Antarctic Meteorite Newsletter
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Antarctic Meteorite News

Kevin Righter, Antarctic Meteorite Curator

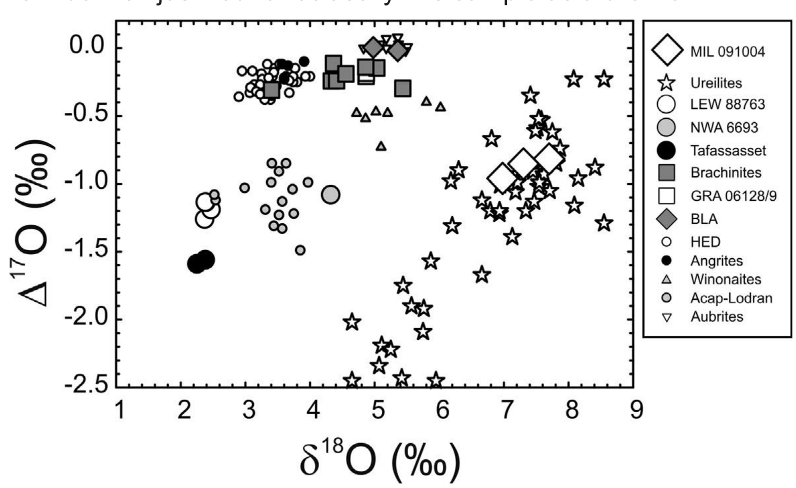
This newsletter announces the availability of 147 new meteorites collected from the 2017-18 and 2018-19 ANSMET seasons. The three GRO17 samples represent the last of the 2017 season samples to be classified, and include an ungrouped achondrite, an ungrouped (low FeO) chondrite, and an EH3 chondrite. Samples from the Dominion Range include a lunar basaltic breccia, an L impact melt and several ordinary chondrites (H3.5, H4, L3.8), including a few with unusual features such as shock melt veins or large chondrules.

In addition to these new samples, we propose reclassification of several samples, as well as pairing reassessment for others. Additionally, field collection information is presented for other samples and now added to our webpages.

Reclassifications and pairing assessments

MIL 091004

MIL 091004 was classified as a lodranite in AMN 35, 2. Petrologic, geochemical, and isotopic data acquired since then has necessitated the reclassification of this sample as a ureilite (Day et al., 2017). Pyroxene and olivine compositions from MIL 091004 fall within the compositional space defined by ureilites. In addition, oxygen isotopic composition clearly shows that MIL 091004 is a ureilite, not a lodranite. It is thus well justified to reclassify this sample as a ureilite.



Day, J.M., Corder, C.A., Cartigny, P., Steele, A., Assayag, N., Rumble III, D. and Taylor, L.A., 2017. A carbon-rich region in Miller Range 091004 and implications for ureilite petrogenesis. Geochimica et Cosmochimica Acta, 198, pp.379-395.

A periodical issued by the Meteorite Working Group to inform scientists of the basic characteristics of specimens recovered in the Antarctic.

Edited by Cecilia Satterwhite, Kellye Pando and Kevin Righter, NASA Johnson Space Center,Houston, Texas 77058

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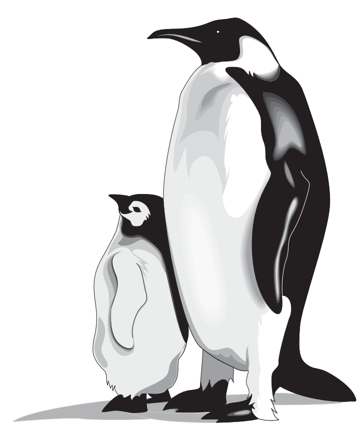

Sample Request Deadline October 7, 2022

AMAP Meets November 2-3, 2022

Free publication available at: **http://curator.jsc.nasa.gov/antmet/amn/amn.cfm**

LAR LL3.8 Chondrites

There are 14 LL3.8 chondrites that were recovered from a small area within the LAR dense collection area. These were announced in earlier newsletters and were not all paired with each other. Inspection of the field map for all these samples indicates they were recovered within 1 km of each other, and likely all paired together. Since they were classified and announced in small batches and over an 8 year period, they were not recognized as pairs until some time had passed. These include LAR from the 06 season 279, 283, 301, 320, 343, 469, 674, 772, 774, and from the 12 season 034, 075, 078, 180 and 203.

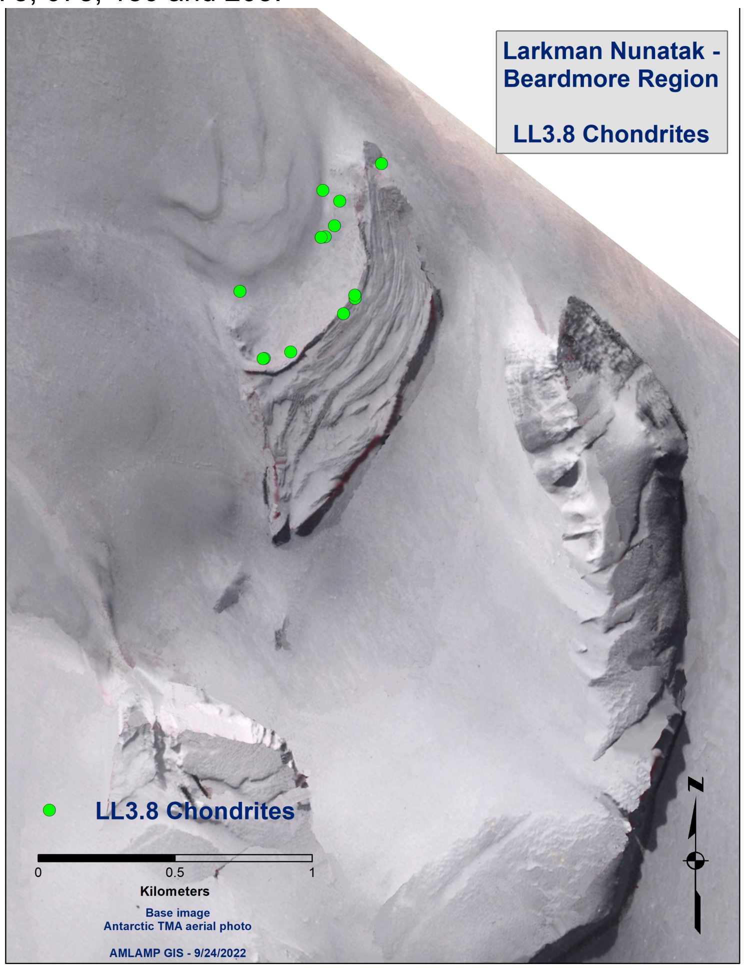

Figure 2: *Larkman Nunatak Beardmore Region LL3.8 Chondrites.*

EET and QUE Howardite Pairings

EET 87532 reclassified as a howardite.

QUE 97002 reclassified as a howardite.

