earth Planet. Sci. Lett.* **36**, 359-362.
- Steele Andy, McCubbin F.M., Fries M., Glamoclija M., Kater L. and Nekvasil H. (2010) Graphite in an Apollo 17 impact melt breccia. *Science* **329**, 51.
- Steele Andy, McCubbin F.M., Fries M., Glamoclija M., Kater L. and Nekvasil H. (2011) Graphite in an Apollo 17 impact melt breccia (abs#1585). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Steele Alison M. (1992) Apollo 15 green glass: Relationships between texture and composition. *Proc. 22<sup>nd</sup> Lunar Planet. Sci. Conf.* 329-341. Lunar Planetary Institute, Houston.
- Steele A.M., Colson R.O., Korotev R.L. and Haskin L.A. (1992) Apollo 15 green glass: Compositional distributions and petrogenesis. *Geochim. Cosmochim. Acta* **56**, 4075-4090.
- Steele Ian M. (1972) Chromian spinels from Apollo 14 rocks. *Earth Planet. Sci. Lett.* **14**, 190-194.
- Steele I.M. (1974) Ilmenite and armalcolite in Apollo 17 breccias. *Am. Mineral.* **59**, 681-689.
- Steele I.M. (1975) Mineralogy of lunar norite 78235: Second lunar occurrence of P21ca pyroxenes from Apollo 17 soils. *Am. Mineral.* **60**, 1086-1091.
- Steele I.M. and Smith J.V. (1971a) Mineralogy of Apollo 15415 "Genesis Rock": Source of anorthosite on the moon. *Nature* **234**, 138-140.
- Steele I.M. and Smith J.V. (1971b) Mineral and bulk compositions of three fragments from Luna 16. *Earth Planet. Sci. Lett.* **13**, 323-327.
- Steele I.M. and Smith J.V. (1972a) Ultrabasic lunar samples. *Nature* **240**, 5-6.
- Steele I.M. and Smith J.V. (1972b) Occurrence of diopside and Cr-Zr armalcolite on the Moon. *Nature Phys. Sci.* **237**, 105-106.

- Steele I.M. and Smith J.V. (1972c) Apollo 16 rake samples 67515 to 68537: Sample classification, description and inventory. Curator Catalog, JSC
- Steele I.M., Smith J.V. and Grossman Larry (1972a) Mineralogy and petrology of Apollo 15 rake samples: I. Basalts. In **The Apollo 15 Lunar Samples** 158-160. Lunar Planetary Institute, Houston.
- Steele I.M., Smith J.V. and Grossman L. (1972b) Mineralogy and petrology of Apollo 15 rake samples: II. Breccias. In **The Apollo 15 Lunar Samples** 161-164. Lunar Planetary Institute, Houston.
- Steele I.M. and Smith J.V. (1973) Compositional and X-ray data for Luna 20 feldspar. *Geochim. Cosmochim. Acta* **37**, 1075-1078.
- Steele I.M. and Smith J.V. (1973) Mineralogy and petrology of some Apollo 16 rocks and fines: General petrologic model of the moon. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 519-536.
- Steele I.M. and Smith J.V. (1975) Minor elements in lunar olivine as a petrologic indicator. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 451-467.
- Steele I.M. and Smith J.V. (1976) Mineralogy and petrology of complex breccia 14063. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1949-1964.
- Steele I.M. and Smith J.V. (1980) Ion-probe determination of Li, Na, Mg, Ti, Sr and Ba in lunar plagioclase (abs). *Lunar Planet. Sci.* **XI**, 1085-1087. Lunar Planetary Institute, Houston.
- Steele I.M., Hutcheon I.D. and Smith J.V. (1980) Ion microprobe analysis and petrogenetic interpretations of Li, Mg, Ti, K, Sr, Ba in lunar plagioclase. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 571-590.
- Steiger R.H. and Jager E. (1977) Subcommittee on geochronology: Convention on the use of decay constants in geo- and cosmochronology. *Earth Planet. Sci. Lett.* **36**, 359-362.
- Stephenson A., Collinson D.W. and Runcorn S.K. (1974) Lunar magnetic field paleointensity determinations on Apollo 11, 16, and 17 rocks. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2859-2871.
- Stephenson A., Collinson D.W. and Runcorn S.K. (1978) Rock magnetic and paleomagnetic studies on Luna 24 samples. In **Mare Crisium: The view from Luna 24**. *Geochem. Cosmochim. Acta suppl.* 9, 701-709. (ed. Merrill) Pergamon Press.
- Stephenson A., Runcorn S.K. and Collinson D.W. (1975) On changes in intensity of the ancient lunar magnetic field. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3049-3062.
- Stephenson A., Runcorn S.K. and Collinson D.W. (1977) Paleointensity estimates from lunar samples 10017 and 10020. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 679-687.
- Stettler A., Eberhardt Peter, Geiss J., Grogler N. and Maurer P. (1973)  $Ar^{39}$ - $Ar^{40}$  ages and  $Ar^{37}$ - $Ar^{38}$  exposure ages of lunar rocks. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1865-1888.
- Stettler A., Eberhardt P., Geiss J., Grogler N. and Maurer P. (1974a) On the duration of the lava flow activity in Mare Tranquillitatis. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1865-1888.
- Stettler A., Eberhardt P., Geiss J. and Grogler N. (1974b)  $^{39}Ar$ - $^{40}Ar$  ages of samples from the Apollo 17 Station 7 boulder and implications for its formation. *Earth Planet. Sci. Lett.* **23**, 453-461.
- Stettler A., Eberhardt P., Geiss J., Grogler N. and Maurer P. (1974c) Sequence of terra rock formation and basaltic lava flows on the moon. *Lunar Sci.* **V**, 738-740.

- Stettler A., Eberhardt P., Geiss J., Grogler N. and Guggisberg S. (1975) Age sequence in the Apollo 17 Station 7 boulder (abs). *Lunar Sci.* **VI**, 771-773. Lunar Planetary Institute, Houston.
- Stettler A. and Albarede Frank (1977) Ar<sup>39</sup>-Ar<sup>40</sup> pattern and light noble gas systematics of two mm-sized rock fragments from Mare Crisium (abs). *In Conf. on Luna* **24**. 175-178. Lunar Planetary Institute, Houston.
- Stettler A. and Albarede F. (1978) Ar<sup>39</sup>-Ar<sup>40</sup> systematics of two mm-sized rock fragments from Mare Crisium. *Earth Planet. Sci. Lett.* **38**, 401-406.
- Stettler A., Eberhardt P., Geiss J., Grogler N. and Guggisberg S. (1978) Chronology of the Apollo 17 Station 7 Boulder and the South Serenitatis impact (abs). *Lunar Planet. Sci.* **IX**, 1113-1115. Lunar Planetary Institute, Houston.
- Stewart D.B., Appleman D.E., Huebner J.S. and Clark J.R. (1970) Crystallography of some lunar plagioclase. *Science* **167**, 634-635.
- Stewart D.B. (1975) Apollonian metamorphic rocks--The products of prolonged subsolidus equilibration (abs). *Lunar Sci.* **VI**, 774-776. Lunar Planetary Institute, Houston.
- Stoener R.W., Lindstrom R.M., Lyman W. and Davis R. (1972) Argon, radon, and tritium radioactivities in the sample return container and the lunar surface. *Proc. 3<sup>rd</sup> Lunar Science Conf.* 1703-1717.
- Stoener R.W., Davis R., Norton E. and Bauer M. (1974) Radioactive rare gases, tritium, hydrogen and helium in the sample return container and in the Apollo 16 and 17 drill stems. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2211-2230.
- Stoeser D.B., Marvin U.B., Wood J.A., Wolfe R.W. and Bower J.F. (1974a) Petrology of a stratified boulder from South Massif, Taurus-Littrow. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 355-377.
- Stoeser D.B., Wolfe R.W., Marvin U.B., Wood J.A. and Bower J.F. (1974b) Petrographic studies of a boulder from the South Massif (abs). *Lunar Sci.* **V**, 743-745. Lunar Planetary Institute, Houston.
- Stoeser D.B., Wolfe R.W., Wood J.A. and Bower J.F. (1974c) Petrology and petrogenesis of boulder 1. In *Interdisciplinary Studies of Samples from Boulder 1, Station 2, Apollo 17. Volume 1, Consortium Indomitabile. Smithsonian Astrophysical Observatory.* Also Lunar Science Institute Cont. no. 210D, 35-109. (grey literature)
- Stoeser D.B., Marvin U.B. and Bower J.F. (1974d) Petrology and petrogenesis of boulder 1. In *Interdisciplinary Studies of Samples from Boulder 1, Station 2, Apollo 17. Volume 2, Consortium Indomitabile. Smithsonian Astrophysical Observatory.* Also Lunar Science Institute Cont. no. 21 ID, 1-59.
- Stoeser D.B., Ryder G. and Marvin U.B. (1975) Lunar granite clasts with unique ternary feldspars (abs). *Lunar Sci.* **VI**, 780-782. Lunar Planetary Institute, Houston.
- Stöffler Dieter (1989) Brecciated nature of the Apollo 14 lunar samples: A review. *In Workshop on the Moon in Transition: Apollo 14, KREEP and evolved rocks.* (eds. Taylor and Warren) LPI Tech Rpt. 89-03, 138-144. Lunar Planetary Institute, Houston.
- Stöffler D. (1972) Deformation and transformation of rock-forming minerals by natural and experimental shock processes. I Behavior of minerals under shock compression. *Forschr. Miner.* **49**, 50-113.
- Stöffler D. (1974) Deformation and transformation of rock-forming minerals by natural and experimental shock processes. II Physical properties of shocked minerals. *Forschr. Miner.* **51**, 256-287.

Stöffler D., Dence M.R., Graup G. and Abadian M. (1974) Interpretation of ejecta formations at the Apollo 14 and 16 sites by a comparative analysis of experimental, terrestrial and lunar craters. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 137-150.

Stöffler D., Schelien S. and Ostertag R. (1975) Rock 61016: Multiphase shock and crystallization history of a polymict troctolite-anorthosite breccia. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 673-692.

Stöffler D., Knoll H-D., Reimold W.U. and Schulien S. (1976) Grain size statistics, composition and provenance of fragmental particles in some Apollo 14 breccias. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1965-1985.

Stöffler D. and Knoll H-D. (1977) Composition and origin of plagioclase, pyroxene and olivine clasts of lunar breccias 14006, 14063, 14066, 14311, 14320 and 14321. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1849-1867.

Stöffler D., Knoll H-D. and Maerz U. (1979) Terrestrial and lunar impact breccias and the classification of lunar rocks. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 639-675.

Stöffler D., Knoll H-D., Marvin U.B., Simonds C.H. and Warren P.H. (1980) Recommended classification and nomenclature of lunar highland rocks - a committee report. *In Proc. of the Conf. on **The Lunar Highlands Crust***. (Merrill and Papike eds.) *Geochim. Cosmochim. Acta, Suppl.* 12, 51-70. Pergamon Press

Stöffler D., Ostertag R., Reimold W.U., Borchardt R., Malley J. and Rehfeldt A. (1981) Distribution and provenance of lunar highland rock types at North Ray Crater, Apollo 16. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 185-207.

Stöffler D., Bischoff A., Borchardt R., Burghelle A., Deutsch A., Jessberger E.K., Ostertag R., Palme H., Spettel B., Reimold W.U., Wacker K. and Wanke H. (1985) Composition and evolution of the lunar crust in the Descartes highlands. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **90**, C449-C506.

Stöffler D., Bode K.D., Jessberger E.K., Lingner S., Palme H., Spettel B., Stadermann F.J. and Wanke H. (1989) Fra Mauro Formation, Apollo 14: IV Synopsis and Synthesis of Consortium Studies. *In Workshop on the **Moon in Transition: Apollo 14, KREEP** and evolved rocks.* (eds Taylor and Warren) LPI Tech Rpt. 89-03, 145-148. Lunar Planetary Institute, Houston.

Stöffler D. and Ryder G. (2001) Stratigraphy and isotopic ages of lunar geologic units: Chronological standard for the inner solar system. *Space Science Rev.* **96**, 9-54.

Stöffler D., Ryder G., Ivanov B.A., Artemieva N.A., Contala M.J. and Grieve R.A.F. (2006) Cratering history and lunar chronology. *In **New Views of the Moon*** (eds Jolliff et al). *Reviews in Mineralogy and Geochemistry* **60**, 519-596 MSA and Geo. Soc.

Stöffler D. and Grieve R.A.F. (2007) Towards a unified nomenclature of metamorphic petrology, Chapter 11: Impactites, A proposal on behalf of the IUGS Subcommittee on the Systematics of Metamorphic Rocks, IUGS Blackwell Publishers.

Stolper E.M. (1974) Lunar ultramafic glasses. A.B. thesis. Harvard Univ.

Stolper E.M., Walker D., Longhi J. and Hayes J.F. (1974) Compositional variation in lunar ultramafic glasses (abs). *Lunar Sci.* **V**, 749-751. Lunar Planetary Institute, Houston.

Stone C.D., Taylor L.A., McKay D.S. and Morris R.V. (1982) Ferromagnetic resonance intensity: A rapid method for determining lunar glass bead origin. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **87**, A182-A196.

Stone J. and Clayton R.N. (1989) Nitrogen isotopes in drive tube 79002/79001: Regolith history and nitrogen isotopic evolution in the solar wind. *Proc. 19<sup>th</sup> Lunar Planet. Sci. Conf.* 285-295.

- Storey W.C., Humphries D.J. and O'Hara M.J. (1974) Experimental petrology of sample 77135. *Earth Planet. Sci. Lett.* **23**, 435-438.
- Storzer D., Poupeau G. and Kratschmer W. (1973) Track-exposure and formation ages of some lunar samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2363-2377.
- Strangway D.W., Pearce G.W., Gose W.A. and Timme R.W. (1971) Remanent magnetization of lunar samples. *Earth Planet. Sci. Lett.* **13**, 43-52.
- Strangway D.W., Chapman W.B., Olhoeft G.R. and Carnes J. (1972) Electrical properties of lunar soil dependence on frequency, temperature and moisture. *Earth Planet. Sci. Lett.* **16**, 275-281.
- Strangway D.W. and Olhoeft G.R. (1977) Electrical properties of planetary surfaces. *Phil. Trans. Roy. Soc. London* **A285**, 441-450.
- Stasheim A., Jackson P.F.S., Coetzee J.H.J., Strelow F.W.E., Wybenga F.T., Gricius A.J., Kokot M.L. and Scott R.H. (1972a) Analysis of lunar samples 14163, 14259 and 14321 with isotopic data for  $^7\text{Li}/^6\text{Li}$ . *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1337-1342.
- Stasheim A., Coetzee J.H.J., Jackson P.F.S., Strelow F.W.E., Wybenga F.T., Gricius A.J. and Kokot M.L. (1972b) Analysis of lunar samples 15065, 15301, and 15556, with isotopic data for  $^7\text{Li}/^6\text{Li}$ . In **The Apollo 15 Lunar Samples** (Chamberlain and Watkins, eds.), 257-259. The Lunar Science Institute, Houston.
- Sugiura N., Strangway D.W. and Pearce G.W. (1978) Heating experiments and paleointensity determinations. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 3151-3163.
- Sugiura N., Wu Y.M., Strangway D.W., Pearce G.W. and Taylor L.A. (1979a) A new magnetic paleointensity value for a "young lunar glass." *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 2189-2197.
- Sugiura N., Wu Y.M., Strangway D.W., Pearce G.W. and Taylor L.A. (1979b) Paleointensity studies on 70019, a young glass sample from Apollo 17 (abs). *Lunar Planet. Sci.* **X**, 1195-1197. Lunar Planetary Institute, Houston.
- Sugiura N. and Strangway D.W. (1980a) Comparisons of magnetic paleointensity methods using a lunar sample. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1801-1813.
- Sugiura N. and Strangway D.W. (1980b) Thellier paleointensity: Studies of lunar samples (abs). *Lunar Planet. Sci.* **XI**, 1111-1113. Lunar Planetary Institute, Houston.
- Sugiura N. and Strangway D.W. (1983) Magnetic paleointensity determination on lunar sample 62235. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* A684-A690. *J. Geophys. Res.* **87**
- Sung C.-M., Abu-Eid R.M. and Burns R.G. (1974a)  $\text{Ti}^{3+}/\text{Ti}^{4+}$  ratios in lunar pyroxenes: implications to depth of origin of mare basalt magma. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 717-726.
- Sung C.-M., Abu-Eid R.M. and Burns R.G. (1974b) A search for trivalent titanium in Apollo 17 pyroxenes (abs). *Lunar Sci.* **V**, 758-760. Lunar Planetary Institute, Houston.
- Sutton R.L. (1981) Documentation of Apollo 16 samples. In *Geology of the Apollo 16 area, central lunar highlands.* (Ulrich et al.) U.S.G.S. Prof. Paper 1048.
- Sutton R.L., Batson R.M., Larson K.B., Schafer J.P., Eggleton R.E. and Swann G.A. (1971) Documentation of the Apollo 14 samples. U.S. Geological Survey, Rpt. 32.

