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SAMSPE REQUEST DEADLINE:
April 10, 1990 !!!

MWG MEETS APRIL 19-21, 1990
SAMPLE REQUEST GUIDELINES

All sample requests should be made in writing to:

Secretary, MWG
SN2/Planetary Science Branch
NASA/Johnson Space Center
Houston, TX 77058 USA

Requests that are received by the MWG Secretary before April 10, 1990 will be reviewed at the MWG meeting on April 19-21 to be held in Houston, Texas. Requests that are received after the April 10 deadline may possibly be delayed for review until the MWG meets again in the Fall of 1990. PLEASE SUBMIT YOUR REQUESTS ON TIME. Questions pertaining to sample requests can be directed in writing to the above address or can be directed to the curator by telephone at (713) 483-5135.

Requests for samples are welcomed from research scientists of all countries, regardless of their current state of funding for meteorite studies. Graduate student requests should be initialed or countersigned by a supervising scientist to confirm access to facilities for analysis. All sample requests will be reviewed by the Meteorite Working Group (MWG), a peer-review committee which meets twice a year to guide the collection, curation, allocation, and distribution of the U.S. collection of Antarctic meteorites. Issuance of samples does not imply a commitment by any agency to fund the proposed research. Requests for financial support must be submitted separately to the appropriate funding agencies. As a matter of policy, U.S. Antarctic meteorites are the property of the National Science Foundation and all allocations are subject to recall.

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, particular locations (if applicable) within individual specimens, or special handling or shipping procedures should be explained in each request. Consortium requests should be initialed or countersigned by a member of each group in the consortium. All necessary information should be condensable into a one- or two-page letter, although informative attachments (reprints of publications that explain rationale, flow diagrams for analyses, etc.) are welcome.

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 four Smithsonian Contr. Earth Sci.: Nos. 23, 24, 26 and 28.
Classifications of New Meteorites

This newsletter presents classifications of 175 meteorites from the 1985-1988 collections and completes the classification of the 1985 collection. Descriptions are given for all meteorites of special petrologic type, including five carbonaceous chondrites, three enstatite chondrites, five type 3 ordinary chondrites, eight achondrites and one iron. Of particular interest are MAC88138, MAC88180, and MAC88184, paired unusual chondrites tentatively classed as E3; MAC88177, a ureilite devoid of carbonaceous material; and sulfide-rich iron HOW88403.

Basaltic Lunar Meteorite Identified

Also included in this issue is a reclassification of EET87521. The meteorite was originally classified as a eucrite, but detailed studies by Jeremy Delaney (Nature 342, 889-890, 1989) and Paul Warren (Geochimica Cosmochimica Acta 53, 3323-3330, 1989) showed it to be a lunar basaltic breccia. Oxygen isotopic measurements by Bob Clayton confirm its lunar origin. This is the first basaltic lunar meteorite and is a very interesting small sample. Requests for allocation of the sample prompted much debate at the Fall MWG meeting. The committee tabled allocations until the reclassification was announced in the newsletter and guidelines for handling such situations were formalized. (See open letter from MWG and guidelines.)

Cancellation of the 1989-1990 Field Season

Most of you are aware that the 1989-1990 ANSMET (Antarctic Search for Meteorites) field season was cancelled at the last moment due to logistical problems in Antarctica. Expedition leader Bill Cassidy and MWG chairman Robert Walker are working with NSF Polar Programs Office to try to avoid similar interruptions in the future. Walker sends his thanks for your support in this effort. Plans for the next field season are proceeding on schedule and we anticipate a successful resumption of the ANSMET collections this year.
James L. Gooding

Recent sawing of the shergottite, EETA79001, has revealed new areas of possible calcium carbonate of the type previously described by Martinez and Gooding (1986) and analyzed as sample EETA79001,239 by Gooding et al. (1988), Clayton and Mayeda (1988), and Wright et al. (1988). If the new druse is the same as that in sample 239, it can be expected to consist of calcite (CaCO3) intergrown with an unusual Mg-phosphate. Current evidence favors pre-terrestrial origin of the carbonate/phosphate assemblage.

As was the case for the parent material of sample 239, the new occurrences are confined to the interior of the meteorite and are associated with glass veins and pockets (Lithology C) that pervade Lithology A, the principal igneous portion of the meteorite. The most conspicuous new deposits occur as white drusy veins that thinly coat freshly broken surfaces produced by the sawing operations. The largest drusy patches (a few square millimeters in area) occur as wall-rock halos near small veins of black glass. At least one other occurrence, however, consists of apparent veins and scattered small grains in a typical, vuggy inclusion of Lithology C. A third type of occurrence comprises a white patch that superficially resembles a lithic inclusion but is still a wall lining associated with Lithology C.