An initially defined pairing group (e.g., AMN 11, 2) consisting of EET 87503, EET 87509, EET 87510, EET 87512, EET 87518, and EET 87531 has been reevaluated by Mittlefehldt et al. (2013). Based on petrography, mineralogy, petrology, bulk composition, and find locations, EET 87503 was removed from this group and paired with EET 87513, and EET 87512 was removed from this group to be unpaired. The original group also gained EET 92022, EET 83376, EET 87532, EET 99400 and EET 99408.

Five GRO howardites have been reevaluated by Mittlefehldt et al. (2013). Based on petrography, mineralogy, petrology, bulk composition, and find locations, QUE 94200, 97001, 99033 and 99058 are paired together; QUE 97002 remains unpaired.

GRO 95602 was initially paired with four other GRO howardites: GRO 95534, GRO 95535, GRO 95574, and GRO 95581. These five howardites have been reevaluated by Mittlefehldt et al. (2013), Cartwright et al. (2014) and Lunning et al. (2016). Based on petrography, mineralogy, petrology, and bulk composition, GRO 95534, 535, 574, and 581 are paired together; GRO 95602 has been removed from this pairing group and is unpaired.

References

- Mittlefehldt, D. W., Herrin, J. S., Quinn, J. E., Mertzman, S. A., Cartwright, J. A., Mertzman, K. R., & Peng, Z. X. (2013). Composition and petrology of HED polymict breccias: The regolith of (4) Vesta. Meteoritics & Planetary Science, 48(11), 2105-2134.
- Lunning, N. G., Welten, K. C., McSween Jr, H. Y., Caffee, M. W., & Beck, A. W. (2016). Grosvenor Mountains 95 howardite pairing group: Insights into the surface regolith of asteroid 4 Vesta. Meteoritics & Planetary Science, 51(1), 167-194.
- Cartwright, J. A., Ott, U., & Mittlefehldt, D. W. (2014). The quest for regolithic howardites. Part 2: Surface origins highlighted by noble gases. Geochimica et Cosmochimica Acta, 140, 488-508.

MET, GRO and LEW Low Grade Ordinary Chondrites

MET 00621 was added to the MET 00452/00526 pairing group as discussed in Righter et. al. (2021).

Righter et al. (2021) also proposed the following changes:

- MET 00489, MET 01211 and MET 01322 are all paired and type L3.6. MET 00621 was removed from this pairing group and instead paired with MET 00452 and MET 00526.
- MET 96503, MET 96515, MET 01051, MET 01056, and MET 01057 are all paired and type L3.10.
- MET 00506, MET 00552, and MET 00607 are all paired and type H3.10.
- GRO 03015 and GRO 03061 are paired and both type L3.10.
- GRO 95502, GRO 95504, GRO 95505, GRO 95512, GRO 95539, GRO 95542, GRO 95544, GRO 95545, GRO 95546, and GRO 95550 are all paired and type L3.2.
- LEW 85434, LEW 85437, LEW 87248, LEW 87284, LEW 88254, and LEW 88462 are all paired and type L3.15.
- LEW 86018, LEW 86102, LEW 86144, LEW 86158, LEW 86207, LEW 86270, LEW 88520, and LEW 88634 are all paired and type L3.2.
- LEW 85401, LEW 86127, and LEW 88033 are all paired type L3.3.
- LEW 85339, 86246, 86367, 86505, 88175, 88261, 88452, 86105, and 86213 are all paired type L3.4.
- LEW 88263 was listed incorrectly as a L3.7 in Righter et al. (2021). This sample should also be paired with the LEW 85339 L3.4 group.

- LEW 86408, LEW 86417, LEW 86436, LEW 86495, LEW 88286, LEW 88617, LEW 88632, and LEW 88644 are all paired type L3.5.
- LEW 88632 was mistakenly listed as L3.5 in Righter et al. (2021) - it is L3.6 and should thus be paired with LEW 85396.
- LEW 85396, LEW 85452, LEW 86347, LEW 88146 are all paired type L3.6.
- LEW 88328, LEW 88594, LEW 88621, LEW 88696, LEW 93891 are paired and Type L3.7.
- LEW 88467 and LEW 87093 are paired and type L3.8.

References

- Righter, K., Schutt, J., Lunning, N., Harvey, R., & Karner, J. (2021) Identification and pairing reassessment of unequilibrated ordinary chondrites from four Antarctic dense collection areas. Meteoritics & Planetary Science 56, 1556-1578.

Allan Hills CM Chondrites

47 CM chondrites have been recovered from the Allan Hills dense collection area, which spans nearly 70 km x 30 km. The area is comprised of four different subfields: main, near western, middle western, and far western icefields. Pairing within these areas has been addressed in the past (e.g., Benoit et al., 2000), but not reassessed in the last 20-25 years. In these intervening years, a wide variety of analytical results have been acquired and published including noble gas data (Herpers et al., 1990; Krietsch et al., 2021), bulk and isotopic H, C, and N measurements (Alexander et al., 2012; 2013), and spectroscopic data (Hiroi et al., 2021). In addition, the recovery and naming of these samples has varied from season to season which has made the history somewhat confusing so we will try to clarify that here.

Current sample pairings:

Main Icefield: ALH 77306, ALH 78261, ALH 81002, ALH 81312 (none paired with each other)

Near Western Icefield: ALH 84054, ALH 84033 (all paired with ALH 81002)

Middle Western Icefield: ALH 81004, ALH 83016, ALH 84191 (all paired with ALH 81002)

Far Western Icefield:

- ALH 77306, ALH 78261, ALH 81002, ALH 81312 (none paired with each other)
- ALH 83102; 20 pieces were recovered and assigned the same number; described in AMN 8, no. 1 (Feb. 1985) and AMN 9, no. 2 (June 1986), Table 8, page 13.

Other samples recovered from this area include:

- ALH 83100 pairs: ALH 99500.
- ALH 83102 pairs: ALH 83106, ALH 84029, ALH 84030, ALH 84031, ALH 84032, ALH 84034, ALH 84035, ALH 84040, ALH 84041, ALH 84042, ALH 84043, ALH 84044, ALH 84045, ALH 84047, ALH 84048, ALH 84049, ALH 84051, ALH 85004.
- ALH 85005 and pairs ALH 85007, ALH 85008, ALH 85009, ALH 85010, ALH 85011, ALH 85012, ALH 85013
- ALH 81002 pairs: ALH 82100, ALH 82131, ALH 84036, ALH 84039, ALH 84046, ALH 84050, ALH 84053

- ALH 85106
- ALH 90407

The following observations have been made that allow us to reconsider the pairing among the Allan Hills CM chondrites.

A. The ALH 81002 pairing group is spread over a very large distance, close to 70 km. This seems too large given knowledge of showers and strewnfield sizes and mass recovered (e.g., Righter et al., (2021)). We thus suggest unpairing the samples from the far and middle western groups dividing this group into three: ALH 81002 from the main icefield (and 2 pairs in near western field, ALH 84033 and ALH 84054), ALH 81004 middle western icefield (and 2 pairs ALH 83016 and ALH 84191), and ALH 82100 far western icefield (and ALH82131, ALH 84036, ALH 84039, ALH 84046, ALH 84050, and ALH 84053, as well as two additional samples discussed in (F) and (G)).