- Sutton R.L. and Schaber G.G. (1971) Lunar locations and orientations of rock samples from Apollo missions 11 and 12. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 17-26.
- Sutton R.L., Hait M.H. and Swann G.A. (1972) Geology of the Apollo 14 landing site. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 27-38.
- Sutton R.L., Hait M.H., Larson K.B., Swann G.A., Reed V.S. and Schaber G.G. (1972) Documentation of Apollo 15 samples. Interagency report: *Astrogeology* **47**. USGS
- Sutton S.R. and others (1992) Reduced chromium in olivine grains from lunar basalt 15555: X-ray absorption near edge structure (XANES). *Geochim. Cosmochim. Acta* **57**, 461-468.
- Swann G.A., Trask N.J., Hait M.H. and Sutton R.L. (1971a) Geologic setting of the Apollo 14 samples. *Science* **173**, 716-719.
- Swann G.A., Bailey N.G., Batson R.M., Eggleton R.E., Hait M.H., Holt H.E., Larson K.B., Reed V.S., Schaber G.G., Sutton R.L., Trask N.J., Ulrich G.E. and Wilshire H.G. (1977) Geology of the Apollo 14 landing site in the Fra Mauro Highlands. U.S.G.S. Prof. Paper 880.
- Swann G.A., Bailey N.G., Batson R.M., Eggleton R.E., Hait M.H., Holt H.E., Larson K.B., McEwen M.C., Mitchell E.D., Schaber G.G., Schafer J.P., Shepard A.B., Sutton R.L., Trask N.J., Ulrich G.E., Wilshire H.G. and Wolfe E.W. (1972) 3. Preliminary Geologic Investigation of the Apollo 14 landing site. *In* Apollo 14 Preliminary Science Rpt. NASA SP-272. pages 39-85.
- Swann G.A., Hait M.H., Schaber G.C., Freeman V.L., Ulrich G.E., Wolfe E.W., Reed V.S. and Sutton R.L. (1971b) Preliminary description of Apollo 15 sample environments. U.S.G.S. Interagency report: 36. pp219 with maps
- Swann G.A., Bailey N.G., Batson R.M., Freeman V.L., Hait M.H., Head J.W., Holt H.E., Howard K.A., Irwin J.B., Larson K.B., Muehlberger W.R., Reed V.S., Rennilson J.J., Schaber G.G., Scott D.R., Silver L.T., Sutton R.L., Ulrich G.E., Wilshire H.G. and Wolfe E.W. (1972) 5. Preliminary Geologic Investigation of the Apollo 15 landing site. *In* Apollo 15 Preliminary Science Rpt. NASA **SP-289**. pages 5-1-112.
- Swann G.A., Bailey N.G., Batson R.M., Freeman V.L., Hait M.H., Head J.W., Holt H.E., Howard K.A., Irwin J.B., Larson K.B., Muehlberger W.R., Reed V.S., Rennilson J.J., Schaber G.G., Scott D.R., Silver L.T., Sutton R.L., Ulrich G.E., Wilshire H.G. and Wolfe E.W. (1971) Geologic setting of the Apollo 15 samples. *Science* **175**, 407
- Schwarz C., Morris R.V. and Korotev R.L. (1994) Preliminary description of double drive tube 68002/1 (abs). *Lunar Planet. Sci.* **XXV**, 1223.
- Swindle T.D., Caffee M.W., Hohenberg C.M., Hudson G.B., Laul J.C., Simon S.B. and Papike J.J. (1985) Noble gas component organization in Apollo 14 breccia 14318: <sup>129</sup>I and <sup>244</sup>Pu regolith chronology. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **89**, C517-C539.
- Swindle T.D., Spudis P.D., Taylor G.J., Korotev R.L., Nichols R.H. and Olinger C.T. (1990) Searching for Crisium basin ejecta: Chemistry and ages of Luna 20 impact melts (abs). *Lunar Planet. Sci.* **XVI**, 1229-1230.
- Swindle T.D., Spudis P.D., Taylor G.J., Korotev R.L., Nichols R.H. and Olinger C.T. (1991) Searching for Crisium basin ejecta: Chemistry and ages of Luna 20 impact melts. *Proc. 21<sup>st</sup> Lunar Planet. Sci.* 167-181. Lunar Planetary Institute, Houston.

- Swindle T.D. and Kring D.A. (2008) Chronological evidence for the late heavy bombardment in ordinary chondrite meteorites (abs). *In* Workshop on **Early Solar System Bombardment**. Lunar Planetary Institute, Houston.
- Swindle T.D., Beard S.P., Isachsen C.E. and Kring D.A. (2012) Ar-Ar ages of centimeter-sized impact melt clasts from ancient regolith breccias 60016 (abs#5048). *75<sup>th</sup> Meteoritical Society @ Cains*
- Switkowski Z.E., Haff P.K., Tombrello T.A. and Burnett D.S. (1977) Mass fractionation of the lunar surface by solar wind sputtering. *J. Geophys. Res.* **82**, 3797-3804.
- Symes S.J.K., Sears D.W.G., Taunton A., Akridge D.G., Yanghong Zhang and Benoit P.H. (1998) The crystalline lunar spherules: Their formation and implications for the origin of meteoritic chondrules. *Meteorit. Planet. Sci.* **33**, 13-29.
- Tagle Roald (2005) LL-ordinary chondrite impact on the Moon: Results from the 3.9 GA impact melt at the landing site of Apollo 17 (abs#2008). *Lunar Planet. Sci.* **XXXVI**, Lunar Planetary Inst. Houston
- Takeda H. (1972) Structural studies of rim augite and core pigeonite from lunar rock 12052. *Earth Planet. Sci. Lett.* **15**, 65-71.
- Takeda H. (1973) Inverted pigeonites from a clast of rock 15459 and basaltic achondrites. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 875-885.
- Takeda H. and Ridley W.I. (1972) Crystallography and chemical trends of orthopyroxene-pigeonite from rock 14310 and coarse fine 12033. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 423-430.
- Takeda H. and Ishii T. (1975) Typical processes of exsolution, decomposition and inversion of pyroxenes and its bearing on thermal history of lunar rocks (abs). *Lunar Sci.* **VI**, 795-797. Lunar Planetary Institute, Houston.
- Takeda H. and Miyamoto M. (1976) Characterization of crust formation on a parent body of achondrites and the Moon by pyroxene crystallography and chemistry (abs). *Lunar Sci.* **VII**, 846-848. Lunar Planetary Institute, Houston.
- Takeda H. and Miyamoto M. (1977a) Inverted pigeonites from lunar breccia 76255 and pyroxene-crystallization trends in lunar and achondritic crusts. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2617-2626.
- Takeda H. and Miyamoto M. (1977b) Inverted pigeonites from lunar breccia 76255 and pyroxene-crystallization trends in lunar and achondritic crusts (abs). *Lunar Sci.* **VIII**, 922-924. Lunar Planetary Institute, Houston.
- Takeda H., Miyamoto M., Ishii T. and Lofgren G.E. (1975) Relative cooling rates of mare basalts at the Apollo 12 and 15 sites as estimated from pyroxene exsolution data. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 987-996.
- Takeda H., Miyamoto M., Ishii T. and Reid A.M. (1976) Characterization of crust formation on a parent body of achondrites and the Moon by pyroxene crystallography and chemistry. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 3535-3548.
- Takeda H., Miyamoto M., Duke M. and Ishii T. (1978) Crystallisation of pyroxenes in lunar KREEP basalt 15386 and meteoritic basalts. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 1157-1171.
- Takeda H., Miyamoto M. and Ishii T. (1979) Pyroxenes in the early crustal cumulates found in achondrites and lunar highland rocks. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1095-1107.
- Takeda H., Miyamoto M. and Ishii T. (1980) Composition of basaltic clasts in lunar and eucrite polymict breccias. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 135-147.



- Takeda H., Mori H., Ishii T. and Miyamoto M. (1981) Thermal and imp[act histories of pyroxenes in lunar eucrite-like gabbros and eucrites. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 1297-1313.
- Takeda H., Mori H. and Miyamoto M. (1982) Comparison of thermal history of orthopyroxenes between lunar norites 78236, 72255, and diogenites. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **87** A124-A130.
- Takeda H., Miyamoto M. and Ishii T. (1983) Mineralogical comparison of lunar and chondritic vesicular melt breccias (abs). *Lunar Planet. Sci.* **XIV**, 771-772. Lunar Planetary Institute, Houston.
- Takeda H., Mori H., Ishii T. and Miyamoto M. (1984) Mesostasis-rich lunar and eucritic basalts with reference to REE-rich minerals (abs). *Lunar Planet. Sci.* **XV**, 842-843.
- Takeda H., Miyamoto M., Galindo C. and Ishii T. (1987) Mineralogy of a basaltic clast in lunar highland regolith breccia 60019. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.*, in *J. Geophys. Res.* **92**, E462-E470.
- Takeda H., Miyamoto M., Mori H. and Tagai T. (1988) Mineralogical studies of clasts in lunar highland regolith breccia 60019 and in lunar meteorite Y82129. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 33-43. Lunar Planet. Institute, Houston.
- Takeda H., Miyamoto M., Mori H., Wentworth S.J. and McKay D.S. (1990) Mineralogical comparison of the Y86032-type lunar meteorites to feldspathic fragmental breccia 67016. *Proc. 20<sup>th</sup> Lunar Planet. Sci. Conf.*, 91-100. Lunar Planet. Institute, Houston.
- Takeda H., Yamaguchi A., Bogard D.D., Karouji Y., Ebihara M., Ohtake M., Saiki K and Ari T. (2006) Magnesian anorthosites and a deep crustal rock from the farside crust of the moon. *Earth Planet. Sci. Lett.* **247**, 171-184.
- Talwani P., Nur A. and Kovach R.L. (1974) Implications of elastic wave velocities for Apollo 17 rock powders. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2919-2926.
- Tanaka S., Sakamoto K. and Komura K. (1972) Aluminum 26 and manganese 53 produced by solar-flare particles in lunar rock and cosmic dust. *J. Geophys. Res.* **77**, 4281-4288.
- Tanaka T., Kurasawa H., Nakamura N. and Masuda A. (1973) Rare earth elements in fines 74220 (abs). *EOS Trans. AGU* **54**, 614.
- Tanaka T., Masuda A., Kurasawa H. and Nakamura N. (1974) Determination of REE and Ba in five Apollo 17 samples (abs). *Lunar Sci.* **V**, 772-774. Lunar Planetary Institute, Houston.
- Tanimizu M. and Tanaka T. (2002) Coupled Ce-Nd isotopic systematics and rare earth elements differentiation of the moon. *Geochim. Cosmochim. Acta* **66**, 4007-4014.
- Tarasov L.S., Nazarov M.A., Shevaleevsky I.D., Makarov E.S. and Ivanov V.I. (1973) Mineralogy of anorthositic rocks from the region of the Crater Apollonius C (Luna-20). *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 333-349.
- Tarasov L.S., Nazarov M.A., Shevaleevsky I.D., Kudryashova A.F., Gaverdovskaya A.S. and Korina M.I. (1977) Mineralogy and petrography of lunar rocks from Mare Crisium. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3333-3356.
- Tatsumoto M. (1970) Age of the Moon: An isotopic study of U-Th-Pb systematics of Apollo 11 lunar samples - II. *Proc. Apollo 11 Lunar Sci. Conf.* 1595-1612.
- Tatsumoto M. (1970) U-Th-Pb age of Apollo 12 rock 12013. *Earth Planet. Sci. Lett.* **9**, 193-200.

- Tatsumoto M. (1973) U-Th-Pb measurements of Luna 20 soil. *Geochim. Cosmochim. Acta* **37**, 1079-1086.
- Tatsumoto M., Knight R.J. and Doe B.R. (1971) U-Th-Pb systematic of Apollo lunar samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1521-1546.
- Tatsumoto M., Hedge C.E., Doe B.R. and Unruh D.M. (1972a) U-Th-Pb and Rb-Sr measurements on some Apollo 14 lunar samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1531-1555.
- Tatsumoto M., Hedge C.E., Knight R.J., Unruh D.M. and Doe Bruce R. (1972b) U-Th-Pb, Rb-Sr and K measurements on some Apollo 15 and Apollo 16 samples. In **The Apollo 15 Lunar Samples** (Chamberlain and Watkins, eds) 391-395. Lunar Planetary Institute, Houston.
- Tatsumoto M., Nunes P.D., Knight R.J., Hedge C.E. and Unruh D.M. (1973) U-Th-Pb, Rb-Sr, and K measurements of two Apollo 17 samples (abs). *EOS Trans. AGU* **54**, 614-615.
- Tatsumoto M., Nunes P.D., Knight R.J. and Unruh D.M. (1974) Rb-Sr and U-Th-Pb systematics of boulders 1 and 7, Apollo 17 (abs). *Lunar Sci.* **V**, 774-776. Lunar Planetary Institute, Houston.
- Tatsumoto M. and Unruh D.M. (1976) KREEP basalt age: Grain by grain U-Th-Pb systematic study of the quartz monozodiorite clast 15405,88. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2107-2129.
- Tatsumoto M., Premo W. and Unruh D.M. (1987) Origin of lead from green glass of Apollo 15426: A search for primitive lunar lead. *Proc. Lunar Planet. Sci. Conf. 17<sup>th</sup>*, in *J. Geophys. Res.* **92**, E361-E371.
- Taylor D.J., McKeegan K.D., Harrison T.M. and McCulloch M. (2007)  $^{176}\text{Lu}/^{176}\text{Hf}$  in lunar zircons: Identification of an early enriched reservoir on the moon (abs#2130). *Lunar Planet. Sci.* **XXXVIII**, Lunar Planetary Institute, Houston.
- Taylor D.J., McKeegan K.D. and Harrison T.M. (2007) Correlated study of Lu-Hf and REE in lunar zircons, with implication for the differentiation age of KREEP (abs). *Meteoritical Soc. Tucson*.
- Taylor D.J., McKeegan K.D. and Harrison T.M. (2007)  $^{176}\text{Lu}-^{176}\text{Hf}$  zircon evidence for rapid lunar differentiation (abs). In *Workshop on Chronology of Meteorites*. Meteoritical. Soc. Hawaii.
- Taylor D.J., McKeegan K.D., Young E.D. and Harrison T.M. (2008) LA-MC-ICPMS Lu-Hf isotopes in lunar zircons: Reliability of peak stripping protocol (abs#2354). *Lunar Planet. Sci.* **XXXIX**, Lunar Planetary Institute, Houston.
- Taylor D.J., McKeegan K.D. and Harrison T.M. (2009) Lu-Hf zircon evidence for rapid lunar differentiation. *Earth Planet. Sci. Lett.* **279**, 157-164.
- Taylor G.J. (1972) Anorthositic lithic fragments in the Apollo 15 soils and fractional crystallization in the early lunar crust. In **The Apollo 15 Lunar Samples**, 165-168. Lunar Planetary Institute, Houston.
- Taylor G.J. (1994) Legacy of Apollo. *Sci. Amer.* **271**, 40-47.
- Taylor G.J. (1991) Impact melts in the MAC88105 lunar meteorite: Inferences. *Geochim. Cosmochim. Acta* **55**, 3031-3036.
- Taylor G.J. (2009) Ancient lunar crust: origin, composition and implications. *Elements* **5**, 17-22.
- Taylor G.J. and Marvin U.B. (1971) A dunite-norite lunar microbreccia. *Meteoritics* **6**, 173-180.
- Taylor G.J., Marvin U.B., Ried J.B. and Wood J.A. (1972) Noritic fragments in the Apollo 14 and 12 soils and the origin of Oceanus Procellarum. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 995-1014.

