

**61224,6**  
Micro-Gabbro  
0.34 grams

**Introduction**

61224 contained several white and off-white particles as well as 3 peppered black and white rock fragments that appeared to fit together as one (figure 1). Thin section studies showed this to be a shocked lunar gabbro (*albiet very fine-grained for a gabbro*).

**Petrography**

Marvin and Warren (1980) describe 61224,6 and liken it to a eucritic meteorite – accept that the Fe/Mn ratio proves it is lunar in origin. Marvin (1972) originally called it “gabbroic microporphy”. The gabbroic texture and mineral mode is illustrated in figure 2. Grain size is about 1- 2 mm.

Marvin and Mosie (1980) wrote 61224,6: “*is a coarse-grained, pristine, plutonic gabbro with a cumulate texture in which chains of anhedral hyperthene and augite grains coexist with plagioclase (An<sub>83</sub>). The plagioclase has been shocked in situ to a leafy, optically-randomized state, and the grain boundaries are occupied by a selvage of pyroxene-plagioclase glass containing minute crystallites*”.

**Mineralogical Mode**

40 % plagioclase  
60% pyroxene

**Mineralogy**

Olivine: none

***Pyroxene:*** Marvin and Warren (1980) and Takeda et al. (1981) studied the composition and structure of pyroxene (figures 3 and 4). The Fe/Mn ratio of pyroxene seems to indicate that this is a lunar gabbro, not a meteorite (figure 5). Bersch et al. (1983) give precise analyses of high- and low-Ca pyroxene in 61224,6.

***Plagioclase:*** Marvin and Warren (1980) reported plagioclase as An<sub>79-87</sub>.

***Selvage glass:*** Marvin and Warren (1980) reported the composition of shock-melted glass in 61224,6.



Figure 1: Group photo for 61224,6. Scale in mm.

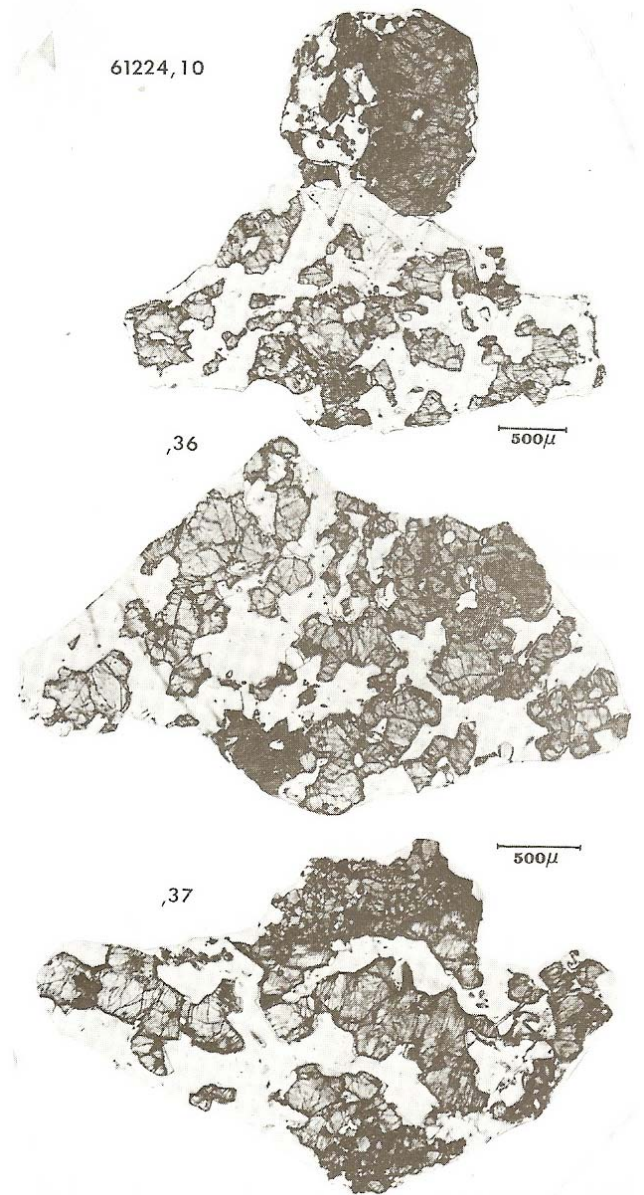


Figure 2: Thin section photo of 61224,6 (from Marvin and Warren (1980)).

**Table 1. Chemical composition of 61224**

reference	Marvin80	
weight	Warren80	
SiO <sub>2</sub> %	50.7	
TiO <sub>2</sub>	0.4	(a)
Al <sub>2</sub> O <sub>3</sub>	13.2	(a)
FeO	9.91	(a)
MnO	0.16	(a)
MgO	12.77	(a)
CaO	11.6	(a)
Na <sub>2</sub> O	0.91	(a)
K <sub>2</sub> O	0.02	(a)
P <sub>2</sub> O <sub>5</sub>		
S %		
sum		
Sc ppm	20.8	(a)
V		
Cr	1990	(a)
Co	23.6	(a)
Ni	8	
Cu		
Zn	4	(a)
Ga	2.8	(a)
Ge ppb	4.3	(a)
As		
Se		
Rb		
Sr		
Y		
Zr	170	(a)
Nb		
Mo		
Ru		
Rh		
Pd ppb		
Ag ppb		
Cd ppb	4.1	(a)
In ppb		
Sn ppb		
Sb ppb		
Te ppb		
Cs ppm		
Ba	32	(a)
La	1.47	(a)
Ce	4.3	(a)
Pr		
Nd	9	(a)
Sm	0.87	(a)
Eu	1.43	(a)
Gd		
Tb	0.22	(a)
Dy		
Ho		
Er		
Tm		
Yb	1.06	(a)
Lu	0.16	(a)
Hf	0.55	(a)
Ta	0.16	(a)
W ppb		
Re ppb	12.6	(a)
Os ppb		
Ir ppb	0.15	(a)
Pt ppb		
Au ppb	0.08	(a)
Th ppm	0.19	(a)
U ppm	0.6	(a)
technique:	(a) INAA	