B. Pieces of ALH 83100 and ALH 83102 and their respective paired samples have a similar appearance in hand specimens with a blocky fracture, sometimes with conchoidal fracture surfaces. This distinctive appearance is supported by (C), (D), and (E) below.

C. Krietsch et al. (2021) show that the ALH fields have at least three groups of different ages: ALH 84042 (0.3 Ma), ALH 84033 (6.1 Ma), and ALH 85013 (19.8 Ma). The youngest age corresponds to the same age as obtained for ALH 84042 by Herpers et al. (1990). The 6.1 Ma age for ALH 84033 is also in agreement with the previous work of Herpers et al. (1990). These results also suggest that ALH 84042, 84044, 84029, 83102, and 83100 all have the same young age ~0.2 Ma.

D. The ALH 83100 and ALH 83102 groups have the same CRE age, as well as the same H,C,N content as measured by Alexander et al. (2012, 2013), while also distinct from that of the ALH 81002 and ALH 85005 (85013) groups.

E. Finally, the reclassification of the samples paired with ALH 83100 (83102 and pairs), from CM2 to CM1/2 is consistent with the original reclassification of ALH 83100 by Zolensky et al. (1997) and subsequent spectroscopic work on the paired pieces by Hiroi et al. (2021) supportive of their more hydrated or aqueously altered than typical CM2.

F. ALH 99500 seems not like ALH 83100, in appearance, but was paired with it anyway. It looks like it should instead be paired with the ALH 82100 pairing group in that area (see discussion in (A) above).

G. ALH 90407 looks like it could be crumbly in photos which would put it with ALH 82100 group (see discussion in (A) above).

H. ALH 85106 looks blocky which would put it with ALH 83100.

Therefore, here are the newly adjusted pairing groups suggested by all this new work, hand sample observations, and find locations:

Main Icefield: ALH 77306, ALH 78261, ALH 81002, ALH 81312 (no changes)

Near Western Icefield: ALH 84054, ALH 84033 (both paired with ALH 81002) (no changes)

Middle Western Icefield: ALH 81004 (paired with ALH 83016, ALH 84191)

Far Western Icefield:

- ALH 83100 (paired with ALH 83102, ALH 83106, ALH 84029, ALH 84030, ALH 84031, ALH 84032, ALH 84034, ALH 84035, ALH 84040, ALH 84041, ALH 84042, ALH 84043, ALH 84044, ALH 84045, ALH 84047, ALH 84048, ALH 84049, ALH 84051, ALH 85004, ALH 85106).
- ALH 85005 (paired with ALH 85007, ALH 85008, ALH 85009, ALH 85010, ALH 85011, ALH 85012, ALH 85013).
- ALH 82100 (paired with ALH 82131, ALH 84036, ALH 84039, ALH 84046, ALH 84050, ALH 84053, ALH 90407, and ALH 99500).

Future work could examine the CRE ages of the Main icefield samples, as well as the Middle Western (ALH 81004) and Far Western (ALH 82100) pairing groups.

References

- Krietsch, D., Busemann, H., Riebe, M. E., King, A. J., Alexander, C. M. D., & Maden, C. (2021) Noble gases in CM carbonaceous chondrites: Effect of parent body aqueous and thermal alteration and cosmic ray exposure ages. *Geochimica et Cosmochimica Acta 310*, 240-280.
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- Hiroi, T., Kaiden, H., Imae, N., Misawa, K., Kojima, H., Sasakia, S., Matsuokaa, M., Nakamura, T., Bish, D.L., Ohtsuka, K., Howard, K.T., Robertson, K.R., and Milliken, R.E. (2021) UV-visible-infrared spectral survey of Antarctic carbonaceous chondrite chips. *Polar Science 29*, 100723.
- Alexander, C.O'D. M. O, Bowden,. R., Fogel, M. L., Howard, K. T., Herd, C. D. K., Nittler, L. R. (2012) The provenances of asteroids, and their contributions to the volatile inventories of the terrestrial planets. *Science 337*, 721-723.
- Alexander, C. M. O'D., Howard, K. T., Bowden, R., Fogel, M. L. (2013) The classification of CM and CR chondrites using bulk H, C and N abundances and isotopic compositions. *Geochimica et Cosmochimica Acta 123*, 244-260.

Samples Recovered in Multiple Pieces:

The following samples from early years of the ANSMET program were recovered in multiple pieces and given the same generic sample number (group 1 below), or two generic numbers were combined and renumbered (group 2 below). We have added notes to their webpage descriptions indicating this unique history.

1) multiple pieces given the same generic:

EET 90051 (2), EET 90053 (15), EET 90610 (19), EET 90698 (2), EET 90700 (2), EET 90364 (2)

2) two generic numbers were combined and renumbered

LEW 87016 (combined with LEW 87024), EET 87520 (combined with EET 87524), EET 79007 (combined with EET 79008), and EET 79009 (combined with EET 79012).

Report From The Smithsonian
Cari Corrigan*, *Research Geologist (Dept. of Mineral Sciences)

After a tumultuous two years, the Smithsonian fully reopened to staff in May of this year. This newsletter announces the classification of 150 new meteorites, possibly a smaller number than our previous pace, but classifications were able to be conducted in the usual collaborative manner, using both electron microprobe and EDS analyses for this newsletter, as well as allowing us to work together in person to review data and describe meteorites.

On a personnel note, we welcomed Kelsey Falquero, a Collections Technician at the NMNH, to our Division of Meteorites team back in the spring on a temporary assignment. Kelsey has been working with us in both the Antarctic and main meteorite collections, and we are excited to announce that she has been permanently reassigned to the Department of Mineral Sciences and will continue working with us, and all of you.

The new scanning electron microscope ordered by our department last year has been delivered, installed, and optimized. Training for the laboratory staff is currently taking place on this new instrument, which will eventually be used to classify ordinary chondrites using the dual EDS system.

Our collections have reopened, and we are diligently moving through the backlog of requests we have received since early 2020. We appreciate your patience as we get back to a more normal way of working.