- Taylor G.J., Drake M.J., Wood J.A. and Marvin U.B. (1973a) The Luna 20 lithic fragments and the composition and origin of the lunar highlands. *Geochim. Cosmochim. Acta* **37**, 1087-1106.
- Taylor G.J., Drake M.J., Hallam M.E., Marvin U.B. and Wood J.A. (1973b) Apollo 16 stratigraphy: The ANT hills, the Cayley Plains and a pre-Imbrian regolith. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 553-568.
- Taylor G.J., Keil K. and Warner R.D. (1977a) Very low-Ti basalts. *Geophys. Res. Lett.* **4**, 207-210.
- Taylor G.J., Keil K. and Warner R.D. (1977b) Petrology of Apollo 17 deep drill core. I: Depositional history based on modal analysis of 70007, 70008 and 70009. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3195-3222.
- Taylor G.J., Warner R.D. and Keil K. (1977) Chemical distinctions among very low-Ti mare basalts. In Papers Presented to the **Conference on Luna 24**, 183-185. Lunar Science Institute, Houston.
- Taylor G.J., Wentworth S. and Warner R.D. (1978) Petrology of Apollo 17 deep drill core. II: Agglutinates as recorders of fossil soil compositions. *Proc. 9<sup>th</sup> Lunar Planet Sci. Conf.* 1959-1968.
- Taylor G.J., Warner R.D. and Keil K. (1978) VLT mare basalts: Impact mixing, parent magma types, and petrogenesis. In **Mare Crisium: The View from Luna 24**. (ed. Merrill R.B. and Papike J.J.) *Geochim. Cosmochim. Acta Suppl.* **9**, 357-370.
- Taylor G.J., Warner R.D., Wentworth S., Keil K. and Sayeed U. (1978) Luna 24 lithologies: Petrochemical relationships among lithic fragments, mineral fragments, and glasses. In **Mare Crisium: The View from Luna 24** (Merrill R.B. and Papike J.J., eds.) 303-320. Pergamon.
- Taylor G.J., Warner R.D. and Keil K. (1979) Stratigraphy and depositional history of the Apollo 17 drill core. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1159-1184.
- Taylor G.J., Warner R.D., Keil K., Ma M.-S. and Schmitt R.A. (1980) Silicate liquid immiscibility, evolved lunar rocks, and the formation of KREEP. In **Proc. Conf. Lunar Highlands Crust**, *Geochim. Cosmochim. Acta Suppl.* **12**. Pergamon Press. 339-352. Lunar Planetary Institute, Houston.
- Taylor G.J., Warren P., Ryder G., Delano J., Pieters C. and Lofgren G. (1991) Lunar Rocks. In **Lunar Sourcebook: a users guide to the moon**. (eds. Heiken et al. ) Cambridge Univ. Press.
- Taylor G.J., Martel L.M.V. and Spudis P.D. (2010) Apollo 15 KREEP basalts and emplacement of the Apennine bench formation (abs1510). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ The Woodlands
- Taylor G.J. and Robinson K.L. (2012) Distinct volatile reservoirs in the moon: Evidence for late addition of volatiles and water (abs#2443). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Taylor G.J., Martel L.M.V. and Spudis P.D. (2012) The Hadley-Apennine KREEP basalt igneous province. *Meteorit. & Planet. Sci.* **47**, 861-879.
- Taylor G.P., Ellis W., Johnson P.H., Kropp K. and Groves T. (1971) Microbial assay of lunar samples. *Proc. 2<sup>nd</sup> Lunar Science Conf.* 1939-1948.
- Taylor H.P. and Epstein S. (1970a)  $O^{18}/O^{16}$  ratios of Apollo 11 lunar rocks and minerals. *Proc. Apollo 11 Lunar Sci. Conf.* 1613-1626.
- Taylor H.P. and Epstein S. (1970b) Oxygen and silicon isotopic ratios of lunar rock 12013. *Earth Planet. Sci. Lett.* **9**, 208-210.
- Taylor H.P. and Epstein S. (1973)  $O^{18}/O^{16}$  and  $Si^{30}/Si^{28}$  studies of some Apollo 15, 16 and 17 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1657-1679.

- Taylor H.P. and Epstein S. (1973) Oxygen and silicon isotopic ratios of the Luna 20 soil. *Geochim. Cosmochim. Acta* **37**, 1107-1009.
- Taylor J.H.C. and Carter J.L. (1973) Silicate mineral chemistry of Apollo soils 15411, 15501, 66081 and 69941. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 291-307.
- Taylor J.H.C. and Carter J.L. (1974) Apollo 17: Comparative chemistry of olivines, pyroxenes, and plagioclase from regolith samples, 74002, 74241 and 75081. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 925-933.
- Taylor L. August (1979) Paleointensity determinations at elevated temperatures: Sample preparation technique. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 2183-2187.
- Taylor L.A. (2008) Formation and evolution of lunar regolith (abs#1346). *Lunar Planet. Sci. XXXIX*. Lunar Planetary Institute, Houston.
- Taylor L.A., Kullerud G. and Bryan W.B. (1971) Opaque mineralogy and textural features of Apollo 12 samples and a comparison with Apollo 11 rocks. *Proc. Second Lunar Sci. Conf.* 855-871.
- Taylor L.A., Williams R.J. and McCallister R.H. (1972) Stability of ilmenite and ulvospinel in the Fe-Ti-O system and applications of these data to lunar mineral assemblages. *Earth Planet. Sci. Lett.* **16**, 282-298.
- Taylor L.A. and McCallister R.H. (1972a) Opaque mineralogy of Apollo 15 rocks: Experimental investigations of elemental partitioning and subsolidus reduction. In **The Apollo 15 Lunar Samples**, 169-173. The Lunar Science Institute.
- Taylor L.A. and McCallister R.H. (1972b) An experimental investigation of the significance of zirconium partitioning in lunar ilmenite and ulvospinel. *Earth Planet. Sci. Lett.* **17**, 105-109.
- Taylor L.A., Mao H.K. and Bell P.M. (1973a) "Rust" in the Apollo 16 rocks. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 829-839.
- Taylor L.A., Williams K.L. and Sardi O. (1973b) Selected Apollo 17 soils: Mineralogy and geochemistry of opaque and non-opaque phases. *Earth Planet. Sci. Lett.* **21**, 6-12.
- Taylor L.A., McCallister R.T. and Sardi O. (1973c) Cooling histories of lunar rocks based on opaque mineral geothermometers. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 819-828.
- Taylor L.A. and Williams K.L. (1974a) Formational history of lunar rocks: applications of experimental geochemistry of the opaque minerals. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 585-596.
- Taylor L.A. and Williams K.L. (1974b) Formational history of lunar rocks: applications of experimental geochemistry of the opaque minerals (abs). *Lunar Sci.* **V**, 783-785. Lunar Planetary Institute, Houston.
- Taylor L.A., Mao H.K. and Bell P.M. (1974c) Identification of the hydrated iron oxide mineral akaganeite in Apollo 16 lunar rocks. *Geology* **2**, 429-432.
- Taylor L.A. and Misra K.C. (1975a) Pyroxene-phyric basalt 15075: Petrography and petrogenesis. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 165-179.
- Taylor L.A., Uhlmann D.R., Hopper R.W. and Misra K.C. (1975b) Absolute cooling rates of lunar rocks: Theory and application. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 181-191.
- Taylor L.A., Misra K.C. and Walker B.M. (1976) Subsolidus reequilibration, grain growth, and compositional changes of native FeNi metal in lunar rocks. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 837-857.

- Taylor L.A. and Burton J.C. (1976) Experiments on the stability of FeOOH on the surface of the Moon. *Meteoritics* **11**, 225-229.
- Taylor L.A., Onorato P.I.K., Uhlman D.R. and Coish R.A. (1978) Subophitic basalts from Mare Crisium: Cooling rates. In **Mare Crisium: The view from Luna 24**. *Geochem. Cosmochim. Acta* suppl. 9, 473-482. (ed. Merrill) Pergamon Press.
- Taylor L.A., Onorato PIK and Uhlmann D.R. (1977) Cooling rate estimations based on kinetic modeling of Fe-Mg diffusion in olivine. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1581-1592.
- Taylor L.A. and Hunter R.H. (1981) The significance of Cl/P<sub>2</sub>O<sub>5</sub> ratios from lunar samples. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 323-331.
- Taylor L.A., Shervais J.W., Hunter R.H., Shih C.-Y., Nyquist L.E., Bansal B.M., Wooden J. and Laul J.C. (1983) Pre-4.2 AE mare-basalt volcanism in the lunar highlands. *Earth Planet. Sci. Lett.* **66**, 33-47.
- Taylor L.A., McKay D.S., Patchen A., Wentworth S., Oder R. and Jerde E. (1992) Magnetic beneficiation of high-Ti mare basalts: Petrographic analyses (abs). *Lunar Planet. Sci.* **XXIII**, 1415-1416. Lunar Planetary Institute, Houston.
- Taylor L.A., Patchen A., Taylor D.H.S., Chambers J.G. and McKay D.S. (1996) X-ray digital imaging of lunar mare soil: Modal analysis of minerals and glasses. *Icarus* **124**, 500-512.
- Taylor L.A., Morris R.V., Keller L.P., Pieters C., Patchen A., Taylor D-H., Wentworth S. and McKay D.S. (2000a) Major contributions to spectral reflectance opacity by non-agglutinitic surface-correlated nanophase iron (abs#1842). *Lunar Planet. Sci.* **XXXI**, Lunar Planetary Institute, Houston.
- Taylor L.A., Morris R.V., Pieters C., Patchen A., Taylor D-H., Keller L.P., Wentworth S. and McKay D.S. (2000b) Chemical characterization of lunar mare soils (abs#1697). *Lunar Planet. Sci.* **XXXI**, Lunar Planetary Institute, Houston.
- Taylor L.A., Patchen A., Taylor D-H., Morris R.V., Pieters C., Keller L.P., Wentworth S. and McKay D.S. (2000c) Mineralogical characterization of lunar mare soils (abs#1706). *Lunar Planet. Sci.* **XXXI**, Lunar Planetary Institute, Houston.
- Taylor L.A., Pieters C., Keller L.P., Morris R.V., McKay D.S., Patchen A. and Wentworth S. (2001a) The effects of space weathering on Apollo 17 mare soils: Petrographic and chemical characterization. *Meteor. & Planet. Sci.* **36**, 285-299.
- Taylor L.A., Pieters C., Keller L.P., Morris R.V. and McKay D.S. (2001b) Lunar mare soils: Space weathering and the major effects of surface-correlated nanophase Fe. *J. Geophys. Res. Planets* **106**, 27985-28000.
- Taylor L.A., Patchen A.P., Mayne R.G. and Taylor D.H. (2004) The most reduced rock from the moon, Apollo 14 basalt 14053: Its unique features and their origin. *Am. Mineral.* **89**, 1617-1624.
- Taylor S.R. (1973a) Geochemistry of the lunar highlands. *The Moon* **7**, 181-195.
- Taylor S.R. (1973b) Chemical evidence for lunar melting and differentiation. *Nature* **245**, 203-205.
- Taylor S.R. (1975) **Lunar Science: A Post-Apollo View**. Pergamon Press, pp. 372.
- Taylor S.R. (1982) **Planetary Science: A Lunar Perspective**. Lunar Planetary Institute, pp. 481.
- Taylor S.R. (1993) **Solar System Evolution: A New Perspective**. Cambridge Univ. Press, pp. 307.

Taylor S.R. (2007) The Moon. *In Encyclopedia of Solar System* (eds. McFadden, Weissman and Johnson) Elsevier

Taylor S.R. (2001) Flood basalts, basalt floods or topless bushvelds? Lunar petrogenesis revisited: A critical comment. *J. Petrogr.* **42**, 1219-1220. (see O'Hara)

Taylor S. R. (2008) The origin and evolution of the Moon in a planetary context. *Golden Jubilee Memoir. Geol. Soc. India*, **66** 13-50

Taylor S.R. and Jakes P. (1974) The geochemical evolution of the Moon. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1287-1305.

Taylor S.R. and Bence A.E. (1975) Trace element characteristics of the mare basalt source region: Implications of the cumulate versus primitive source model. *In **Origins of Mare Basalts and their Implications for Lunar Evolution*** (Lunar Science Institute, Houston), 159-163. Lunar Planetary Institute, Houston.

Taylor S.R., Muir P. and Kaye M. (1971a) Trace element chemistry of Apollo 14 lunar soils from Fra Mauro. *Geochim. Cosmochim. Acta* **35**, 975-981.

Taylor S.R., Rudowski R., Muir P., Graham A. and Kaye M. (1971b) Trace element chemistry of lunar samples from the Ocean of Storms. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1083-1099.

Taylor S.R., Kaye M., Muir P., Nance W., Rudowski R. and Ware N. (1972a) Composition of the lunar uplands: Chemistry of Apollo 14 samples from Fra Mauro. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1231-1249.

Taylor S.R., Gorton M., Muir P., Nance W., Rudowski R. and Ware N. (1972b) Composition of the lunar highlands II The Apennine Front. *In **The Apollo 15 Lunar Samples***, 262-264. Lunar Planetary Institute, Houston.

Taylor S.R., Gorton M.P., Muir P., Nance W.B., Rudowski R. and Ware N. (1973a) Composition of the Descartes region, lunar highlands. *Geochim. Cosmochim Acta* **37**, 2665-2683.

Taylor S.R., Gorton M.P., Muir P., Nance W., Rudowski R. and Ware N. (1973b) Lunar highlands composition: Apennine Front. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1445-1459.

Taylor S.R., Gorton M., Muir P., Nance W., Rudowski R. and Ware N. (1974) Lunar highland composition (abs). *Lunar Sci.* **V**, 789-791. Lunar Planetary Institute, Houston.

Taylor S.Ross, Taylor G.Jeff and Taylor L.August (2006) The Moon: A Taylor perspective. *Geochim. Cosmochim. Acta* **70**, 5904-5918.

Tera F., Eugster O., Burnett D.S. and Wasserburg G.J. (1970) Comparative study of Li, Na, K, Rb, Cs, Ca, Sr, and Ba abundances in achondrites and in Apollo 11 lunar samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1637-1657.

Tera F. and Wasserburg G.J. (1972c) U-Th-Pb analyses of soil from the sea of fertility. *Earth Planet. Sci. Lett.* **13**, 457-466.

Tera F. and Wasserburg G.J. (1972a) U-Th-Pb systematics in three Apollo 14 basalts and the problem of initial Pb in lunar rocks. *Earth Planet. Sci. Lett.* **14**, 281-304.

Tera F. and Wasserburg G.J. (1972b) U-Th-Pb systematics in the lunar highland samples from the Luna 20 and Apollo 16 missions. *Earth Planet. Sci. Lett.* **17**, 36-51.