Experience with the parent deposit of sample 239 showed that only a few micrograms of drusy material could be recovered for each milligram of wall rock that was extracted. The total deposit of white druse in the original (239) deposit was approximately 300 micrograms. Based on the larger areal extent of the newly discovered deposits, the total mass of white druse is estimated to be on the order of 1000 micrograms. Accordingly, only analytical methods than can operate on microgram quantities of sample would be practical for studying the new deposits.

References:


Dear Colleagues:

A primary role of the MWG is to expedite the provision of meteorite samples to qualified scientists. Although the process generally works smoothly, problems can arise in the allocation process. Some of these result from poorly formulated requests that leave the committee uncertain as to what is required. Part of the purpose of this letter is to detail some of the common problems that arise, in the hopes that they will be minimized in future requests.

The other major allocation problem arises when an especially interesting meteorite is discovered. Many requests are generally received. We do the best that we can in trying to satisfy the desires of the individual scientists, while at the same time developing an allocation plan that optimizes the total scientific yield from the meteorite. The process becomes difficult when only a small amount of material is available for study. It is further complicated by the MWG ground rule that enough material must be retained by the Curator to permit future detailed scientific investigations of rare specimens. Based on its experience, MWG has developed a set of guidelines for future allocation of small, rare specimens. We have appended these guidelines to this letter.

MWG recently developed a further set of guidelines to deal with a new situation, namely, a small specimen that was recognized as being especially interesting (and, hence, subject to the small, rare sample guidelines) only after the original description and allocation. These additional guidelines are also appended to this letter.

We now return to the problem of poorly formulated requests. We receive many proposals where the sample requested clearly does not coincide with the goals of the experimenter e.g.: a number which identifies an ordinary chondrite is requested by someone who is interested only in carbonaceous meteorites. Sometimes it is possible to figure out which numbers got transposed by the requestors; sometimes not - samples that do not even exist are sometimes requested. Of course, we can (and frequently do) contact requestors in real time to find out what they really want, but this is risky for the requestor.

Another situation that crops up is one in which the requestor has failed to do the necessary homework to see whether the request is feasible; for example, it is not possible to give someone a 100 mg sample that is ≥ 1 cm from any external surface, if the total meteorite weight is 5 gms!!

Some experimenters request samples for a series of experiments that they themselves are in no position to do; for example, a mineralogist (experimenter X) who requests a series of samples for isotope measurements. In some cases, the persons who will do the extended measurements are not identified. In other cases the person (experimenter Y) who will do the measurements is identified, but clearly has not been consulted. This is evidenced by the fact that we get independent requests for the same meteorite from both experimenter Y and from experimenter X, but with a different sample size specified. Obviously, a carefully designed request should have the signed agreement of the persons who will actually do the work.

Another difficult problem arises with what we term “blanket requests.” For certain rare specimens we sometimes get requests for “samples of all interesting clasts.” Such requests stand in stark (and unfavorable) contrast to others which describe either a more focused approach, or which propose to first examine the specimen in Houston in order to formulate a detailed plan of attack.

We will welcome your inputs on any of the issues raised in this letter.

Sincerely yours,

Meteorite Working Group
GUIDELINES

MWG Guidelines for the Curation of Small, Rare Antarctic Meteorites

October 1988

Allocation of samples from small (e.g. <30g) specimens of Antarctic meteorites, for which a large demand is anticipated, poses special problems. The guiding principle in developing allocation plans for the detailed analyses of such meteorites is to maximize the yield of fundamental scientific information.

A. The MWG shall involve as many qualified and interested scientific investigators as possible in the study of rare Antarctic specimens.

B. The above objectives are to be accomplished in as timely a fashion as possible, and with a minimum of administrative burdens.

C. It shall also be the responsibility of the MWG to conserve enough material for future studies of rare meteorites. Therefore, no more than 50% of the desirable sample remaining after initial thin section preparation should be allocated during the first two MWG meetings following announcement in the Newsletter.

D. The process of allocation must be conducted in a scrupulously fair fashion that gives no special advantage to any present or past member of the committee or any part of the community at large. The process must not only be fair, it must be perceived as fair by the community of interested scientists.

Some specific guidelines that follow from these general principles given below:

1. Care should be taken to ensure that minimal material (<5% or 100 mg, whichever is more, of total mass) is consumed in the preparation of polished thin sections for the initial characterization. These sections, and others made from the potted butt, should then be made widely available to qualified investigators who have expressed an interest in these materials.