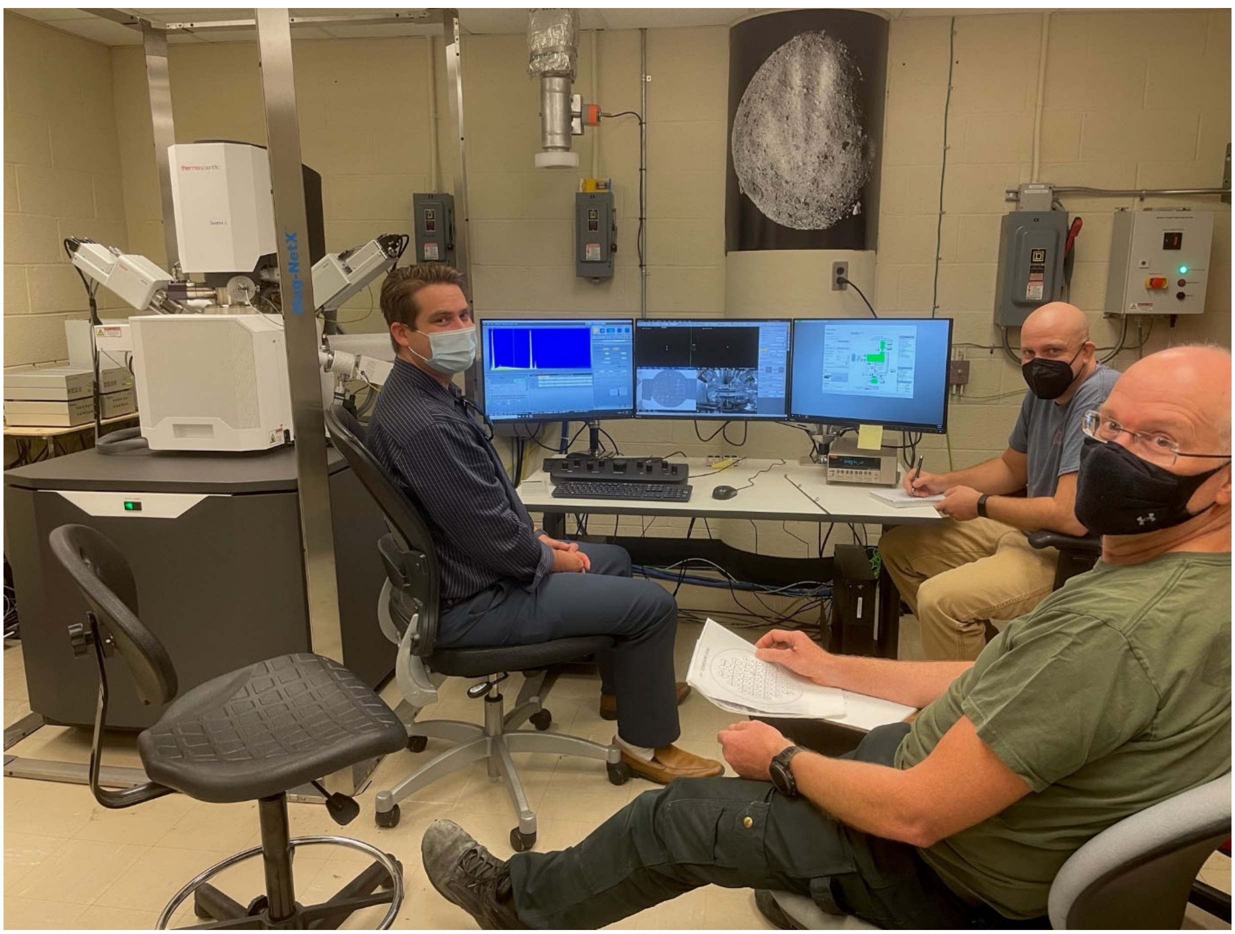

Figure 3: *New SEM at the Smithsonian Institution*

ANSMET Report

Jim Karner, University of Utah

Ugggh, we've been canceled again! Last May, ANSMET learned that our highly anticipated return to the field in 2022-23 is not going to happen. There are just too many science projects waiting to get back into the field, and too few logistical resources available to support them all. While we are disappointed, we understand the reasons for the cancellation, and we are stoked for a return to the field in 2023-24.

In the meantime, we will plan for the final return to the Davis Nunataks-Mt. Ward (DW) icefields, at the top of the Beardmore Glacier. ANSMET has recovered over 3000 meteorites from DW, and we really hope we can finish up the area in a couple of weeks' worth of work with mainly snowmobile sweeps (Figure 3) and walking a couple of unsearched moraines. If we do finish up at DW in a timely fashion, we'd then make a camp move to the nearby Dominion Range Main Icefield (DOM) and resume efforts there (last ANSMET visit in 2003). These are our preferred field plans and hopefully we'll be in the field in December of '23 to execute them!

Figure 4. *Snowmobile sweeps across the vast blue ice at Davis-Ward!*

New Meteorites
2017, 2018 Collection

Pages 10-17 contain preliminary descriptions and classifications of meteorites that were completed since publication of issue 44(2), September, 2021. Specimens of special petrologic type (carbonaceous chondrite, unequilibrated ordinary chondrite, achondrite, etc.) are represented by separate descriptions unless they are paired with previously described meteorites. However, some specimens of non-special petrologic type are listed only as single line entries in Table 1. For convenience, new specimens of special petrological type are also recast in Table 2.

Macroscopic descriptions of stony meteorites were performed at NASA/JSC. These descriptions summarize hands specimen features observed during initial examination. Classification is based on microscopic petrography and reconnaissance level electron microprobe analyses using polished sections prepared from a small chip of each meteorite. For each stony meteorite the sample number assigned to the preliminary examination section is included. In some cases, however, a single microscopic description was based on thin sections of several specimens believed to be members of a single fall.

Meteorite descriptions contained in this issue were contributed by the following individuals:

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NASA Johnson Space Center
Houston, Texas

Cari Corrigan, Julie Hoskin and Tim McCoy
Department of Mineral Sciences
U.S. National Museum of Natural History - Smithsonian Institution
Washington, D.C.