- Tera F. and Wasserburg G.J. (1975) The evolution and history of mare basalts as inferred from U-Th-Pb systematics (abs). *Lunar Sci.* **VI**, 807-809. Lunar Planetary Institute, Houston.
- Tera F. and Wasserburg G.J. (1976) Lunar ball games and other sports (abs). *Lunar Sci.* **VII**, 858-860. Lunar Planetary Institute, Houston.
- Tera Fouad, Ray L.A. and Wasserburg G.J. (1972) Distribution of Pb-U-Th in lunar anorthosite 15415 and inferences about its age. In **The Apollo 15 Lunar Samples** (Chamberlain and Watkins eds) p. 396-401. Lunar Planetary Institute, Houston.
- Tera F., Papanastassiou D.A. and Wasserburg G.J. (1973) A lunar cataclysm at 3.95 AE and the structure of the lunar crust (abs). *Lunar Sci.* **IV**, 723-725. Lunar Planetary Institute, Houston.
- Tera F., Papanastassiou D.A. and Wasserburg G.J. (1974a) Isotopic evidence for a terminal lunar cataclysm. *Earth Planet. Sci. Lett.* **22**, 1-21.
- Tera F., Papanastassiou D.A. and Wasserburg G.J. (1974b) The lunar time scale and a summary of isotopic evidence for a terminal lunar cataclysm (abs). *Lunar Sci.* **V**, 792-794. Lunar Planetary Institute, Houston.
- Tera F., Papanastassiou D.A. and Wasserburg G.J. (1974c) U-Th-Pb systematic on lunar rocks and inferences about lunar evolution and the age of the moon. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1571-1599.
- Terada K., Anand M., Sokol A.K., Bischoff A. and Sano Y. (2007) Cryptomare magmatism 4.35 Gyr ago recorded in lunar meteorite Kalahari 009. *Nature* **450**, 849-852.
- Terada K., Sasaki Y., Oka Y., Tanabe A., Fujikawa N., Tanikawa S., Sano Y., Anand M. and Taylor L.A. (2008) Ion microprobe U-Pb dating of phosphates in lunar basaltic meteorites (abs#1681). *Lunar Planet. Sci.* **XXXIX**, Lunar Planetary Institute, Houston.
- Terada K., Hidaka H. and Sano Y. (2008) Chronology of lunar basaltic meteorites based on the in situ U-Pb dating (abs). *Meteorit. Planet. Sci.* **43**, A153.
- Thacker Carla, Yan Liang Y., Qinglan Peng Q. and Hess P. (2009) The stability and major element partitioning of ilmenite and armalcolite during lunar cumulate mantle overturn. *Geochim. Cosmochim. Acta* **73**, 820-836.
- Thiel K., Herr W. and Becker J. (1972) Uranium distribution in basalt fragments of 5 lunar samples. *Earth Planet. Sci. Lett.* **16**, 31-44.
- Thiemens M.H. and Clayton R.N. (1980) Solar and cosmogenic nitrogen in the Apollo 17 deep drill core. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1435-1451.
- Thiemens M.H. and Clayton R.N. (1980) Ancient solar wind in lunar microbreccias. *Earth Planet. Sci. Lett.* **47**, 34-42.
- Thode H.G. and Reese C.E. (1971) Measurement of sulphur concentrations and the isotopic ratios  $^{33}\text{S}/^{32}\text{S}$ ,  $^{34}\text{S}/^{32}\text{S}$  and  $^{36}\text{S}/^{32}\text{S}$  in Apollo 12 samples. *Earth Planet. Sci. Lett.* **12**, 434-438.
- Thode H.G. and Rees C.E. (1972) Sulphur concentrations and isotope ratios in Apollo 14 and 15 samples. In **The Apollo 15 Lunar Samples** (Chamberlain J.W. and Watkins C., eds.), 402-403. The Lunar Science Institute, Houston.
- Thode H.G. and Rees C.E. (1976) Sulfur isotopes in grain size fractions of lunar soils. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 459-468.

Thode H.G. and Rees C.E. (1979) Sulfur isotopes in lunar and meteorite samples. *Proc. 10<sup>th</sup> Lunar Planet. Sci.* 1629-1636.

Thomas-Keprta K.L., Clement S.J., Ross D.K., Le L., Gibson E.K. and Gonzalez C. (2012) Indigenous carbonaceous phases embedded within surface deposits on Apollo 17 volcanic glass beads (abs#5282). *75<sup>th</sup> Meteoritical Society @ Cains*

Thornber C.R. and Huebner J.S. (1980) An experimental study of the thermal history of fragment-laden "basalt" 77115. In **Proc. Conf. Lunar Highlands Crust**. *Geochim. Cosmochim. Acta*, Suppl. 12. Pergamon Press. 233-252.

Tilton G.R. and Chen J.H. (1979) Lead isotope systematics of three Apollo 17 mare basalts. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 259-274.

Timms Nick, Reddy Steve, Healy Dave, Nemchin Sasha, Grange Marion, Pidgeon Bob and Hart Bob (2011) Resolution of impact-related microstructures in lunar zircon: A shock-deformation mechanism map. *Meteorit. Planet. Sci.* **47**, 120-141.

Tittmann B.R., Housley R.M., Cirlin E.H. and Abul-Gawad M. (1972) Rayleigh wave studies of two Apollo 15 rocks. In **The Apollo 15 Lunar Samples**, 462-465. Lunar Planetary Institute, Houston.

Tittmann B.R., Curnow J.M. and Housley R.M. (1975a) Internal friction quality factor  $Q > 3100$  achieved in lunar rock 70215,85. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 3217-3226.

Tittmann B.R., Housley R.M. and Abdel-Gawad M. (1975b) Internal friction quality factor  $> 3100$  achieved in lunar rock 70215,85 (abs). *Lunar Sci.* **VI**, 812-814. Lunar Planetary Institute, Houston.

Tittmann B.R., Ahlberg L. and Cumow J. (1976) Internal friction and velocity measurements. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 3123-3132.

Tittmann B.R., Ahlberg H., Nadler H., Curnow J., Smith T. and Cohen E.R. (1977) Internal friction quality-factor  $Q$  under confining pressure. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1209-1224.

Tittmann B.R., Nadler H., Richardson J.M. and Ahlberg L. (1978) Laboratory measurements of p-wave seismic  $Q$  on lunar and analog rocks. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 3627-3635.

Todd T., Wang H., Baldrige W.S. and Simmons G. (1972) Elastic properties of Apollo 14 and 15 rocks. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 2577-2586.

Todd T., Richter D.A., Simmons G. and Wang H. (1973) Unique characterization of lunar samples by physical properties. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2639-2662.

Tompkins Stefanie and Pieters Carle (2010) Spectral characteristics of lunar impact melts and inferred mineralogy. *Meteorit. Planet. Sci.* **45**, 1152-1169.

Touboul M., Kleine T., Bourdon B., Palme H. and Wieler R. (2007) Late formation and prolonged differentiation of the moon inferred from W isotopes in lunar metals. *Nature* **450**, 1206-1209.

Touboul M., Kleine T., Bourdon B. and Palme H. (2007) The duration of magma ocean crystallization on the moon – evidence from new W isotope data for metals from high- and low-Ti mare basalts (abs#2385). *Lunar Planet. Sci.* **XXXVIII**, Lunar Planetary Institute, Houston.

Touboul M., Kleine T., Bourdon B., Palme H. and Wieler R. (2008) Hf-W chronometry of the moon – new results from ferroan anorthosites and low-Ti mare basalt 15555 (abs#1940). *Lunar Planet. Sci.* **XXXIX**, Lunar Planetary Institute, Houston.



- Touboul M., Kleine T., Boudon B., Nyquist L. and Shih C-Y. (2009) New  $^{142}\text{Nd}$  evidence for a non-chondritic composition of the Moon (abs#2269). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Treiman A. (2008) Rhonite in Luna 24 pyroxenes: First find from the Moon and implications for volatiles in planetary magmas. *Amer. Mineral.* **93**, 488-491.
- Treimann A. and Gross J. (2012) Abundant apatite in granulite 79215: Spoor of another volatile-rich lunar fluid (abs#1223). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Treimann A. and Gross J. (2012) Lunar cordierite-spinel troctolite: Igneous history and volatiles (abs# 1196). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Trice R., Warren N. and Anderson O.L. (1974) Rock elastic properties and near-surface structure of Taurus-Littrow. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2903-2911.
- Trivedi B.M.P. and Goel P.S. (1973) Nuclide production rates in stone meteorites and lunar samples by galactic cosmic radiation. *J. Geophys. Res.* **78**, 4885-4500.
- Tsay F-D., Manatt S.L., Live D.H. and Chan S.I. (1973) Metallic Fe phases in Apollo 16 fines: Their origin and characteristics as revealed by electron spin resonance studies. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2751-2761.
- Tsay F-D. and Live D.H. (1974) Ferromagnetic resonance studies of thermal effects on lunar metallic Fe phases. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2737-2746.
- Tsay F-D. and Bauman A.J. (1975) Ferromagnetic resonance as a geothermometer for probing the thermal history of lunar samples (abs). *Lunar Sci.* **VI**, 821-823. Lunar Planetary Institute, Houston.
- Trzcieski W.E. and Kulick C.G. (1972) Plagioclase and Ba-K phases from Apollo samples 12063 and 14310. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 591-602.
- Turekian K.K. and Kharkar D.P. (1970) Neutron activation analysis of milligram quantities of Apollo 11 lunar rocks and soil. *Proc. Apollo 11 Lunar Sci. Conf.* 1659-1664.
- Turner G. (1970a) Argon-40/argon-39 dating of lunar rock samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1665-1684.
- Turner G. (1970b)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  age determination of lunar rock 12013. *Earth Planet. Sci. Lett.* **9**, 177-180.
- Turner G. (1971)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  ages from the lunar maria. *Earth Planet. Sci. Lett.* **11**, 169-191.
- Turner G. (1972)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  age and cosmic ray irradiation history of Apollo 15 anorthosite 15415. *Earth Planet. Sci. Lett.* **14**, 169-175.
- Turner G. (1977a) Potassium-argon chronology of the moon. *Phys. Chem. Earth* **10**, 145-195.
- Turner G. (1977b) The early chronology of the Moon: Evidence for the early collisional history of the solar system. *Phil. Trans. Roy. Soc. London* **A285**, 97-104.
- Turner G., Huneke J.C., Podosek F.A. and Wasserburg G.J. (1971)  $^{40}\text{Ar}$ - $^{39}\text{Ar}$  ages and cosmic ray exposure ages of Apollo 14 samples. *Earth Planet. Sci. Lett.* **12**, 19-35.
- Turner G., Huneke J.C., Podosek F.A. and Wasserburg G.J. (1972) Ar40-39 systematics in rocks and separated minerals from Apollo 14. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1589-1612.

- Turner G., Cadogan P.H. and Yonge C.J. (1973a) Argon selenochronology. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1889-1914.
- Turner G., Cadogan P.H. and Yonge C.J. (1973b) Apollo 17 age determinations. *Nature* **242**, 513-515.
- Turner G. and Cadogan P.H. (1974) Possible effects of <sup>39</sup>Ar recoil in <sup>40</sup>Ar-<sup>39</sup>Ar dating. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1601-1615.
- Turner G. and Cadogan P.H. (1975a) The history of lunar bombardment inferred from <sup>40</sup>Ar-<sup>39</sup>Ar dating of highland rocks. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1509-1538.
- Turner G. and Cadogan P.H. (1975b) The history of lunar basin formation inferred from <sup>40</sup>Ar-<sup>39</sup>Ar dating of highland rocks (abs). *Lunar Sci.* **VI**, 826-828. Lunar Planetary Institute, Houston.
- Twedell D., Feight S., Carlson I. and Meyer C. (1978) Lithologic maps of selected Apollo 14 breccia samples. Curators Office. JSC 13842
- Uhlmann D.R., Cukierman M., Scherer G. and Hopper R.W. (1973) Viscous flow, crystallization behavior and thermal history of orange soil material (abs). *EOS Trans. AGU* 54, 617-618.
- Uhlmann D.R., Klein L., Kritchevsky G. and Hopper R.W. (1974) The formation of lunar glasses. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2317-2331.
- Uhlmann D.R., Klein L., Onorato P.I.K. and Hopper R.W. (1975) The formation of lunar breccias: sintering and crystallization kinetics. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 693-705.
- Uhlmann D.R. and Klein L.C. (1976) Crystallization kinetics, viscous flow and thermal histories of lunar breccias 15286 and 15498. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2529-2541.
- Uhlmann D.R., Klein L.C. and Handwerker C.A. (1977) Crystallization kinetics, viscosity flow, and thermal history of lunar breccia 67975. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2067-2078.
- Uhlmann D.R., Handwerker C.A., Onorato P.I.K., Salomaa R. and Goncz D. (1978) The formation kinetics of lunar glasses. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 1527-1536.
- Uhlmann D.R. and Onorato P.I.K. (1979) A simplified model for glass formation (abs). *Lunar Planet. Sci.* **X**, 1250-1252. Lunar Planetary Institute, Houston
- Uhlmann D.R., Onorato P.I.K. and Scherer G.W. (1979) A simplified model for glass formation. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 375-381.
- Uhlmann D.R. and Yinnon H. (1981) Simplified model evaluation of cooling rates for glass-containing lunar compositions (abs). *Lunar Planet. Sci.* **XII**, 1103-1105. Lunar Planetary Institute, Houston
- Uhlmann D.R., Yinnon H. and Fang C.-Y. (1981) Simplified model evaluation of cooling rates for glass-containing lunar compositions. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 281-288.
- Ulbrich M.C. (1970) Chemical individuality of lunar, meteoritic and terrestrial silicate rocks. *Science* **168**, 1375-1376.
- Ulrich G.E. (1973) A geologic model for North Ray Crater and stratigraphic implications for the Descartes region. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 27-39.
- Ulrich G.E., Hodges C.A. and Muehlberger W.R. (1981) Geology of the Apollo 16 Area, Central Lunar Highlands. U.S. Geol. Survey Prof. Paper 1048

- Ulrich D.R. and Weber J. (1973) Correlation of the thermal history of lunar and synthetic glass by DTA and X-ray techniques. *In Lunar Science IV*, 743-744. Lunar Science Institute, Houston.
- Ulrich, Muehlberger and many others (1973) Apollo 16 geologic exploration of Descartes: A geologic summary. *Science* **179**, 42-49.
- Unruh D.M. and Tatsumoto M. (1976) KREEP basalt intrusion age: U-Th-Pb systematic of Imbrium Consortium samples (abs). *Lunar Sci.* **VII**, 885-887.
- Unruh D.M. and Tatsumoto M. (1977) Evolution of mare basalts: The complexity of the U-Th-Pb system. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1673-1696.
- Unruh D.M. and Tatsumoto M. (1978) Implications from Luna 24 sample 24170 to U-Pb evolution in the lunar mantle. *In Mare Crisium: a view from Luna 24* (eds, Merrill and Papike) 679-694.
- Unruh D.M., Stille P., Patchett P.J. and Tatsumoto M. (1984) Lu-Hf and Sm-Nd evolution in lunar mare basalts. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **88**, B459-B477.
- Urey H. (1966) Dust on the Moon. *Science* **153**, 1419-1420.
- Usselman T.M. (1975) Ilmenite chemistry in mare basalts, an experimental study. *In Origins of Mare Basalts and their Implications for Lunar Evolution* (Lunar Science Institute, Houston), 164-168.
- Usselman T.M., Lofgren G.E., Donaldson C.H. and Williams R.J. (1975) Experimentally reproduced textures and mineral chemistries of high-titanium mare basalts. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 997-1020.
- Usselman T.M. and Lofgren G.E. (1976a) The phase relations, textures, and mineral chemistries of high-titanium mare basalts as a function of oxygen fugacity and cooling rate. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1345-1363.
- Usselman T.M. and Lofgren G.E. (1976b) Phase relations of high-titanium mare basalts as a function of oxygen fugacity (abs). *Lunar Sci.* **VII**, 888-890. Lunar Planetary Institute, Houston.
- Ustunisik Gokce, Nekvasil H. and Lindsey D. (2011) Differential degassing of H<sub>2</sub>O, Cl, F and S: Potential effects on lunar apatite. *Amer. Mineral.* **96**, 1650-1653.
- Vaniman D.T. (1990) Glass variants and multiple HASP trends in Apollo 14 regolith breccias. *Proc. 20<sup>th</sup> Lunar Planet. Sci. Conf.* 209-217. Lunar Planetary Institute, Houston.
- Vaniman D.T. and Papike J.J. (1977a) VLT basalts: A new mare rock type from the Apollo 17 drill core. *Proc. 8<sup>th</sup> Lunar Planet. Sci. Conf.* 1443-1471.
- Vaniman D.T. and Papike J.J. (1977b) Ferrobasalts from Mare Crisium: Luna 24. *Geophys. Res. Lett.* **4**, 497-500.
- Vaniman D.T. and Papike J.J. (1977c) Luna 24 ferrobasalt: Petrology and comparisons with other mare basalt types. *In Papers Presented to the Conference on Luna 24*, 196-199. Lunar Science Institute, Houston.
- Vaniman D.T. and Papike J.J. (1977d) The Apollo 17 drill core: Modal petrology and glass chemistry (sections 70007, 70008, 70009). *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3161-3193.
- Vaniman D.T. and Papike J.J. (1978) The lunar highland melt-rock suite. *Geophys. Res. Lett.* **5**, 429-432.