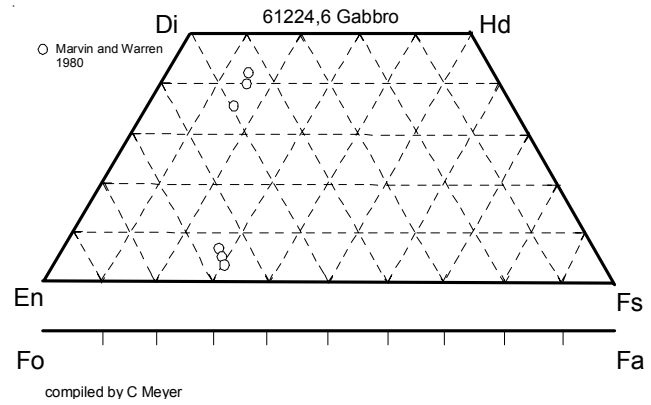


Figure 3: Pyroxene as reported by Marvin and Warren (1980).

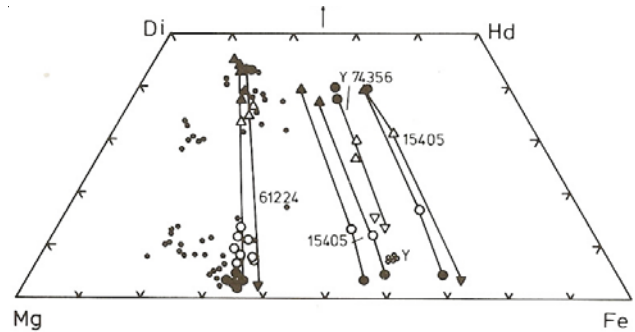


Figure 4: Takeda et al. (1981) determined the composition of fine pyroxene lamellae in 61224 (small dots).

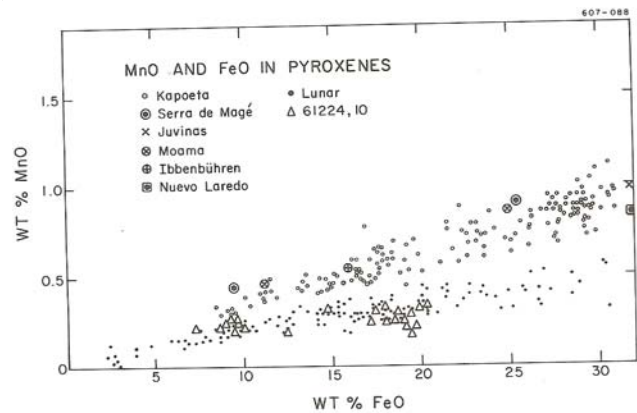


Figure 5: Composition of pyroxene in 61224,6 compared with pyroxene from meteorites and other lunar samples (Marvin and Warren 1980).

### Chemistry

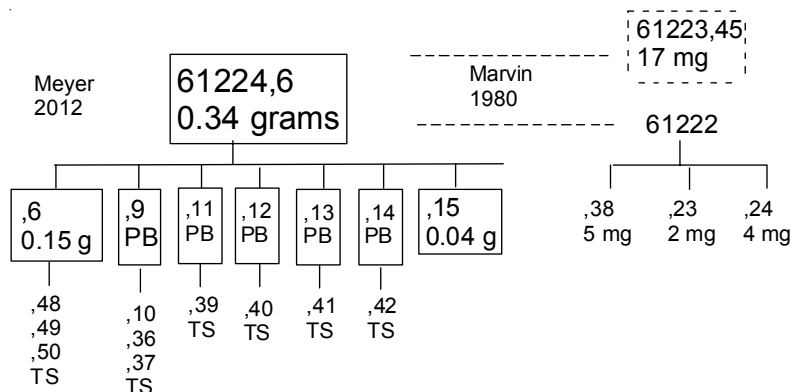
Marvin and Warren (1980) and Warren and Wasson (1980) both reported the composition of 61224,6 (table). Warren (1992) termed it “pristine”.

### Radiogenic age dating

None

## Processing

Marvin and Mosie (1980) searched for additional pieces of 61224,6 in the finer fractions of this soil (61223 and 61222).



## **References for 61224,6**

- 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.
- Butler P. (1972a) Lunar Sample Information Catalog Apollo 16. Lunar Receiving Laboratory. MSC 03210 Curator's Catalog. pp. 370.
- LSPET (1973b) The Apollo 16 lunar samples: Petrographic and chemical description. *Science* **179**, 23-34.
- Marvin U.B. (1972) Apollo 16 coarse fines (4-10 mm): Sample classification, description and inventory. Curators office, JSC.
- 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. 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.
- 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. (1980) Catalog of Apollo 16 rocks (3 vol.). Curator's Office pub. #52, JSC #16904
- 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.
- 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.
- Warren P.H. (1993) A concise compilation of petrologic information on possibly pristine nonmare Moon rocks. *Am. Mineral.* **78**, 360-376.
- 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.