Table 1
Newly Classified Antarctic Meteorites

Sample Number	Weight (g)	Classification	Weathering	Fracturing	%Fa	%Fs	Magnetic Susceptibility
GRO 17119	22.700	ACHON. UNGROUPED	B/C	A/B	7	7	5.14
GRO 17138	7.470	CHONDRITE UNGROUPED	B	A/B	12	9-11	5.39
GRO 17188	45.865	EH3 CHONDRITE	B/Ce	A		0-2	5.27
DOM 18045	48.528	H5 CHONDRITE	B/C	A/B	18		5.09
DOM 18046	41.798	H6 CHONDRITE	B/C	A/B	19		5.00
DOM 18047	57.008	L6 CHONDRITE	B	B/C	23		4.69
DOM 18072	23.850	L5 CHONDRITE	B/C	A	24		4.57
DOM 18073	17.330	L6 CHONDRITE	B/C	A	24		4.67
DOM 18074	19.850	L5 CHONDRITE	B	A	24		4.61
DOM 18075	18.720	L6 CHONDRITE	B/C	A	24		4.65
DOM 18076	17.030	L5 CHONDRITE	B	A	23		4.58
DOM 18077	23.150	H5 CHONDRITE	B	A/B	18	16	4.91
DOM 18078	7.870	L5 CHONDRITE	B	A/B	24		4.51
DOM 18079	7.870	L5 CHONDRITE	B	A	23		4.60
DOM 18080	18.520	L6 CHONDRITE	B/C	A	23		4.55
DOM 18081	9.890	H5 CHONDRITE	B/C	A	18	16	5.01
DOM 18082	14.700	L5 CHONDRITE	B	A/B	24		4.59
DOM 18083	22.740	L5 CHONDRITE	B	A/B	24		4.60
DOM 18084	9.530	H6 CHONDRITE	B/C	B/C	19	17	4.84
DOM 18085	29.370	H6 CHONDRITE	B/C	A	18		5.12
DOM 18086	24.370	L6 CHONDRITE	B	A	23		4.57
DOM 18087	16.240	L5 CHONDRITE	B	A/B	24		4.63
DOM 18088	13.070	L5 CHONDRITE	B	A/B	23		4.56
DOM 18089	19.510	L5 CHONDRITE	B	A/B	24		4.67
DOM 18100	16.029	L6 CHONDRITE	B/C	B/C	25		4.52
DOM 18101	10.003	L5 CHONDRITE	B	A/B	24		4.74
DOM 18102	12.296	L5 CHONDRITE	B/C	B	24		4.42
DOM 18103	9.783	L5 CHONDRITE	B/C	A/B	25	21	4.59
DOM 18104	8.994	L6 CHONDRITE	B/C	A/B	24		4.57
DOM 18105	20.813	L6 CHONDRITE	B	A/B	23		4.62
DOM 18106	20.021	L5 CHONDRITE	B	A/B	24		4.64
DOM 18107	14.554	L5 CHONDRITE	B/C	B	24		4.56
DOM 18108	23.898	H6 CHONDRITE	C	A/B	19		5.06
DOM 18109	9.265	H6 CHONDRITE			18		5.06
DOM 18120	7.966	H4 CHONDRITE	B/C	B	18	16	5.07
DOM 18121	11.395	L6 CHONDRITE	B/C	A/B	25	21	4.60
DOM 18122	4.748	L5 CHONDRITE	B/C	B	23		4.56
DOM 18123	7.376	L6 CHONDRITE	B/C	B	23		4.67
DOM 18124	7.168	L5 CHONDRITE	B/C	B	24		4.72
DOM 18125	8.190	L6 CHONDRITE	B/C	B/C	24	21	4.50
DOM 18126	13.465	H6 CHONDRITE	B/C	B/C	19		4.82
DOM 18127	11.218	L5 CHONDRITE	B/C	B	24		4.59
DOM 18128	3.738	L5 CHONDRITE	B/C	A/B	24		4.43
DOM 18129	9.032	L6 CHONDRITE	B/C	B/C	24		4.46
DOM 18140	47.380	L5 CHONDRITE	A/B	A/B	24		4.79
DOM 18141	30.190	L6 CHONDRITE	B	B	25	21	4.81
DOM 18142	45.730	L5 CHONDRITE	A/B	A/B	23		4.53
DOM 18143	63.370	L6 CHONDRITE	A/B	A/B	24		4.63
DOM 18144	37.310	L5 CHONDRITE	A/B	A/B	24		4.65
DOM 18145	17.060	H5 CHONDRITE	B	A	18	16	5.02
DOM 18146	21.870	L6 CHONDRITE	Be	B/C	25	21	4.51
DOM 18147	47.100	L6 CHONDRITE	A/B	A	24		4.66

Sample Number	Weight (g)	Classification	Weathering	Fracturing	%Fa	%Fs	Magnetic Susceptibility
DOM 18148	31.160	L5 CHONDRITE	A/B	A	24		4.54
DOM 18149	42.420	L6 CHONDRITE	B	B	24		4.53
DOM 18150	23.850	L6 CHONDRITE	B	A/B	24		4.59
DOM 18151	10.820	L6 CHONDRITE	B	A	24		4.76
DOM 18152	16.740	L6 CHONDRITE	B/C	B	24		4.64
DOM 18153	15.760	L6 CHONDRITE	B	A/B	24		4.67
DOM 18154	9.940	H6 CHONDRITE	B	A/B	19		4.90
DOM 18155	8.040	L6 CHONDRITE	B	A/B	23		4.77
DOM 18156	8.840	L5 CHONDRITE	B	A/B	24		4.76
DOM 18157	21.970	L6 CHONDRITE	B	A	23		4.54
DOM 18158	21.950	L6 CHONDRITE	A/B	A	23		4.60
DOM 18159	27.230	L5 CHONDRITE	B	A/B	24		4.63
DOM 18180	6.319	H6 CHONDRITE	B	A/B	19		4.70
DOM 18181	4.144	L5 CHONDRITE	B	B	24		4.62
DOM 18182	7.469	L6 CHONDRITE	B/C	B	24		4.63
DOM 18183	6.814	L6 CHONDRITE	B	B/C	24	20	4.63
DOM 18184	13.097	L5 CHONDRITE	B	B	24		4.65
DOM 18185	10.689	H6 CHONDRITE	B/C	A/B	19		4.71
DOM 18186	18.533	L5 CHONDRITE	B	B	24		4.68
DOM 18187	14.454	L6 CHONDRITE	B	B	24		4.67
DOM 18188	18.356	L6 CHONDRITE	B/C	A/B	24		4.68
DOM 18189	21.110	L5 CHONDRITE	B	B	23		4.69
DOM 18210	9.530	L6 CHONDRITE	B	B	25		4.60
DOM 18211	11.568	L5 CHONDRITE	B	A/B	24		4.56
DOM 18212	13.585	L5 CHONDRITE	B	B	24		4.52
DOM 18213	12.107	L6 CHONDRITE	B/C	B	23		4.60
DOM 18214	7.696	H6 CHONDRITE	B/C	B/C	18		4.87
DOM 18215	9.101	L4 CHONDRITE	A/B	B/C	25-28	20-22	4.18
DOM 18216	3.992	L6 CHONDRITE	B	A/B	23		4.93
DOM 18217	8.624	L6 CHONDRITE	B	B	25	21	4.64
DOM 18218	12.087	L3.8 CHONDRITE	A/B	B	23-28	20-21	4.11
DOM 18219	10.307	H6 CHONDRITE	B/C	A/B	20		5.08
DOM 18350	38.058	L6 CHONDRITE	B/C	A	24		4.58
DOM 18351	26.688	L6 CHONDRITE	B/C	A	24		4.46
DOM 18353	15.991	L6 CHONDRITE	B/C	A	23		4.53
DOM 18354	11.734	L5 CHONDRITE	B/C	A	24		4.69
DOM 18355	12.516	L5 CHONDRITE	A/B	A	24		4.45
DOM 18356	21.84	L5 CHONDRITE	B/C	A	24		4.55
DOM 18357	21.349	H6 CHONDRITE	B/C	A	19		4.83
DOM 18359	9.989	H6 CHONDRITE	B/Ce	A	19		5.07
DOM 18545	5.460	LUNAR BASALTIC BRECCIA	A/B	A/B		32-62	4.01
DOM 18567	12.438	H3.5 CHONDRITE	A/B	A	5-44	2-20	4.20
DOM 18568	17.448	H6 CHONDRITE	B/C	A	19	17	5.15
DOM 18620	22.304	L5 CHONDRITE	B	B	24		4.51
DOM 18621	10.751	L5 CHONDRITE	B	B/C	24		4.66
DOM 18622	9.227	L6 CHONDRITE	B/C	A/B	24		4.55
DOM 18623	17.857	L CHONDRITE (IMPACT MELT)	B/C	B	24		4.35
DOM 18624	23.201	L5 CHONDRITE	B/C	B	24		4.57
DOM 18625	20.434	L6 CHONDRITE	B	B/C	24		4.49
DOM 18626	8.577	L5 CHONDRITE	B	B	24		4.55
DOM 18627	9.226	L6 CHONDRITE	B	A/B	23		4.52
DOM 18628	6.282	L6 CHONDRITE	B/C	B	25	21	4.53
DOM 18631	2.484	L6 CHONDRITE	B/C	A/B	24		4.57
DOM 18632	2.843	L6 CHONDRITE	B	A/B	23		4.67
DOM 18633	1.962	L6 CHONDRITE	B/C	A/B	24		4.41
DOM 18634	2.760	L6 CHONDRITE	B/Ce	A/B	24		4.62
DOM 18635	3.683	L5 CHONDRITE	B	B/C	24		4.63