Vaniman D.T., Labotka T.C., Papike J.J., Simon S.B. and Laul J.C. (1979) The Apollo 17 drill core: Petrologic systematics and the identification of a possible Tyco component. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1185-1227.

Vaniman D.T. and Papike J.J. (1980) Lunar highland melt rocks: Chemistry, petrology and silicate mineralogy. In Proc. **Conf. Lunar Highlands Crust** (Papike J.J. and Merrill R.B., eds.) 271-337. Pergamon. Lunar Planetary Institute, Houston.

Vaniman D.T. and Bish D.L. (1990) Yoshiokaite, a new Ca, Al-silicate mineral from the Moon. *Am. Mineral.* **75**, 676-686.

Van Orman J.A. and Grove T.L. (2000) Origin of lunar high-titanium ultramafic glasses: constraints from phase relations and dissolution kinetics of clinopyroxene-ilmenite cumulates. *Meteorit. Planet. Sci.* **35**, 783-794.

Vaughan D.J. and Burns R.G. (1973) Low oxidation states of Fe and Ti in the Apollo 17 orange soil (abs). *EOS Trans. AGU* **54**, 618-619.

Vaughan D.J. and Burns R.G. (1977) Electronic absorption spectra of lunar minerals. *Phil. Trans. Roy. Soc. London* **A285**, 249-258.

Vaughan J.P., Nemchin A.A., Pidgeon R.T. and Meyer C. (2006) U-Pb ages of lunar apatites (abs#1606). *Lunar Planet. Sci.* **XXXVII**, Lunar Planetary Institute, Houston.

Venkatesan T.R. and Alexander E.C. (1976) <sup>40</sup>Ar-<sup>39</sup>Ar study of a clast 12-I from 67915 (abs). *Lunar Sci.* **VII**, 894. Lunar Planetary Institute, Houston.

Venkatesan T.R., Nautiyal C.M., Padia J.T. and Rao M.N. (1981) Compositional characteristics of solar wind and solar flare neon in the past using lunar soils and rocks (abs). *Lunar Planet. Sci.* **XII**, 1112-1114. Lunar Planetary Institute, Houston.

Venkatesan T.R., Nautiyal C.M., Padia J.T. and Rao M.N. (1980) Solar flare cosmic ray proton fluxes in the recent past. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1271-1284.

Venkatesan T.R., Nautiyal C.M., Padia J.T. and Rao M.N. (1982) SCR-proton produced xenon isotopes in lunar rocks (abs). *Lunar Planet. Sci.* **XIII**, 821-822. Lunar Planetary Institute, Houston.

Vetter S.K., Shervais J.W. and Lindstrom M.M. (1988) Petrology and geochemistry of olivine-normative and quartz-normative basalts from regolith breccia 15498: New diversity in Apollo 15 mare basalts. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 255-271. Lunar Planetary Institute, Houston.

Vickers D.G. and Bastin J.A. (1977) The interaction of lunar rock and far infrared radiation. *Phil. Trans. Roy. Soc. London* **A285**, 319-324.

Vinogradov A.P. (1971) Preliminary data on lunar ground brought to Earth by Automatic Probe "Luna 16". *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1-16.

Vinogradov A.P. (1972) Lunar rock. *EOS Trans. Am. Geophys. Union* **53**, 820-822.

Vinogradov A.P. and Zadorozhny I.K. (1973) Rare gases in regolith and fragments of rock supplied by the automatic station: Luna 20". *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2065-2077.

Vinogradov A.P. (1973) Preliminary data on lunar soil collected by the Luna 20 unmanned spacecraft. *Geochim. Cosmochim. Acta* **37**, 721-729.

- Virgo D. (1973) Clinopyroxene from Apollo 15: Fe<sup>2+</sup>, Mg intercrystalline distributions (abs). *Lunar Sci.* **IV**, 749-751.
- Virgo D. and Hafner S.S. (1972) Temperature-dependant Mg, Fe distribution in a lunar olivine. *Earth Planet. Sci. Lett.* **14**, 305-312.
- Vobecky M., Frana J., Bauer J., Randa Z., Benada J., and Kuncir J. (1971) Radioanalytical determination of elemental compositions of lunar samples. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1291-1300.
- Yokoyama Y., Reyss J.L. and Guichard F. (1972) Cosmonuclides in lunar soil from Apollo 15. *In The Apollo 15 Lunar Samples*, 404-406.
- Wagner T.P. and Grove T.L. (1997) Experimental constraints on the origin of lunar high-Ti ultramafic glasses. *Geochim. Cosmochim. Acta* **61**, 1315-1327.
- Wahlen M., Honda M., Imamura M., Fruchter J.S., Finkel R.C., Kohl C.P., Arnold J.R. and Reedy R.C. (1972) Cosmogenic nuclides in football-sized rocks. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1719-1732.
- Wahlen M., Finkel R.C., Imamura M., Kohl C.P. and Arnold J.R. (1973) <sup>60</sup>Co in lunar samples. *Earth Planet. Sci. Lett.* **19**, 315-320.
- Wakita H., Schmitt R.A. and Rey P. (1970) Elemental abundances of major, minor, and trace elements in Apollo 11 lunar rocks, soil, and core samples. *Proc. Apollo 11 Lunar Sci. Conf.* 1685-1717.
- Wakita H. and Schmitt R.A. (1970) Elemental abundances in seven fragments from lunar rock 12013. *Earth Planet. Sci. Lett.* **9**, 177-180.
- Wakita H. and Schmitt R.A. (1971) Bulk elemental composition of Apollo 12 samples: Five igneous and one breccia rocks and four soils. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1231-1236.
- Wakita H., Rey P. and Schmitt R.A. (1971) Abundances of the 14 rare earth elements and 12 other trace elements in Apollo 12 samples: Five igneous and one breccia rocks and four soils. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1319-1329.
- Wakita H., Laul J.C. and Schmitt R.A. (1975) Some thoughts on the origin of the lunar ANT-KREEP and mare basalts. *Geochim. J.*, **9**, 25-41.
- Walker D. (1983) Lunar and terrestrial crust formation. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in J. Geophys. Res. **88**, 17-25.
- Walker D., Longhi J. and Hays J.F. (1972) Experimental petrology and origin of Fra Mauro rocks and soil. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 797-817.
- Walker D., Grove T.L., Longhi J., Stolper E.M. and Hays J.F. (1973a) Origin of lunar feldspathic rocks. *Earth Planet. Sci. Lett.* **20**, 325-336.
- Walker D., Longhi J., Grove T., Stolper E. and Hays J.F. (1973b) Experimental petrology and origin of rocks from the Descartes highlands. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1013-1032.
- Walker D., Longhi J., Stolper E., Grove T. and Hays J.F. (1974) Experimental petrology and origin of titaniferous lunar basalts (abs). *Lunar Sci.* **V**, 814-816. Lunar Planetary Institute, Houston.
- Walker D., Longhi J. and Hays J.F. (1975a) Heterogeneity in titaniferous lunar basalts. *In Conference on Origins of Mare Basalts and their Implications for Lunar Evolution*, 169-173. Lunar Science Institute, Houston.

- Walker D., Longhi J., Stolper E.M., Grove T.L. and Hays J.F. (1975b) Origin of titaniferous lunar basalts. *Geochim. Cosmochim. Acta* **39**, 1219-1235.
- Walker D., Longhi J. and Hays J.F. (1976a) Heterogeneity in titaniferous lunar basalts. *Earth Planet. Sci. Lett.* **30**, 27-36.
- Walker D., Kirkpatrick R.J., Longhi J. and Hays J.F. (1976) Crystallization history of lunar picritic basalt sample 12002: Phase-equilibria and cooling-rate studies. *Geol. Soc. Am. Bull.* **87**, 646-656.
- Walker D. and Hays J.F. (1977) Plagioclase floatation and lunar crust formation. *Geology* **5**, 425-428.
- Walker D., Longhi J., Lasaga A.C., Stolper E.M., Grove T.L. and Hays J.F. (1977) Slowly cooled microgabbros 15555 and 15065. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1521-1547.
- Walker R.M. (1975) Interactions of energetic nuclear particles in space with the lunar surface. *Ann. Rev. Earth Planet. Sci.* **3**, 99-128.
- Walker R.J. and Papike J.J. (1981a) The relationship of the lunar regolith < 10 micron fraction and agglutinates. Part II: Chemical composition of agglutinate glass as a test of the F3 model. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 421-432.
- Walker R.J. and Papike J.J. (1981) The Apollo 15 regolith: Comparative petrology of drive tube 15010/15011 and drill core section 15003. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 485-508..
- Walker R.J. and Papike J.J. (1981c) The Apollo 15 regolith: Chemical modeling and mare/highland mixing. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 509-517.
- Walker R.J., Horan M.F., Shearer C.K. and Papike J.J. (2004) Low abundances of highly siderophile elements in the lunar mantle: evidence for prolonged late accretion. *Earth Planet. Sci. Lett.* **224**, 399-413.
- Walker R.J., Morgan J.W., Shearer C.K. and Papike J.J. (1998) Rhenium-osmium isotopic systematics of lunar orange glass (abs#1271). *Lunar Planet. Sci. XXIV*, Lunar Planetary Institute, Houston.
- Walker R.J., Touboul M. and Puchel I.S. (2012) Application of the <sup>182</sup>Hf-<sup>182</sup>W isotope system to constraining the timing of late accretion to the Earth and Moon (abs#4004). Early Solar System Bombardment II. Lunar Planet. Sci. Institute, Houston.
- Wallace W.T., Phillips Crystal, Jeevarajan A.S., Chen B. and Taylor L.A. (2010) Nanophase iron-enhanced chemical reactivity of ground lunar soil. *Earth Planet. Sci. Lett.* **295**, 571-577.
- Walton J.R., Lakatos S. and Heymann D. (1973) Distribution of inert gases in fines from the Cayley-Descartes region. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2079-2096.
- Walter L.S., French B.M., Heinrich K.F.J., Lowman P.D., Doan A.S. and Adler I. (1971) Mineralogical studies of Apollo 12 samples. *Proc. Second Lunar Sci. Conf.* 343-358.
- Wang H., Todd T., Weidner D. and Simmons G. (1971) Elastic properties of Apollo 12 rocks. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 2327-2336.
- Wang H., Todd T., Richter D. and Simmons G. (1973) Elastic properties of plagioclase aggregates and seismic velocities in the Moon. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2663-2671.
- Wang Y., Guan Y., Hsu W. and Eiler J.M. (2012) Water content, chlorine and hydrogen composition of lunar apatite (abs#5170) *75<sup>th</sup> Meteoritical Society @ Cains*
- Wänke H., Rieder R., Baddenhausen H., Spettler B., Teschke F., Quijano-Rico M. and Balacescu A.

- (1970) Major and trace elements in lunar material. *Proc. Apollo 11 Lunar Sci. Conf.* 1719-1727.
- Wänke H., Rlotzka F., Jagoutz E. and Begemann F. (1970) Composition and structure of metallic iron particles in lunar fines. *Proc. Apollo 11 Lunar Sci. Conf.* 931-935.
- Wänke H., Wlotzka F., M. and Rieder R. (1971) Apollo 12 samples: Chemical composition and its relation to sample locations and exposure ages, the two component origin of the various soil samples and studies on lunar metallic particles. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1187-1208.
- Wänke H., Baddenhausen H., Balacescu A., Teschke F., Spettel B., Dreibus G., Palme H., Quijano-Rico M., Kruse H., Wlotzka F. and Begemann F. (1972) Multielement analysis of lunar samples and some implications of the results. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1251-1268.
- Wänke H., Palme H., Spettel B. and Teschke F. (1972) Multielement analyses and a comparison of the degree of oxidation of lunar and meteoritic matter. *In The Apollo 15 Lunar Samples*, 265-267.
- Wänke H., Baddenhausen H., Dreibus G., Jagoutz E., Kruse H., Palme H., Spettel B. and Teschke F. (1973) Multielement analysis of Apollo 15, 16 and 17 samples and the bulk composition of the moon. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1461-1481.
- Wänke H., Palme H., Baddenhausen H., Dreibus G., Jagoutz E., Kruse H., Spettel B., Teschke F. and Thacker R. (1974) Chemistry of Apollo 16 and 17 samples: bulk composition, late-stage accumulation and early differentiation of the Moon. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 1307-1335.
- Wänke H., Palme H., Baddenhausen H., Dreibus G., Jagoutz E., Kruse H., Palme C., Spettel B., Teschke F. and Thacker R. (1975a) New data on the chemistry of lunar samples: Primary matter in the lunar highlands and the bulk composition of the moon. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1313-1340.
- Wänke H., Palme H., Baddenhausen H., Dreibus G., Jagoutz E., Kruse H., Spettel B., Teschke F. and Thacker R. (1975b) New data on the chemistry of lunar samples and about the major element composition of KREEP (abs). *Lunar Sci.* **VI**, 844-846. Lunar Planetary Institute, Houston.
- Wänke H., Palme H., Kruse H., Baddenhausen H., Cendales M., Dreibus G., Hofmeister H., Jagoutz E., Palme C., Spettel B. and Thacker R. (1976) Chemistry of lunar highland rocks: a refined evaluation of the composition of the primary matter. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 3479-3499.
- Wänke H., Baddenhausen H., Blum K., Cendales M., Dreibus G., Hofmeister H., Kruse H., Jagoutz E., Palme C., Spettel B., Thacker R. and Vilcsek E. (1977a) On the chemistry of lunar samples and achondrites. Primary matter in the lunar highlands: A re-evaluation. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2191-2213.
- Wänke H., Palme H., Baddenhausen H., Dreibus G., Kruse H. and Spettel B. (1977b) Element correlations and the bulk composition of the Moon. *Phil. Trans. Roy. Soc. London* **A285**, 41-48.
- Wänke H., Dreibus G. and Palme H. (1978) Primary matter in the lunar highlands: The case of the siderophile elements. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 83-110.
- Wanke H., Blum K., Dreibus G., Palme H. and Spettel B. (1981) Multielement analysis of samples from highlands breccias 66095 (abs). *Lunar Planet. Sci.* **XII**, 1136-1138. Lunar Planetary Institute, Houston.
- Wanless R.K., Loveridge W.D. and Stevens R.D. (1970) Age determinations and isotopic abundance measurements on lunar samples (Apollo 11). *Proc. Apollo 11 Lunar Sci. Conf.* 1729-1739.
- Ware N.G. and Green D.H. (1977) Troctolitic and basaltic clasts from a Fra Mauro breccia. *In Lunar Sample Studies*. NASA SP-418, 49. JSC ed. Phinney

- Wark D.A., Reid A.F., Lovering J.F. and El Goresy A. (1973) Zirconolite (versus Zirkelite) in lunar rocks (abs). *Lunar Sci.* **IV**, 764-766.
- Warner J. (1970) Apollo 12 Lunar Sample Information. NASA TR R-353. JSC (catalog)
- Warner J.L. (1971) Lunar crystalline rocks: Petrology and geology. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 469-480.
- Warner J.L. (1972) Metamorphism of Apollo 14 breccias. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 623-643.
- Warner J.L. (1975) Mineralogy, petrology and geochemistry of the lunar samples. *Rev. Geophys. Space Phys.* **13**, 107-168.
- Warner J.L. and Duke M.B. (1971) Apollo 14 lunar sample information catalog. NASA TM X-58062.
- Warner J.L., Ridley W.I., Reid A.M. and Brown R.W. (1972) Apollo 15 glasses and the distribution of non-mare crystal rock types. In **The Apollo 15 Lunar Samples** 179-182. Lunar Planetary Institute, Houston.
- Warner J.L., Simonds C.H., Phinney W.C. and Gooley R. (1973a) Petrology and genesis of two "igneous" rocks from Apollo 17 (76055 and 77135) (abs). *EOS Trans. AGU* **54**, 620-621.
- Warner J.L., Simonds C.H. and Phinney W.C. (1973b) Apollo 16 rocks: Classification and petrogenetic model. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 481-504.
- Warner J.L., Reid A.M., Ridley W.I. and Brown R.W. (1973) Major element composition of Luna 20 glasses. *Earth Planet. Sci. Lett.* **17**, 7-12.
- Warner J.L., Simonds C.H. and Phinney W.C. (1974) Impact-induced fractionation in the lunar highlands. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 379-397.
- Warner J.L., Simonds C.H. and Phinney W.C. (1976a) Apollo 17, Station 6 boulder sample 76255: Absolute petrology of breccia matrix and igneous clasts. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 21233-2250.
- Warner J.L., Simonds C.H. and Phinney W.C. (1976b) Genetic distinction between anorthosites and Mg-rich plutonic rocks (abs). *Lunar Sci.* **VII**, 915-917. Lunar Planetary Institute, Houston.
- Warner J.L., Phinney W.C., Bickel C.E. and Simonds C.H. (1977) Feldspathic granulitic impactites and pre-final bombardment lunar evolution. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2051-2066.
- Warner J.L. and Bickel C.E. (1978) Lunar plutonic rocks: a suite of materials depleted in trace siderophile elements. *Am. Mineral.* **63**, 1010-1015.
- Warner J.L., Simonds C.H., McGee P.E. and Cochran A. (1978) Luna 24: Lateral heterogeneity in the lunar crust. In **Mare Crisium: The view from Luna 24**. (Merrill and Papike eds) pp. 229-244. Pergamon Press
- Warner R.D., Keil K., Murali A.V. and Schmitt R.A. (1975a) Petrogenetic relationships among Apollo-17 basalts. In Papers presented to the **Conference on Origins of Mare Basalts** and their Implications for Lunar Evolution (Lunar Science Institute, Houston), 179-183.
- Warner R.D., Keil K., Prinz M., Laul J.C., Murali A.V. and Schmitt R.A. (1975b) Mineralogy, petrology, and chemistry of mare basalts from Apollo 17 rake samples. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 193-220.
- Warner R.D., Prinz M. and Keil K. (1975c) Mineralogy and petrology of mare basalts from Apollo 17 rake samples (abs). *Lunar Sci.* **VI**, 850-852. Lunar Planetary Institute, Houston.