2. MWG should participate in the categorization of the scientific measurements for a specific meteorite. However, individual members shall not participate in the actual allocations of their own samples or the samples of others with whom they are affiliated institutionally or scientifically.

3. The categories of investigation are as follows:

   a. Absolutely necessary for a basic characterization of the samples. The mass consumed by these measurements should not exceed 20% of the total available.

   b. Of the highest importance scientifically and should be performed if appropriate samples can be made available. The sum of such measurements should not exceed 20% of the total material available.

   c. Scientifically desirable measurements to be made if the results
are commensurate with the size of samples to be consumed.

d. Of potential scientific interest, but of a nature where the
interest cannot be guaranteed.

4. In general, replicate analyses of certain quantities is desirable and should be encouraged for
categories I and II, but not III and IV (although permitted, nonetheless). However, the sum of
replicate analyses for a given type of information should not exceed 5% of the total available
sample mass.

5. In general, analyses which consume the smallest amounts of material to obtain information are
to be preferred. Judgment will have to be used to distinguish between laboratories whose
techniques are genuinely better, from those which simply request smaller samples in the
hopes of being approved.

6. In general, P.I.s should not be restricted in the types of investigations they pursue provided
they do not destroy more sample than specified in their original request and, that they
provide the information they originally proposed.

7. The categories I-IV are ranked in order of their deemed scientific importance, but they need
not be performed sequentially.

8. In cases where sample weight restrictions, as stated above, do not permit multiple allocations
for the same (or highly similar) measurements, priority shall be given based on the following
criteria:

a. An objective assessment of the capabilities of different laboratories.

b. Where such distinctions cannot be made, priority shall be given to
those investigators who have planned to extract the maximum amount
of information from their samples by combining complementary
investigations.

c. In cases where the above distinction a) and/or b) cannot be made,
priority will be given to investigators based on the date they
submitted their requests.

ADDITION TO GUIDELINES - NOVEMBER 1989

The operational definition of "small" is a sample whose size is such that fulfilling all current
requests, would severely compromise future studies of the meteorite. The figure = 30 grams is an average
number was arrived at from our prior experience. It is clearly arbitrary and subject to interpretation; some
samples containing large clasts may be classified by MWG or "small" even if they weigh considerably more
than 30 grams; other, more homogeneous samples, may not be classified as small even if they weigh
considerably less than 30 grams.
GUIDELINES FOR SMALL SAMPLES DISCOVERED TO BE OF SPECIAL INTEREST AFTER INITIAL ALLOCATION

NOVEMBER 1989

1. PI's recognition does not give absolute priority; the widest dissemination of information, leading to proposals that give the optimum scientific approach, is desirable.

2. However, the PI who discovered the interesting aspects of the specimen will be given strong preference in future allocations; thus the original PI will have precedence when competing proposals to pursue similar lines of research are considered.

3. To facilitate both recognition of the priority of the PI and to give wider dissemination, in the future PIs will have the right (though not the obligation) to publish signed letters in Antarctic Meteorite Newsletter (subject to editorial control).

4. The Curator should inform the meteorite community of the new results, with the permission of the discoverers, in the Antarctic Meteorite Newsletter as soon as is reasonable (judgment call).

5. The processes of dissemination and allocation should be as open and fair as possible, conferring no special advantage to those who are privy to unpublished information.
FROM 1985-1988 COLLECTIONS

Pages 11-24 contain preliminary descriptions and classifications of meteorites that were completed since publication of issue 12(3) (September, 1989). Some large (>150g) specimens (regardless of petrologic type) and all "pebble"-sized (<150g) specimens of special petrologic type (carbonaceous chondrite, unequilibrated ordinary chondrite, achondrite, etc.) are represented by separate descriptions. However, some specimens of non-special petrologic type are listed only as single line entries in Table 1. For convenience, new specimens of special petrologic type are also recast in Table 2.

Macroscopic descriptions of stony meteorites were performed at NASA/JSC. These descriptions summarize hand-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:

- Robbie Marlow, Cecilia Satterwhite, Carol Schwarz, Roberta Score and Marilyn Lindstrom
- Antarctic Meteorite Laboratory
- NASA/Johnson Space Center
- Houston, Texas

- Brian H. Mason, Roy S. Clarke, Jr. and V.F. Buchwald
- Department of Mineral Sciences
- U.S. National Museum of Natural History
- Smithsonian Institution
- Washington, D.C.