Sample Number	Weight (g)	Classification	Weathering	Fracturing	%Fa	%Fs	Magnetic Susceptibility
DOM 18637	8.119	H5 CHONDRITE	B	B	19	17	4.93
DOM 18638	8.020	L6 CHONDRITE	B/C	A/B	23		4.65
DOM 18639	4.034	H6 CHONDRITE	B/C	B	18		4.83
DOM 18655	23.791	L5 CHONDRITE	B/C	B	24		4.52
DOM 18656	15.963	L5 CHONDRITE	B/C	B	25		4.42
DOM 18657	27.500	L5 CHONDRITE	Be	B	24		4.53
DOM 18670	12.560	L5 CHONDRITE	B/C	A/B	25		4.65
DOM 18671	13.410	L5 CHONDRITE	Be	A/B	23		4.52
DOM 18672	12.252	L6 CHONDRITE	B/Ce	B/C	24		4.54
DOM 18679	6.216	L6 CHONDRITE	B	B	23		4.61
DOM 18721	13.252	L6 CHONDRITE	B/Ce	A/B	24		4.62
DOM 18722	22.701	H6 CHONDRITE	B/C	A/B	18		5.00
DOM 18723	13.368	L5 CHONDRITE	B	A/B	24		4.56
DOM 18725	7.158	L6 CHONDRITE	B/C	A	24		4.25
DOM 18726	14.727	L5 CHONDRITE	B	A/B	24		4.11
DOM 18727	18.395	H6 CHONDRITE	B/C	A/B	20		4.57
DOM 18728	27.097	L5 CHONDRITE	Be	A/B	24		4.59
DOM 18729	21.039	H6 CHONDRITE	B/C	A/B	18		5.09
DOM 18760	28.272	H6 CHONDRITE	B/C	B/C	19	17	4.77
DOM 18761	10.275	L6 CHON. (BRECCIA)	B	A/B	24		4.62
DOM 18762	14.936	H6 CHONDRITE	B/C	A/B	17		5.03
DOM 18763	11.952	L6 CHON. (BRECCIA)	B	B	23		4.54
DOM 18764	12.472	H4 CHONDRITE	B	B	18	16	5.23
DOM 18765	16.866	L6 CHON. (BRECCIA)	B/Ce	B/C	25	21	4.55
DOM 18766	17.220	H6 CHONDRITE	B	A/B	18		4.91
DOM 18767	13.517	L5 CHONDRITE	B/C	B	24		4.58
DOM 18768	19.570	H6 CHONDRITE	B/C	A/B	18		4.96
DOM 18769	10.940	H6 CHONDRITE	B/C	A/B	17		5.16
DOM 18810	3.134	L6 CHONDRITE	B/C	A/B	24		4.33
DOM 18811	7.387	H6 CHONDRITE	B/C	B	18		5.04
DOM 18812	4.405	L5 CHONDRITE	B/C	A/B	25	21	4.28
DOM 18813	7.475	L6 CHONDRITE	B/C	A/B	24		4.36
DOM 18814	8.269	H6 CHONDRITE	B/C	B/C	18		4.86
DOM 18815	6.284	H6 CHONDRITE	B	A/B	17		4.78
DOM 18816	1.983	L5 CHONDRITE	B/C	A/B	25	21	3.94
DOM 18817	0.950	L5 CHONDRITE	B/C	A/B	25	21	4.31
DOM 18818	5.381	H6 CHONDRITE	B/C	B	18		5.00
DOM 18819	9.370	H6 CHONDRITE	B/C	A/B	18		5.00

Table 2
Newly Classified Meteorites Listed by Type

Achondrites

Sample Number	Weight(g)	Classification	Weathering	Fracturing	%Fa	%Fs
GRO 17119	22.700	ACHON. UNGROUPED	B/C	A/B	7	7
DOM 18545	5.460	LUNAR BASALTIC BRECCIA	A/B	A/B		32-62

Chondrites

Sample Number	Weight(g)	Classification	Weathering	Fracturing	%Fa	%Fs
GRO 17138	7.470	CHONDRITE UNGROUPED	B	A/B	12	9-11
DOM 18567	12.438	H3.5 CHONDRITE	A/B	A	5-44	2-20
DOM 18764	12.472	H4 CHONDRITE	B	B	18	16
DOM 18623	17.857	L CHONDRITE (IMPACT MELT)	B/C	B	24	
DOM 18183	6.814	L6 CHONDRITE	B	B/C	24	20
DOM 18218	12.087	L3.8 CHONDRITE	A/B	B	23-28	20-21

E Chondrites

Sample Number	Weight(g)	Classification	Weathering	Fracturing	%Fa	%Fs
GRO 17188	45.865	EH3 CHONDRITE	B/Ce	A		0-2

**Notes to Tables 1 and 2:

"Weathering" Categories:

A: Minor rustiness; rust haloes on metal particles and rust stains along fractures are minor.
B: Moderate rustiness; large rust haloes occur on metal particles and rust stains on internal fractures are extensive.
C: Severe rustiness; metal particles have been mostly stained by rust throughout.
E: Evaporite minerals visible to the naked eye.

"Fracturing" Categories:

A: Minor cracks; few or no cracks are conspicuous to the naked eye and no cracks penetrate the entire specimen.
B: Moderate cracks; several cracks extend across exterior surfaces and the specimen can be readily broken along the cracks.
C: Severe cracks; specimen readily crumbles along cracks that are both extensive and abundant.