Warner R.D., Warren R.G., Mansker W.L., Berkley J.L. and Keil K. (1976a) Electron microprobe analyses of olivine, pyroxene and plagioclase from Apollo 17 rake sample mare basalts. Spec. Publ. # 15, UNM Institute of Meteoritics, Albuquerque. 158 pp.

Warner R.D., Berkley J.L., Mansker W.L., Warren R.G. and Keil K. (1976b) Electron microprobe analyses of spinel, Fe-Ti oxides and metal from Apollo 17 rake sample mare basalts. Spec. Publ. #16, UNM Institute of Meteoritics, Albuquerque. 114 pp.

Warner R.D., Dowty E., Prinz M., Conrad G.H., Nehru C.E. and Keil K. (1976c) Catalog of Apollo 16 rake samples from the LM area and station 5. Spec. Publ. #13, UNM Institute of Meteoritics, Albuquerque. 87 pp.

Warner R.D., Planner H.N., Keil K., Murali A.V., Ma M.-S., Schmitt R.A., Ehmann W.D., James W.D., Clayton R.N. and Mayeda T.K. (1976) Consortium investigation of breccia 67435. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 2379-2402.

Warner R.D., Keil K. and Taylor G.J. (1977a) Coarse-grained basalt 71597: A product of partial olivine accumulation. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1429-1442.

Warner R.D., Taylor G.J. and Keil K. (1977b) Petrology of crystalline matrix breccias from Apollo 17 rake samples. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1987-2006.

Warner R.D., Taylor G.J. and Keil K. (1977c) Petrology of breccias from Apollo 17 rake samples (abs). *Lunar Sci.* **VIII**, 985 - 987. Lunar Planetary Institute, Houston.

Warner R.D., Taylor G.J., Keil K., Planner H.N., Nehru C.E., Ma M.-S. and Schmitt R.A. (1978a) Green glass vitrophyre 78526: an impact melt of very low-Ti mare basalt composition. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 547-563.

Warner R.D., Taylor G.J., Mansker W.L. and Keil K. (1978b) Clast assemblages of possible deep-seated (77517) and immiscible melt (77538) origins in Apollo 17 breccias. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 941-958.

Warner R.D., Keil K., Taylor G.J. and Nehru C.E. (1978c) Petrology of recrystallized ANT rocks from Apollo 17 rake samples: 72558 (anorthositic troctolite) and 78527 (norite) (abs). *Lunar Planet. Sci.* **IX**, 1220-1222. Lunar Planetary Institute, Houston.

Warner R.D., Taylor G.J. and Keil K. (1978d) Clasts in breccias 77517 and 77538: Evidence for deep-seated and immiscible melt origins (abs). *Lunar Planet. Sci.* **IX**, 1222-1224. Lunar Planetary Institute, Houston.

Warner R.D., Taylor G.J., Keil K. and Nehru C.E. (1978e) Green glassy rock 78526: An impact melt rock of very low- Ti mare basalt? (abs) *Lunar Planet. Sci.* **IX**, 1225-1227. Lunar Planetary Institute, Houston.

Warner R.D., Keil K., Nehru C.E. and Taylor G.J. (1978) Catalogue of Apollo 17 rake samples from Stations 1a, 2, 7, and 8. Spec. Publ. #18, UNM Institute of Meteoritics, Albuquerque. 88 pp.

Warner R.D., Nehru C.E. and Keil K. (1978g) Opaque oxide mineral crystallization in lunar high-titanium basalts. *Am. Mineral.* **63**, 1209-1224.

Warner R.D., Taylor G.J., Conrad G.H., Northrop H.R., Barker S., Keil K., Ma M.-S. and Schmitt R. (1979a) Apollo 17 high-Ti mare basalts: New bulk compositional data, magma types, and petrogenesis. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 225-247.

Warner R.D., Taylor G.J. and Keil K. (1979b) Composition of glasses in Apollo 17 samples and their relation to known lunar rock types. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 1437-1456.

- Warner R.D., Taylor G.J. and Keil K. (1979c) Composition of glasses in Apollo 17 soil breccias (abs). *Lunar Planet. Sci.* **X**, 1298-1300. Lunar Planetary Institute, Houston.
- Warner R.D., Taylor G.J., Wentworth S.J., Huss G.R., Mansker W.L., Planner H.N., Sayeed U.A. and Keil K. (1979d) Electron microprobe analyses of glasses from Apollo 17 rake sample breccias and Apollo 17 drill core. UNM Spec. Publ. #20, Albuquerque, 20 pp.
- Warner R.D., Taylor G.J., Keil K., Ma M.-S. and Schmitt R. (1980a) Aluminous mare basalts: New data from Apollo 14 coarse-fines. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 87-104.
- Warner R.D., Taylor G.J. and Keil K. (1980b) Petrology of 60035: Evolution of a polymict ANT breccia. In **Proc. Conf. Lunar Highlands Crust**, (eds. Papike and Merrill) 377-394. Lunar Planetary Institute, Houston.
- Warren N., Trice R., Soga N. and Anderson O.L. (1973) Rock physics properties of some lunar samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2611-2629.
- Warren N., Trice R. and Stephens J. (1974) Ultrasonic attenuation: Q measurements on 70215,29. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2927-2938.
- Warren P.H. (1979) The quest for pristine nonmare rocks: A new crop of Toisons d'Or (abs). *Lunar Planet. Sci.* **X**, 1301-1303. Lunar Planetary Institute, Houston.
- Warren P.H. (1985) The magma ocean concept and lunar evolution. *Annu. Rev. Earth Planet. Sci.* **13**, 201-240.
- Warren P.H. (1988) The origin of pristine KREEP: Effects of mixing between urKREEP and the magmas parental to the Mg-rich cumulates. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 233-241. Lunar Planetary Institute, Houston.
- Warren P.H. (1990) Lunar anorthosites and the magma ocean hypothesis: Importance of FeO enrichment in the parent magma. *Am. Mineral.* **75**, 46-58.
- Warren P.H. (1992) Inheritance of silicate differentiation during lunar origin by giant impact. *Earth Planet. Sci. Lett.* **112**, 101-116.
- Warren P.H. (1993) A concise compilation of petrologic information on possibly pristine nonmare Moon rocks. *Am. Mineral.* **78**, 360-376.
- Warren P.H. (2001) Porosities of lunar meteorites: Strength, porosity, and petrologic screening during the meteorite delivery process. *J. Geophys. Res.* **106**, 10,101-10,111.
- Warren P.H. (2003) 1.21 The Moon. In **Treatise on Geochemistry**. Vol. 1, pages 559-599. Elsevier Ltd.
- Warren P.H. (2005) Lunar meteorites and whatnot. *Meteorit. Planet. Sci.* **40**, 477-506.
- Warren P.H. (2008) Lunar rock-rain: Diverse silicate impact-vapor condensates in an Apollo-14 regolith breccia. *Geochim. Cosmochim. Acta* **72**, 3562-3585.
- Warren P.H., Mittlefehldt D.W., Boynton W.V. and Wasson J.T. (1977) In quest of primary highlands rocks (abs). *Lunar Planet. Sci.* **VIII**, 988-990. Lunar Planetary Institute, Houston
- Warren P.H. and Wasson J.T. (1977) Pristine nonmare rocks and the nature of the lunar crust. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2215-2235.

- Warren P.H. and Wasson J.T. (1978) Compositional-petrographic investigation of pristine nonmare rocks. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 185-217.
- Warren P.H., McEwing C.E., Afiattalab F. and Wasson J.T. (1978a) The quest for pristine non-mare rocks: Nine nonmare samples free of meteoritic siderophiles (abs). *Lunar Planet. Sci.* **IX**, 1228-1230. Lunar Planetary Institute, Houston.
- Warren P.H., Afiattalab F. and Wasson J.T. (1978b) Investigation of unusual KREEPy samples: Pristine rock 15386, Cone Crater soil fragments 14143, and 12023, a typical Apollo 12 soil. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 653-660.
- Warren P.H. and Wasson J.T. (1979a) The compositional-petrographic search for pristine nonmare rocks: Third foray. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 583-610.
- Warren P.H. and Wasson J.T. (1979b) The origin of KREEP. *Rev. Geophys. Space Phys.* **17**, 73-88.
- Warren P.H. and Wasson J.T. (1980a) Further foraging of pristine nonmare rocks: Correlations between geochemistry and longitude. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 431-470.
- Warren P.H. and Wasson J.T. (1980b) Early lunar petrogenesis, oceanic and extraoceanic. *In Proc. Conf. Lunar Highlands Crust*, Geochim. Cosmochim. Acta, Suppl. 12. Pergamon Press. 81-99. Lunar Planetary Institute, Houston.
- Warren P.H., Taylor G.J., Keil K., Marshall C. and Wasson J.T. (1981) Foraging wetward for pristine nonmare rocks: Complications for petrogenetic models. *Proc. 12<sup>th</sup> Lunar Planet. Sci. Conf.* 21-40.
- Warren P.H., Taylor G.J., Keil K., Kallemeyn G.W., Rosener P.S. and Wasson J.T. (1982) Foraging for pristine nonmare rocks: Four more from the west (abs). *Lunar Planet. Sci.* **XIII**, 841-842. Lunar Planetary Institute, Houston.
- Warren P.H., Taylor G.J. and Keil K. (1983a) Regolith breccia Allan Hills A81005: Evidence of lunar origin and petrography of pristine and nonpristine clasts. *Geophys. Res. Lett.* **10**, 779-782.
- Warren P.H., Taylor G.J., Keil K., Shirley D.N. and Wasson J.T. (1983b) Petrology and chemistry of two large granite clasts from the Moon. *Earth Planet. Sci. Lett.* **64**, 175-185.
- Warren P.H., Taylor G.J., Keil K., Kallemeyn G.W., Rosener P.S. and Wasson J.T. (1983c) Sixth foray for pristine nonmare rocks and an assessment of the diversity of lunar anorthosites. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **88**, A615-A630.
- Warren P.H., Taylor G.J., Keil K., Kallemeyn G.W., Shirley D. and Wasson J.T. (1983d) Seventh foray: Whitlockite-rich lithologies, a diopside-bearing troctolitic anorthosite, ferroan anorthosite and KREEP. *Proc. 14<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **88**, B151-B164.
- Warren P.H. and Kallemeyn G.W. (1984) Pristine rocks (8th foray): Plagiophile element ratios, crustal genesis, and the bulk composition of the Moon. *Proc. 15<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **89**, C16-C24.
- Warren P.H., Kallemeyn G.W. and Wasson J.T. (1984) Pristine rocks (8th foray): Genetic distinctions using Eu/Al and Sr/Al ratios (abs). *Lunar Planet. Sci.* **XV**, 894-895. Lunar Planetary Institute, Houston.
- Warren P.H., Shirley D.N. and Kallemeyn G.W. (1986) A potpourri of pristine moon rocks, including a VHK mare basalt and a unique, augite-rich Apollo 17 anorthosite. *Proc. 16<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **89**, D319-D330.

- Warren P.H. and Rasmussen K.L. (1987) Megaregolith insulation, internal temperatures and the bulk uranium content of the Moon. *J. Geophys. Res.* 3453-3465.
- Warren P.H., Jerde E.A. and Kallemeyn G.W. (1987) Pristine moon rocks: A large felsite and a metal-rich ferroan anorthosite. *Proc. 17<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* **90**, E303-E313.
- Warren P.H., Jerde E.A. and Kallemeyn G.W. (1989) Lunar meteorites: Siderophile element contents and implications for the composition and origin of the Moon. *Earth Planet. Sci. Lett.* **91**, 245-260.
- Warren P.H. and Jerde E.A. (1990) Olivine-porphyratic vitrophyre 12024,15: A sample of the margin of a lunar lava flow (abs). *Lunar Planet. Sci.* **XXI**, 1293-1294. Lunar Planetary Institute, Houston.
- Warren P.H., Jerde E.A. and Kallemeyn G.W. (1990) Pristine moon rocks: An alkali anorthosite with coarse augite exsolution from plagioclase, a magnesian harzburgite and other oddities. *Proc. 20<sup>th</sup> Lunar Planet. Sci. Conf.* 31-59. Lunar Planetary Institute, Houston.
- Warren P.H., Jerde E.H. and Kallemeyn G.W. (1991a) Pristine moon rocks: Apollo 17 anorthosites. *Proc. 21<sup>st</sup> Lunar Planet. Sci. Conf.* 51-61. Lunar Planetary Institute, Houston.
- Warren P.H. and Kallemeyn G.W. (1991b) The MacAlpine Hills lunar meteorite and implications of the lunar meteorites collectively for the composition and origin of the Moon. *Geochim. Cosmochim. Acta* **55**, 3123-3138.
- Warren P.H., Haack H. and Rasmussen K.L. (1991c) Megaregolith insulation and the duration of cooling to isotopic closure within differentiated asteroids and the Moon. *J. Geophys. Res.* **96**, 5909-5923.
- Warren P.H. and Kallemeyn G.W. (1993a) The ferroan-anorthosite suite, the extent of primordial lunar melting, and the bulk composition of the Moon. *J. Geophys. Res.* **98**, 5445-5455.
- Warren P.H. and Kallemeyn G.W. (1993b) Troctolitic anorthosite from 77115: A magnesian member of the alkalic suite. In **Workshop on Geology of the Apollo 17 Landing Site**. LPI Tech. Rpt. 92-09. 61. Lunar Planetary Institute, Houston.
- Warren P.H., Kallemeyn G.W. and Kyte F.T. (1997) Siderophile element evidence indicates that Apollo 14 high-Al mare basalts are not impact melts (abs). *Lunar Planet. Sci.* **XXVIII**, 1501-1502. Lunar Planetary Institute, Houston.
- Warren P.H., Ulf-Moller F. and Kallemeyn G.W. (2005) "New" lunar meteorites: Impact melt and regolith breccias and large-scale heterogeneities of the upper lunar crust. *Meteorit. Planet. Sci.* **40**, 989-1014.
- Warren P.H., Tonui E., Young E.D. and Newman W.L. (2007) Lunar Rock-rain: Diverse silicate impact-vapor condensation in an Apollo 14 regolith breccia (abs#2406). *Lunar Planet. Sci.* **XXXVIII**, Lunar Planetary Institute, Houston.
- Warren P.H. and Isa Junko (2012) A petrologic-compositional study of 26 rocklets from the south side of North Ray Crater (abs#5374) *75<sup>th</sup> Meteoritical Society @ Cains*
- Wasserburg G.J. and Papanastassiou D.A. (1971) Age of an Apollo 15 mare basalt: lunar crust and mantle evolution. *Earth Planet. Sci. Lett.* **13**, 97-104.
- Wasserburg G.J., Papanastassiou D.A., Tera F. and Huneke J.C. (1977) The accumulation and bulk composition of the moon: Outline of a lunar chronology. *Phil. Trans. Roy. Soc. Lond.* **A285**, 7-22.
- Wasserburg and 8 others (1978) Petrology, chemistry, age and irradiation history of Luna 24 samples. In **Mare Crisium: The view from Luna 24**. (Merrill and Papike eds) pp. 657-678. Pergamon Press