Classification of all meteorites in Table 1 & 2 was done using electron microprobe analysis. Petrologic types are determined by optical microscopy and are assigned based on the distinctiveness of chondrule boundaries in thin section and thin section photographs. Those undertaking detailed study of any of the meteorites classified in this newsletter should use caution. It is recommended that a polished thin section be requested to accompany any chip and appropriate steps for a more detailed characterization should be undertaken by the user. (Cari Corrigan, Smithsonian Institution)

Petrographic Descriptions

Sample No.: **GRO 17119**
Location: Grosvenor Mountains
Field No.: 25564
Dimensions (cm): 2.8 x 2.3 x 2.5
Weight (g): 22.700
Classification: Achon. Ungrouped

Macroscopic Description: Kellye Pando
Rough black fusion crust with fractures and rust spots covers about 40% of the exterior. Exposed area is grey matrix that is heavily weathered with a dark red-brown varnish covering most of it. Fresh interior is grey matrix with orange rust and metal inclusions throughout.

Thin Section (,2) Description: Cari Corrigan, Tim McCoy
The section consists of a fine to medium equigranular mixture of olivine (Fa_7) and pyroxene (Fs_7Wo_1) with plagioclase that poikilitically encloses mafic silicates. No chondrules or relic chondrules were observed. Veins of, and areas enriched in metal and/or sulfide occur commonly. This meteorite is an ungrouped primitive achondrite, possibly either in the acapulcoite/lodranite or part of the winonaite/IAB group.

Sample No.: **GRO 17138**
Location: Grosvenor Mountains
Field No.: 25611
Dimensions (cm): 1.9 x 2.0 x 1.0
Weight (g): 7.470
Classification: Chondrite Ungrouped

Macroscopic Description: Kellye Pando
Entire exterior is covered with possible fusion crust that is very dark brown-black, rough and has frothy texture in some areas as well as some spots of orange rust. Fresh interior is grey matrix that is mostly rusted to a dark orange-brown with black and metal inclusions throughout.

Thin Section (,2) Description: Cari Corrigan, Tim McCoy
The thin section consists of abundant chondrules set in a metal- and sulfide-bearing weathered matrix. Olivine is homogeneous at Fa_{12} and pyroxene exhibits a small range from Fs_{9-11}. Links to the acapulcoites (GRV 020043) or low-FeO chondrites (such as LAP 04773/04757) should be considered.

Sample No.: **GRO 17188**
Location: Grosvenor Mountains
Field No.: 25773
Dimensions (cm): 3.3 x 2.9 x 2.0
Weight (g): 45.865
Classification: EH3 chondrite

Macroscopic Description: Cecilia Satterwhite
Black/brown fusion crust with oxidation covers 90% of the exterior surface. The interior has a dark grey matrix with metal and oxidation scattered, with some rusty areas.

Thin Section (,2) Description: Cari Corrigan, Tim McCoy
The section shows an aggregate of chondrules (up to 1 mm), chondrule fragments, and pyroxene grains in a matrix of ~30% metal and sulfide. Weathering is minor, with staining of enstatite grains and minor alteration of metal and sulfides. Microprobe analyses show the pyroxene is Fs_{0-2}. FeNi metal contains 2.7 wt.% Si. The meteorite is an EH3 enstatite chondrite.

Sample No.: **DOM 18183**
Location: Dominion Range
Field No.: 25733
Dimensions (cm): 2.1 x 1.5 x 1.5
Weight (g): 6.814
Classification: L6 chondrite

Macroscopic Description: Curtis Calva
The exterior has a smooth, dark brown fusion crust with iridescent weathering spots. The exposed interior has a light grey matrix with some rusty patches. The interior has a light grey matrix with rusty spots and a large fracture. Metal and white inclusions are visible.

Thin Section (,2) Description: Cari Corrigan, Tim McCoy
The meteorite is an L6 chondrite (Fa_{24}, Fs_{20}). Notably, a shock vein that reaches ~1.5 mm in width cross-cuts the section, containing numerous pale violet grains (when viewed in plane polarized light) of the same composition as the host olivine, which are almost certainly ringwoodite.

Sample No.: **DOM 18218**
Location: Dominion Range
Field No.: 25194
Dimensions (cm): 2.1 x 2.0 x 1.6
Weight (g): 12.087
Classification: L3.8 chondrite

Macroscopic Description: Curtis Calva
The fusion crust is rough and very dark brown to black in color. The sample is round with fractures and large rust halos that are orange. The interior has a black matrix that is slightly rusty with grey spherical inclusions and metal.

Thin Section (,2) Description: Cari Corrigan, Tim McCoy
This section exhibits numerous, well-defined chondrules, chondrule fragments and individual mineral grains (up to ~1 mm). Pyroxene is polysynthetically twinned. The meteorite is only modestly weathered with staining of some grains visible. Shock effects are minimal. Olivines are unequilibrated and are Fa_{23-28}. Pyroxenes are $Fs_{20-21}Wo_2$. The meteorite is an L3 chondrite, likely subtype 3.8.

Sample No.: **DOM 18545**
Location: Dominion Range
Field No.: 24510
Dimensions (cm): 2.1 x 1.5 x 1.4
Weight (g): 5.460
Classification: Lunar Basaltic Breccia

Macroscopic Description: Kellye Pando
90% of the exterior is covered with a very shiny, black fusion crust. Exposed surface is dark grey with numerous light brown and white inclusions visible. Fresh interior matrix is dark grey-black with light grey, light brown and white inclusions that measure up to 2 mm.

Thin Section (,2) Description: Cari Corrigan, Tim McCoy
This section consists of a highly brecciated assemblage of mostly single mineral grains ranging up to 0.5 mm in size. Grains are dominated by pyroxene and plagioclase. Ploymineralic igneous fragments/clasts are gabbroic. Evidence of melting was observed as small, fine-grained, perhaps quenched clasts. Pyroxenes range from $Fs_{32-62}Wo_{16-33}$. Fe/Mn of pyroxenes ranges from 53-70. Plagioclase is calcic with $An_{87-98}Or_{0.1-0.6}$. This meteorite is a lunar basaltic breccia. Pairing with the DOM 18242 group should be considered.

Sample No.: **DOM 18567**
Location: Dominion Range
Field No.: 25652
Dimensions (cm): 2.7 x 2.4 x 1.4
Weight (g): 12.438
Classification: H3.5 chondrite

Macroscopic Description: Curtis Calva
The fusion crust is slightly rough and black with iridescent weathering spots. The exposed interior appears light grey. The interior has a black matrix with dark, light, and rusty grey inclusions up to 2 mm.

Thin Section (,2) Description: Cari Corrigan, Tim McCoy
The section exhibits numerous small, well-defined chondrules (up to 1.5 mm) in a black matrix of fine-grained silicates, metal and troilite. Weak shock effects are present. Polysynthetically twinned pyroxene is abundant.

The meteorite is modestly weathered. Silicates are unequilibrated; olivines range from Fa_{5-44} and pyroxenes from Fs_{2-20}. The meteorite is an H3 chondrite (estimated subtype 3.5).