- Wasson J.T. and Baedecker P.A. (1970) Ga, Ge, In, Ir, and Au in lunar terrestrial and meteoritic basalts. *Proc. Apollo 11 Lunar Sci. Conf.* 1741-1750.
- Wasson J.T., Chou C-L., Bild R.W. and Baedecker P.A. (1973) Extralunar materials in Cone-crater soil 14141. *Geochim. Cosmochim Acta* **37**, 2349-2353.
- Wasson J.T., Chou C.L., Robinson K.L. and Baedecker P.A. (1975) Siderophiles and volatiles in Apollo 16 rocks and soils. *Geochim. Cosmochim. Acta* **39**, 1475-1485.
- Wasson J.T., Boynton W.V., Chou C-L. and Baedecker P.A. (1975) Compositional evidence regarding the influx of interplanetary materials onto the lunar surface. *The Moon* **13**, 131-141.
- Wasson J.T., Boynton W.V., Kалlemeyn G.W., Sundberg L.L. and Wai C.M. (1976) Volatile compounds released during lunar lava fountaining. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1583-1595.
- Wasson J.T., Warren P.H., Kалlemeyn G.W., McEwing C.E., Mittlefehldt D.W. and Boynton W.V. (1977) SCCRV, a major component of highlands rocks. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 2237-2252.
- Watson D.E., Larson E.E. and Reynolds R.L. (1974) Microscopic and thermomagnetic analysis of Apollo 17 breccia and basalt: feasibility of obtaining meaningful paleointensities of the lunar magnetic field (abs). *Lunar Sci.* **V**, 827-829. Lunar Planetary Institute, Houston.
- Weber H.W. and Schultz L. (1978) Rare gases in matrix and clast samples of 60016 (abs). *Lunar Planet. Sci.* **IX**, 1234-1236. Lunar Planetary Institute, Houston.
- Weber A., Saal A.E., Hauri E.H., Rutherford M.J. and van Orman J. (2011) The volatile content and D/H ratios of the lunar picritic glasses (abs#2571). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.
- Wechsler B.A., Prewitt C.T. and Papike J.J. (1976) Chemistry and structure of lunar and synthetic armalcolite. *Earth Planet. Sci. Lett.* **29**, 91-103.
- Weeks R.A. (1973) Ferromagnetic phases of lunar fines and breccias: Electron magnetic resonance spectra of Apollo 16 samples. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2763-2781.
- Weeks R.A. (1973) Paramagnetic resonance spectra of  $Ti^{3+}$ ,  $Fe^{3+}$  and  $Mn^{2+}$  in lunar plagioclases. *J. Geophys. Res.* **78**, 2393-2401.
- Wegmuller F., Sorensen J., Krahenbuhl U. and von Gunten H.R. (1980) Lunar regolith investigated by heating techniques: Surface deposits and volatilities of trace elements. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1763-1776.
- Weiblen P.W. (1977) Examination of the liquid line of descent of mare basalts in the light of data from melt inclusions in olivine. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1751-1765.
- Weiblen P.W. and Roedder Edwin (1973) Petrology of melt inclusions in Apollo samples 15598 and 62295 and of clasts in 67915 and several lunar soils. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 681-703.
- Weiblen P.W. and Roedder E. (1976) Compositional interrelationships of mare basalts from bulk chemical and melt inclusions. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 1449-1466.
- Weiblen P.W., Day W.C. and Miller J.D. (1980) Significance of major and minor element variations in plagioclase in sodic ferrogabbro and breccia matrix in lunar highlands sample 67915. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 591-610.
- Weigand P.W. (1973) Petrology of a coarse-grained Apollo 17 ilmenite basalt (abs). *EOS Trans. AGU* **54**, 621-622.

- Weigand P.W. and Hollister L.S. (1973) Basaltic vitrophyre 15597: An undifferentiated melt sample. *Earth Planet. Sci. Lett.* **19**, 61-74.
- Weill D.F., McCallum I.S., Bottinga Y., Drake M.J., McKay G.A. (1970) Mineralogy and petrology of some Apollo 11 igneous rocks. *Proc. Apollo 11 Lunar Sci. Conf.* 937-955.
- Weill D.F., Grieve R.A., McCallum I.S. and Bottinga Y. (1971) Mineralogy-petrology of lunar samples. Microprobe studies of samples 12021 and 12022; viscosity of melts of selected lunar compositions. *Proc. Second Lunar Sci. Conf.* 413-430.
- Weill D.F. and McKay G.A. (1973) The partitioning of Mg, Fe, Sr, Ce, Sm, Eu and Yb in lunar igneous systems and a possible origin of KREEP by equilibrium partial melting. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1143-1158.
- Weitz C.M., Rutherford M.J., Head J.W. and McKay D.S. (1999) Ascent and eruption of a lunar high-titanium magma as inferred from the petrology of the 74001/2 drill core. *Meteorit. Planet. Sci.* **34**, 527-540.
- Wenk H.R. and Nord G.L. (1971) Lunar bytownite from sample 12032,44. *Proc. Second Lunar Sci Conf.* 135-140.
- Wenk E., Glauser A. and Schwander H. (1972) On bytonite in 15086,36. In **The Apollo 15 Lunar Samples**, 189-190. The Lunar Science Institute.
- Wenk E., Glauser A., Schwander H. and Trommsdorff V. (1972) Twin laws, optic orientation and composition of plagioclase from rocks 12051, 14043 and 14310. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 581-589.
- Wenk H.R. and Wilde W.R. (1973) Chemical anomalies of lunar plagioclase, described by substitution vectors and their relation to optical and structural properties. *Contrib. Mineral. Petrol.* **41**, 89-104.
- Wenk H.R., Muller W.F. and Thomas G. (1973) Antiphase domains in lunar plagioclase. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 909-923.
- Wentworth S.J., Taylor G.J., Warner R.D., Keil K., Ma M.-S. and Schmitt R.A. (1979) The unique nature of Apollo 17 VLT mare basalts. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 207-223.
- Wentworth S.J. and McKay D.S. (1984) Density and porosity calculations for Apollo 15 and 16 regolith breccias (abs). *Lunar Planet Sci.* **XV**, 906-907. Lunar Planetary Institute, Houston.
- Wentworth S.J. and McKay D.S. (1988) Glasses in ancient and young Apollo 16 regolith breccias: Populations and ultra-Mg glass. *Proc. 18<sup>th</sup> Lunar Planet. Sci. Conf.* 67-77. Lunar Planetary Institute, Houston.
- Wentworth S.J. and McKay D. (1991) Apollo 14 glasses and the origin of lunar soils. *Proc. 21<sup>st</sup> Lunar Planet. Sci. Conf.* 185-192. Lunar Planetary Institute, Houston.
- Wentworth S.J. et al. (1994) Apollo 12 ropy glasses revisited. *Meteoritics* **29**, 323-333.
- Wentworth S.J., Keller L.P., McKay D.S. and Morris R.V. (1999) Space weathering on the Moon: Patina on Apollo 17 samples 75075 and 76015. *Meteor. & Planet. Sci.* **34**, 593-603.
- Wetherill G.W. (1971) Of time and the moon. *Science* **173**, 383-392.
- Whitehouse M.J. and Nemchin A.A. (2009) High precision, high accuracy measurement of oxygen isotopes in a large lunar zircon by SIMS. *Chemical Geology* **261**, 31-41.

Wiechert U., Halliday A.N., Lee D-C., Snyder G.A., Taylor L.A. and Rumble D. (2001) Oxygen isotopes and the Moon-forming giant impact. *Science* **294**, 345-348.

Wieczorek M.A. and 15 authors (1991) The constitution and structure of the lunar interior. In **New Views of the Moon** (eds Jolliff et al.). **Reviews in Mineralogy and Geochemistry** Vol 60 MSA and Geo. Soc.

Wieczorek M.A. and Phillips R.J. (2000) The Procellarum KREEP Terrane: Implications for mare volcanism and lunar evolution. *J. Geophys. Res. - Planets* **105**, 20417-20430.

Wieler R. (1998) The solar noble gas record in lunar samples and meteorites. *Space Sci. Rev.* **85**, 303-314.

Wieler R., Etique Ph., Signer P. and Poupeau G. (1980) Record of the solar corpuscular radiation in minerals from lunar soils: A comparative study of noble gases and tracks. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 1369-1393.

Wieler R., Etique P., Signer P. and Poupeau G. (1983) Decrease of the solar flare/solar wind flux ratio in the past several aeons deduced from solar neon and tracks in lunar soil plagioclases. *Proc. 13<sup>th</sup> Lunar Planet. Sci. Conf.* in *J. Geophys. Res.* A713 -A724.

Wieler R., Baur H. and Signer P. (1986) Noble gases from solar energetic particles revealed by closed system step wise etching of lunar soil minerals. *Geochim. Cosmochim. Acta* **50**, 1997-2017.

Wieler R., Baur H. and Signer P. (1993) A long-term change of the Ar/Kr/Xe fractionation in the solar corpuscular radiation (abs). *Lunar Planet. Sci.* **XXIV**, 1519-1520. Lunar Planetary Institute, Houston.

Wieler R. and Baur H. (1994) Parentless fission xenon in mineral separates of lunar breccia 14301 studied by close-system etching (abs). *Meteoritics* **29**, 550.

Wieler R., Kehm K., Meshik A.P. and Hohenberg C.M. (1996) Secular changes in the xenon and krypton abundances in the solar wind recorded in single lunar grains. *Nature* **384**, 46-49.

Wieler R. and Heber V.S. (2003) Noble gas isotopes on the Moon. *Space Sci. Rev.* **106**, 197-210.

Wiens R.C., Burnett D.S., Neugebauer M. and Pepin R.O. (1991) A comparison of solar wind and solar system xenon abundances (abs). *Lunar Planet. Sci.* **XXII**, 1503-1504. Lunar Planetary Institute, Houston

Wiens R.C., Burnett D.S., Neugebauer M. and Pepin R.O. (1992) A comparison of solar wind and estimated solar system xenon abundances: A test for solid/gas fractionation in the solar nebula. *Proc. 22<sup>nd</sup> Lunar Planet. Sci.* 153-159. Lunar Planetary Institute, Houston.

Wiesmann H. and Hubbard N.J. (1975) A compilation of the Lunar Sample Data Generated by the Gast, Nyquist and Hubbard Lunar Sample PI-Ships. Unpublished. JSC

Wieczorek M., Weiss B. and Stewart S. (2012) An impactor origin for lunar magnetic anomalies. *Science* **335**, 1212-1215.

Wiik H.B. and Ojanpera P. (1969) Chemical analyses of Lunar samples 10017, 10072 and 10084. *Science* **167**, 531-532.

Wiik H.B., Maxwell J.A. and Bouvier J.-L. (1973) Chemical composition of some Apollo 14 lunar samples. *Earth Planet. Sci. Lett.* **17**, 365-368.

Wilhelms D.E. (1987) **Geologic History of the Moon.** US Geol. Survey Prof. Paper 1348. pp302

- Williams K.L. and Taylor L.A. (1974) Optical properties and chemical compositions of Apollo 17 armalcolites. *Geology* **2**, 5-8.
- Williams R.J. (1972) The lithification of metamorphism of lunar breccias. *Earth Planet. Sci. Lett.* **16**, 250-256.
- Willis K.J. (1985) Three lithologic units of 72275 (abs). *Lunar Planet. Sci.* **XVI**, 910-911. Lunar Planetary Institute, Houston.
- Willis K.J. (1985) Mapping of five new faces of 72275. Lunar sample Newsletter #42, Append. 1, 9-23. Curator's Office, JSC.
- Willis J.P., Ahrens L.H., Danchin R.V., Erlank A.J., Gurney J.J., Hofmeyr P.K., McCarthy T.S. and Orren M.J. (1971) Some inter-element relationships between lunar rocks and fines, and stony meteorites. *Proc. 2<sup>nd</sup> Lunar Sci. Conf.* 1123-1138.
- Willis J.P., Erlank A.J., Gurney J.J. and Ahrens L.H. (1972) Geochemical features of Apollo 15 materials. *In The Apollo 15 Lunar Samples* (Chamberlain and Watkins eds.), 268-271. The Lunar Science Institute, Houston.
- Willis J.P., Erlank A.J., Gurney J.J., Theil R.H. and Ahrens L.H. (1972) Major, minor, and trace element data for some Apollo 11, 12, 14 and 15 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1269-1273.
- Wilshire H.G. and Jackson E.D. (1972a) Lunar "dunite," "pyroxenite," and "anorthosite." *Earth Planet. Sci. Lett.* **16**, 396-400.
- Wilshire H.G. and Jackson E.D. (1972b) Petrology and stratigraphy of the Fra Mauro Formation at the Apollo 14 site. US Geol. Survey Prof. Paper 785
- Wilshire H.G., Schaber G.C.G., Silver L.T., Phinney W.C. and Jackson E.D. (1972) Geological setting and petrology of Apollo 15 anorthosite (15415). *Geol. Soc. Am. Bull.* **83**, 1083-1092.
- Wilshire H.G., Stuart-Alexander D.E. and Jackson E.D. (1973) Apollo 16 rocks – Petrology and classification. *J. Geophys. Res.* **78**, 2379-2391.
- Wilshire H.G. and Moore H.J. (1974) Glass-coated lunar rock fragments. *J. Geol.* **82**, 403-417.
- Winzer S.R. (1976) Studies of consortium breccia 61175 (abs). *Meteoritics* **11**, 390-393.
- Winzer S.R., Nava D.F., Schuhmann S., Kouns C.W., Lum R.K.L. and Philpotts J.A. (1974) Major, minor and trace element abundances in samples from the Apollo 17 Station 7 boulder: Implications for the origin of early lunar crustal rocks. *Earth Planet. Sci. Lett.* **23**, 439-444.
- Winzer S.R., Nava D.F., Schuhmann S., Lum R.K.L. and Philpotts J.A. (1975a) Origin of the Station 7 boulder: A note. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 707-710.
- Winzer S.R., Nava D.F., Lum R.K.L., Schuhmann S., Schuhmann P. and Philpotts J.A. (1975b) Origin of 78235, a lunar norite cumulate. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1219-1229.
- Winzer S.R., Lum R.K.L., Schuhmann S. and Philpotts J.A. (1975c) Large ion lithophile trace element abundances in phases from 78235,34, a lunar norite cumulate (abs). *Lunar Sci.* **VI**, 872-873. Lunar Planetary Institute, Houston.
- Winzer S.R., Nava D.F., Schuhmann P.J., Schuhmann S., Lindstrom M.M., Lum R.K.L., Lindstrom D.J. and Philpotts J.A. (1976) Origin of melts, breccias and rocks from the Apollo 17 landing site (abs). *Lunar Sci.* **VII**, 941-943. Lunar Planetary Institute, Houston.



Winzer S.R., Nava D.F., Meyerhoff M., Lindstrom D.J., Lum R.K.L., Lindstrom M.M., Schuhmann P., Schumann S. and Philpotts J.A. (1977a) The petrology and geochemistry of impact melts, granulites and hornfels from consortium breccia 61175. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 1943-1966.

Winzer S.R., Nava D.F., Schuhmann P.J., Lum R.K.L., Schuhmann S., Lindstrom M.M., Lindstrom D.J. and Philpotts J.A. (1977b) The Apollo 17 "melt sheet": Chemistry, age and Rb/Sr systematics. *Earth Planet. Sci. Lett.* **33**, 389-400.