Sample No.: **DOM 18623**
Location: Dominion Range
Field No.: 25328
Dimensions (cm): 2.4 x 2.6 x 2.8
Weight (g): 17.857
Classification: L chondrite (Impact Melt)

Macroscopic Description: Curtis Calva
The exterior is smooth and dark greenish-grey with iridescent weathering spots and fractures. There are some black and rough areas of fusion crust. The exposed interior is heavily rusted. The interior is heavily rusted and dark brown with evaporites.

Thin Section (,2) Description: Cari Corrigan, Tim McCoy
The section consists of clasts up to several mm of heavily shocked L5 material (Fa_{24}). Olivines exhibit mosaicism. Approximately half of the section is impact melted material consisting of exceptionally fine grained olivine in a glassy matrix and rounded to elongate metal sulfide blebs up to 2 mm in length. At the scale of the thin section the meteorite is an L chondrite impact melt breccia.

Sample No.: **DOM 18764**
Location: Dominion Range
Field No.: 24925
Dimensions (cm): 2.5 x 2.5 x 1.4
Weight (g): 12.472
Classification: H4 Chondrite

Macroscopic Description: Curtis Calva
The fusion crust is dark brown to black and rough with rusty iridescent weathering spots. The exposed interior is rusty light grey with dark grey inclusions up to 2 mm in size. The interior has a light grey matrix with dark grey inclusions. There are areas of rusty orange/brown with metal. This sample is friable.

Thin Section (,2) Description: Cari Corrigan, Tim McCoy
The meteorite is an otherwise unexceptional H4 chondrite (Fa_{18}, Fs_{16}), however it contains a mm-sized spherical object that resembles a chondrule but contains ~30% sulfide. Such objects are unusual and worthy of note.

Sample Request Guidelines:

Requests for Antarctic Meteorites are reviewed twice per year, the deadline is posted on-line:
https://curator.jsc.nasa.gov/bboard.cfm

Information about requesting samples can be found on-line at:
https://curator.jsc.nasa.gov/antmet/requests.cfm?section=general

Samples can be requested from any meteorite that has been made available through announcement in any issue of the Antarctic Meteorite Newsletter (beginning with 1(1) in June 1978). Many of the meteorites have also been described in five Smithsonian Contributions to the Earth Sciences: Nos. 23, 24, 26, 28, and 30. Tables containing all classified meteorites since August 2006 have been published in the Meteoritical Bulletins and Meteoritics and Meteoritics and Planetary Science.

They are also available on-line at:
https://meteoritical.org/publications/the-meteoritical-bulletin

The most current listing is found on-line at:
http://curator.jsc.nasa.gov/antmet/us_clctn.cfm

All sample requests should be made electronically using the form at:
http://curator.jsc.nasa.gov/antmet/requests.cfm

The purpose of the sample request form is to obtain all information needed prior to deliberations to make an informed decision on the request.

The preferred method of request transmittal is via e-mail. Please send requests and attachments to:
JSC-ARES-MeteoriteRequest@nasa.gov

Type ***"Request"*** in the e-mail subject line.

Each request should accurately refer to meteorite samples by their respective identification numbers and should provide detailed scientific justification for proposed research. Specific requirements for samples, such as sizes or weights, locations (if applicable) within individual specimens, or special handling or shipping procedures should be explained in each request. Some meteorites are small, of rare type, or are considered special because of unusual properties. Therefore, it is very important that all requests specify both the optimum amount of material needed for the study and the minimum amount of material that can be used. Requests for thin sections that will be used in destructive procedures such as ion probe, laser ablation, etch, or re-polishing must be stated explicitly. Consortium requests should list the members in the consortium. All necessary information should be typed on the electronic form, although informative attachments (reprints of publication that explain rationale, flow diagrams for analyses, etc.) are welcome.

Antarctic Meteorite Laboratory
Contact Numbers

Please submit request to: **JSC-ARES-MeteoriteRequest@nasa.gov**

Kevin Righter	Cecilia Satterwhite
Curator	Lab Manager/AMAP Secretary
Mail code X12	Mail code X12
NASA Johnson Space Center	NASA Johnson Space Center
Houston, Texas 77058	Houston, Texas 77058
(281) 483-5125	(281) 483-6776
kevin.righter-1@nasa.gov	cecilia.e.satterwhite@nasa.gov

Meteorites On-Line

Several meteorite web sites are available to provide information on meteorites from Antarctica and elsewhere in the world. Some specialize in information on martian meteorites and on possible life on Mars. Here is a general listing of ones we have found. We have not included sites focused on selling meteorites even though some of them have general information. Please contribute information on other sites so we can update the list.

JSC Curator, Antarctic meteorites	http://curator.jsc.nasa.gov/antmet/
JSC Curator, HED Compendium	http://curator.jsc.nasa.gov/antmet/hed/
JSC Curator, Lunar Meteorite Compendium	http://curator.jsc.nasa.gov/antmet/lmc/
JSC Curator, Martian Meteorite Compendium	http://curator.jsc.nasa.gov/antmet/mmc/
ANSMET	http://caslabs.case.edu/ansmet/
Smithsonian Institution	http://mineralsciences.si.edu/
Lunar Planetary Institute	http://www.lpi.usra.edu
NIPR Antarctic meteorites	http://www.nipr.ac.jp/
Meteoritical Bulletin online Database	http://www.lpi.usra.edu/meteor/metbull.php
Museo Nazionale dell'Antartide	http://www.mna.it/collezioni/catalogo-meteoriti-sede-di-siena
BMNH general meteorites	https://www.nhm.ac.uk/our-science/collections/mineralogy-collections.html
UHI planetary science discoveries	http://www.psrd.hawaii.edu/index.html
Meteoritical Society	http://www.meteoriticalsociety.org/
Meteoritics and Planetary Science	https://onlinelibrary.wiley.com/journal/19455100
Meteorite Times Magazine	https://www.meteorite-times.com/
Geochemical Society	http://www.geochemsoc.org
Washington Univ. Lunar Meteorite	http://meteorites.wustl.edu/lunar/moon_meteorites.htm
Washington Univ. "meteor-wrong"	http://meteorites.wustl.edu/meteorwrongs/meteorwrongs.htm
Portland State Univ. Meteorite Lab	http://meteorites.pdx.edu/
Northern Arizona University	https://www.cefns.nau.edu/geology/naml/
Martian Meteorites	http://www.imca.cc/mars/martian-meteorites.htm

Other Websites of Interest

OSIRIS-REx	http://osiris-rex.lpl.arizona.edu/
Mars Exploration	http://mars.jpl.nasa.gov
Rovers	http://marsrovers.jpl.nasa.gov/home/
Near Earth Asteroid Rendezvous	http://near.jhuapl.edu/
Stardust Mission	http://stardust.jpl.nasa.gov
Genesis Mission	http://genesismission.jpl.nasa.gov
ARES	http://ares.jsc.nasa.gov/
Astromaterials Curation	http://curator.jsc.nasa.gov/
Hayabusa2	http://www.hayabusa2.jaxa.jp/en/