Winzer S.R., Breen K., Ritter A., Meyerhoff M. and Schuhmann P.J. (1978) A study of glass coatings from some Apollo 15 breccias (abs). *Lunar Sci.* **IX**, 1259-1261. Lunar Planetary Institute, Houston.

Wittmann Axel, Lapen T., Swindle T.D. and Kring D.A. (2011) Petrography and provenance of impact melt and granulite particles from the ancient regolith breccias 60016, 61135 and 66035 (abs#2289). *42<sup>nd</sup> Lunar Planet. Sci. Conf.* @ The Woodlands.

Wlotzka F., Jagoutz E., Spettel B., Baddenhausen H., Balacescu A. and Wanke H. (1972) On lunar metallic particles and their contribution to the trace element content of Apollo 14 and 15 soils. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1077-1084.

Wlotzka F., Spettel B. and Wanke H. (1973) On the composition of metal from Apollo 16 fines and the meteoritic component. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1483-1491.

Wolf R., Woodrow A. and Anders E. (1979) Lunar basalts and pristine highland rocks: Comparison of siderophile and volatile elements. *Proc. 10<sup>th</sup> Lunar Planet. Sci. Conf.* 2107-2130.

Wolf R. and Anders E. (1980) Moon and Earth: Compositional differences inferred from siderophiles, volatiles and alkalis in basalts. *Geochim. Cosmochim. Acta* **44**, 2111-2124.

Wolfe E.W., Lucchitta B.K., Reed V.S., Ulrich G.E. and Sanchez A.G. (1975) Geology of the Taurus-Littrow valley floor. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 2463-2482.

Wolfe E.W., Bailey N.G., Lucchitta B.K., Muehlberger W.R., Scott D.H., Sutton R.L. and Wilshire H.G. (1981) The geologic investigation of the Taurus-Littrow Valley: Apollo 17 Landing Site. US Geol. Survey Prof. Paper, 1080, pp. 280.

Wood J.A. (1970) Petrology of the lunar soil and geophysical implications. *J. Geophys. Res.* **75**, 6497-6513.

Wood J.A. (1972a) Thermal history and early magmatism in the Moon. *Icarus* **16**, 229-240.

Wood J.A. (1972b) Fragments of Terra rock in the Apollo 12 soil samples and a structural model of the moon. *Icarus* **16**, 462-501.

Wood J.A. (1975) Lunar petrogenesis in a well-stirred magma ocean. *Proc. 6<sup>th</sup> Lunar Sci. Conf.* 1087-1102.

Wood J.A. (1975) The nature and origin of Boulder 1, Station 2, Apollo 17. *The Moon* **14**, 505-517.

Wood J.A., Marvin U.B., Powell B.N. and Dickey J.S. (1970) Mineralogy and petrology of the Apollo 11 lunar sample. *Smithson. Astrophys. Observ. Spec. Rep.* 307

Wood J.A., Dickey J.S., Marvin U.B. and Powell B.N. (1970a) Lunar anorthosites. *Science* **167**, 602-604.

Wood J.A., Dickey J.S., Marvin U.B. and Powell B.N. (1970b) Lunar anorthosites and a geophysical model of the Moon. *Proc. Apollo 11 Lunar Sci. Conf.* 965-988.

- Wood J.A., Marvin U.B., Reid J.B., Taylor G.J., Bower J.F., Powell B.N. and Dickey J.S. (1971a) Mineralogy and petrology of the Apollo 12 lunar sample. *Smithson. Astrophys. Observ. Spec. Rep.* 333
- Wood J.A., Reid J.B., Taylor G.J. and Marvin U.B. (1971b) Petrological character of the Luna 16 sample from Mare Fecunditatis. *Meteoritics* **6**, 181-193.
- Wood J.A. and Ryder G. (1977) The Apollo 15 green glass enigma (abs). *Lunar Sci.* **VIII**, 1026-1028. Lunar Planetary Institute, Houston.
- Wood J.A. and a cast of 28 others (1977) Interdisciplinary studies by the Imbrium Consortium. Two volumes. Pink and Green literature.
- Woodcock M.R. and Pillinger C.T. (1978) Major element chemistry of agglutinate size fractions. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2195-2214.
- Wopenka B., Jolliff B.L., Zinner E. and Kremser D.T. (1996) Trace element zoning and incipient metamictization in a lunar zircon: application of three microprobe techniques. *Amer. Mineral.* **81**, 902-912.
- Wosinski J.F., Williams J.P., Korda E.J., Kane W.T., Carrier G.B. and Schreurs J.W.H. (1972) Inclusions and interface relationships between glass and breccia in lunar sample 14306,50. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 853-864.
- Wosinski J.F., Williams J.P., Korda E.J. and Geiger G.A. (1973) Glass and devitrified zones on lunar breccia rock 15286,3. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 383-388.
- Wright I.P., Russell S.S., Boyd S.R., Meyer C. and Pillinger C.T. (1992) Xylan: A potential contaminant for lunar samples and Antarctic Meteorites. *Proc. 22<sup>nd</sup> Lunar Planet. Sci. Conf.* 449-458.
- Wrigley R.C. (1971) Some cosmogenic and primordial radionuclides in Apollo 12 lunar surface materials. *Proc. Second Lunar Sci. Conf.* 1791-1796.
- Wrigley R.C. (1973) Radionuclides at Descartes in the central highlands. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 2203-2208.
- Wrigley R.C. and Quaide W.L. (1970) Al<sup>26</sup> and Na<sup>22</sup> in lunar surface materials: Implications for depth distribution studies. *Proc. Apollo 11 Lunar Sci. Conf.* 1751-1755.
- Wszolek P.C., Jackson R.F. and Burlingame A.L. (1972) Carbon chemistry of a glass-rich sample related to the uniformity of the regolith and lunar surface processes. In **The Apollo 15 Lunar Samples**, 324-328. Lunar Planetary Institute, Houston.
- Wszolek P.C., Simonett B.R. and Burlingame A.L. (1973) Studies of magnetic fines and volatile-rich soils: Possible meteoritic and volcanic contributions to lunar carbon and light element chemistry. *Proc. 4<sup>th</sup> Lunar Sci. Conf.* 1693-1706.
- Yajima T. and Hafner S.S. (1974) Cation distribution and equilibrium temperature of pigeonite from basalt 15065. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 769-784.
- Yakovlev O.I., Gerasimov M.V. and Dikov Yu.P. (2009) Temperatures of formation of HASP and GASP particles (abs#1261). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Yaniv A. and Heymann D. (1971) Inert gases from Apollo 11 and Apollo 12 fines: Reversals in the trends of relative element abundances. *Earth Planet. Sci. Lett.* **10**, 387-391.

- Yaniv A. and Heymann D. (1972) Atmospheric Ar<sup>40</sup> in lunar fines. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1967-1981.
- Yaniv A. and Marti K. (1981) Detection of stopped solar flare helium in lunar rock 68815. *Astrophys. J. Lett.* **247**, L143-146.
- Yinnon H., Roshko A and Uhlman D.R. (1980) On the barrier to crystal nucleation in lunar glasses. *Proc. 11<sup>th</sup> Lunar Planet. Sci. Conf.* 197-211.
- Yokoyama Y., Reyss J.L. and Guichard F. (1974) <sup>22</sup>Na-<sup>26</sup>Al chronology of lunar surface processes. *Proc. 5<sup>th</sup> Lunar Sci. Conf.* 2231-2247.
- York D., Kenyon W.J. and Doyle R.J. (1972) <sup>40</sup>Ar-<sup>39</sup>Ar ages of Apollo 14 and 15 samples. *Proc. 3<sup>rd</sup> Lunar Sci. Conf.* 1613-1622.
- Yu G. and Jacobsen S.B. (2009) Core formation and the Fe/FeO ratio of the Earth, Mars and Vesta: Constraints from the <sup>182</sup>Hf-<sup>182</sup>W system (abs#2123). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Yugas D.E. (1974) The particle track record in lunar silicates: Long term behavior of solar and galactic VH nuclei and lunar surface dynamics. Ph. D. thesis, Washington Univer. St. Louis, Mo.
- Zeigler R.A., Jolliff B.L., Korotev R.L. and Haskin L.A. (2000) Petrology, geochemistry, and possible origin of monomict mafic lithologies of the Cayley Plains (abs#1859). *Lunar Planet. Sci.* **XXXI**, Lunar Planetary Institute, Houston.
- Zeigler R.A., Haskin L.A., Korotev R.L., Jolliff B.L. and Gillis J.J. (2003) The Apollo 16 mare component: Petrography, geochemistry, and provenance (abs#1454). *Lunar Planet. Sci.* **XXXIV**, Lunar Planetary Institute, Houston.
- Zeigler R.A., Korotev R.L., Jolliff B.L., Haskin L.A. and Floss C. (2004) Apollo 16 mafic glass: Geochemistry, provenance, and implications (abs#2082). *Lunar Planet. Sci.* **XXXV**, Lunar Planetary Institute, Houston.
- Zeigler R.A., Korotev R.L., Haskin L.A., Jolliff B.L. and Gillis J.J. (2006) Petrology and geochemistry of five Apollo 16 mare basalts and evidence for post-basin deposition of basaltic material at the site. *Meteor. & Planet. Sci.* **41**, 263-284.
- Zeigler R.A., Korotev R.L., Jolliff B.L., Haskin L.A. and Floss C. (2006) The geochemistry and provenance of Apollo 16 mafic glasses. *Geochim. Cosmochim. Acta* **70**, 6050-6067.
- Zeigler R.A., Korotev R.L. and Jolliff B.L. (2006) Geochemistry and petrography of high-Ti, mafic impact-melt breccia from Apollo 12 and Sayh al Uhaymir (abs#2366). *Lunar Planet. Sci.* **XXXVII**, Lunar Planetary Institute, Houston.
- Zeigler R.A., Korotev R.L. and Jolliff B.L. (2009) A study of Apollo 16 feldspathic glasses locally produced or ballistically deposited (abs#2533). *Lunar Planet. Sci.* **XL**, Lunar Planetary Institute, The Woodlands.
- Zeigler R.A., Jolliff B.L. and Korotev R.L. (2010) Petrography and pairing relationships of lunar meteorites Sayh al Uhaymir 449 and Dhofar 925, 960 and 961 (abs#1985). *41<sup>st</sup> Lunar Planet. Sci. Conf.* @ the Woodlands
- Zellner N.E.B., Spudis P.D., Delano J.W. and Whittet D.C.B. (2002) Impact glasses from the Apollo 14 landing site and implications for regional geology. *J. Geophys. Res.* **107**, 5102-5115.

Zellner N.E.B., Delano J.W., Swindle T.D. and Whittet D.C.B. (2007) Geochemistry and impact history at the Apollo 17 landing site (abs#1007). *Lunar Planet. Sci. XXXVIII*, Lunar Planetary Institute, Houston.

Zellner N.E.B., Delano J.W., Swindle T.D., Barra F., Olsen E. and Whittet D.C.B. (2009a) Evidence from  $^{40}\text{Ar}/^{39}\text{Ar}$  ages of lunar impact glasses for an increase in the impact rate ~800 Ma ago. *Geochim. Cosmochim. Acta* **73**, 4590-4597.

Zellner N.E.B., Delano J.W., Swindle T.D., Barra F., Olsen E. and Whittet D.C.B. (2009b) Apollo 17 regolith, 71501,262: A record of impact events and mare volcanism in lunar glasses. *Meteor. & Planet. Sci.* **44**, 839-851.

Zellner N.E.B. and Gombosi D. (2011) How significant are the recent lunar impact events? (abs# 2109) *42<sup>nd</sup> Lunar Planet. Sci. Conf. @ The Woodlands*.

Zellner N.E.B., Swindle T. and Delano J.W. (2012) Understanding the significance of lunar sample data for interpreting lunar impact history (abs#4011). *Early Solar System Impact Bombardment II*. Lunar Planetary Institute, Houston.

Zellner N.E.B. and Norman M.D. (2012a) Compositions and ages of Apollo 15 lunar impact and volcanic glasses: First results (abs#1711). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* Lunar Planetary Institute @ The Woodlands.

Zellner N.E.B. and Norman M.D. (2012b) Apollo 15 lunar impact glasses: Geochemistry, age and the Earth-Moon bombardment (second try)(abs#5277). *75<sup>th</sup> Meteoritical Society @ Cains*

Zhang A., Hsu W., Li X., Li Q., Liu Y., Tang G. and Jiang Y. (2010) Cameca IMS-1280 Pb/Pb dating of baddeleyite in LAP02224 (abs#1080). *41<sup>st</sup> Lunar Planet. Sci. Conf.* Lunar Planetary Institute @ The Woodlands.

Zhang Y. and Wang K.L. (2010) Bubble growth in lunar basalts and lunar volatile budget (abs#1120). *41<sup>st</sup> Lunar Planet. Sci. Conf.* Lunar Planetary Institute @ The Woodlands.

Zhang A.C., Taylor L.A., Wang R.C., Li X.H., Li Q.L., Patchen A.D. and Liu Y. (2012) SIMS Pb/Pb ages of baddeleyite and zirconolite in Apollo 17 norite 78235: Implications for shock histories of extraterrestrial rocks (abs#1038). *43<sup>rd</sup> Lunar Planet. Sci. Conf.* Lunar Planetary Institute @ The Woodlands.

Zhang J., Dauphas N., Davis A.M., Iley G. and Fedkin A. (2012) The proto-Earth as a significant source of lunar material. *Nature Geoscience* **5**, 251-255.

Ziethen Ruth, Seiferlin K. and Hiesinger H. (2009) Duration and extent of lunar volcanism: Composition of 3D convection models to mare basalt ages. *Earth Planet. Sci. Lett.* **57**, 784-796.

Zindler A. and Jacobsen S.B. (2009) Isotopic equilibration of Earth's mantle and the Moon subsequent to the giant impact? (abs#2542). *Lunar Planet. Sci. XL*, Lunar Planetary Institute @ The Woodlands.

Zinner E. (1980) On the constancy of solar particle fluxes from track, thermoluminescence and solar wind measurements in lunar rocks. In **Proc. Conf. Ancient Sun** (eds, Pepin et al.) *Geochim. Cosmochim. Acta Supp.* 13, 201-226. Lunar Planetary Institute, Houston.

Zinner E. and Morrison D.A. (1976) Comment on micrometeorites and solar flare particles in and out of the ecliptic. *J. Geophys. Res.* **81**, 6364-6366.

Zinner E., Walker R.M., Chaumont J. and Dran J.C. (1976a) Ion probe analysis of artificially implanted ions in terrestrial samples and surface enhanced ions in lunar sample 76215,77. *Proc. 7<sup>th</sup> Lunar Sci. Conf.* 953-984.

Zinner E., Walker R.M., Chaumont J. and Dran J.C. (1976b) Ion probe analysis of artificially implanted ions in terrestrial samples and solar wind implanted ions in lunar surface samples (abs). *Lunar Sci.* **VII**, 965-967. Lunar Planetary Institute @ Clear Lake.

Zinner E., Walker R.M., Chaumont J. and Dran J.C. (1977a) Ion microprobe surface concentration measurements of Mg and Fe and microcraters in crystals from lunar rock and soil samples. *Proc. 8<sup>th</sup> Lunar Sci. Conf.* 3859-3883.

Zinner E., Walker R.M., Chaumont J. and Dran J.C. (1977b) Surface enhanced elements and microcraters in lunar rock 76215 (abs). *Lunar Planet. Sci.* **VIII**, 1044-1046. Lunar Planetary Institute, Houston.

Zolensky M.E. (1997) Structural water in the Bench Crater chondrite returned from the Moon. *Meteoritics* **32**, 15-18

Zook H.A. (1978) Dust, impact pits, and accrete on lunar rock 12054. *Proc. 9<sup>th</sup> Lunar Planet. Sci. Conf.* 2469-2484.

Zook H.A., Hartung J.B. and Storzer D. (1977) Solar flare activity: Evidence for large-scale changes in the past. *Icarus* **32**, 106-126.

Zook H.A. (1980) On lunar evidence for a possible large increase in solar flare activity  $\sim 2 \times 10^4$  years ago. In **Proc. Conf. Ancient Sun**, (ed. Pepin) *Geochim. Cosmochim. Acta Suppl.* 13, 245-266. Lunar Planetary Institute, Houston.