- Jeremy Delaney
- Rutgers University

- Paul Warren
- UCLA
## ANTARCTIC METEORITE LOCATIONS

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<th>Location</th>
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**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.
**List of Newly Classified Antarctic Meteorites**

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* Classified by using refractive indices.

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~ Classified by using refractive indices.
### TABLE 2

**Newly Classified Specimens Listed By Type**

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#### Achondrites

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* Classified by using refractive indices.*
TENTATIVE PAIRINGS FOR NEW SPECIMENS

Table 3 summarizes possible pairings of the new specimens with each other and with previously classified specimens, based on descriptive data in this newsletter issue. Readers who desire a more comprehensive review of the meteorite pairings in the U. S. Antarctic collection should refer to the compilation provided by Dr. E. R. D. Scott, as published in issue 9(2)(June, 1986).

C2 CHONDRITE:
LEW88001, LEW88002, LEW88003.

E3 CHONDRITE:
MAC88136, MAC88180, MAC88184.

H4 CHONDRITE:
LEW88019, LEW88020.
MAC88145, MAC88146.

H6 CHONDRITE:
MAC88130, MAC88131, MAC88132, MAC88133.

L3 CHONDRITE:
LEW85434, LEW85437.

UREILITE:
LEW88012 with LEW85440.
RECLASSIFICATION

Sample No: EET87521
Weight (g): 30.7
Dimensions (cm): 3.7 x 2.5 x 2
Meteorite Type: Lunar Basaltic Breccia

Location: Elephant Morale

Field No: 4452

Macrosopic Description: Carol Schwarz and Marilyn Lindstrom
About 30% of this smooth rounded specimen is covered with black to brown shiny fusion crust. The interior of this coherent breccia is dark and fine-grained and contains numerous small white and yellow inclusions. Two 2-3 mm clasts are visible on the surface: One is a white clast consisting of plagioclase with 10-15% yellow and black mafic minerals; the other is a buff-colored clast made up of plagioclase and 35-50% yellow and black mafic minerals.

Thin Section (EET87521.8 & .9) and Bulk Composition (EET87521.6) Description: Jeremy Delaney and Paul Warren
EET87521 was originally classified as a eucrite. However, more detailed investigations indicate that it is a very-low-titanium (VLT) basaltic breccia of lunar derivation. The modal mineralogy is 5-10% olivine, 45-50% pyroxene, 35-40% plagioclase and 1-2% ilmenite, chromite, ulvospinel/magnetite, sulfide, silica minerals, and FeNi-metal. The matrix of the meteorite also contains several percent of glass similar in composition to the bulk meteorite. The olivine ranges in composition from Fo95 to Fo91, a range typical of VLT mare basalts, and shows a strong bimodality with clusters centered at Fo97-95 and Fo94-93. Intermediate olivine compositions are uncommon. Molar Fe/Mn ratios of the olivine are 90-100. The pyroxene is pigeonite/subcalcic augite/augite with a composition range of En85Wo49. Most pyroxene is iron-rich and comparable to eucritic pyroxene, but is generally more calcic than eucritic pyroxene. The pyroxene does not show the bimodal distribution of the olivine. Pyroxene Fe/Mn ratios are 50-75. These ratios are typical of mare basalts, and much higher than those of basaltic achondrites (30-40). The feldspar is mostly An99-97 with a few more sodic grains present. Several clasts within the thin sections have survived with textures little altered by brecciation. These clasts tend to be relatively coarse-grained, by mare basalt standards.

Thin section [.9] contains a small (1 mm) clast of what is probably a highlands impact melt breccia. This extremely fine-grained clast contains at least 70% plagioclase. It also contains the only observed grains of FeNi-metal, with compositions (average 94.1% Fe, 4.53% Ni, 0.37% Co) typical of metals derived as "contamination" from metal-rich meteorites.

The bulk composition of EET87521 has been studied by INAA, using two adjacent chips, 278-290 mg in mass. The TiO2 concentration is 0.8-1.1%, and results for ratios such as Fe/Mn, Ga/Al, Na/Ca, and Co/Cr indicate that this sample is lunar, and certainly not a eucrite. In general, the bulk composition shows a striking resemblance to VLT mare basalts from Luna 24. Perhaps the most significant difference is that EET87521 has higher concentrations of incompatible elements, especially light REE. This difference might be caused by the highlands component associated with the FeNi-bearing clast. However, the bulk-rock Ni content (29-43 µg/g) indicates that the total proportion of non-VLT "contaminant" is probably small.

References:

Oxygen Isotopic Composition: Robert Clayton
The oxygen isotopic composition is δ18O = +5.39, δ17O = +2.79. These analyses are comparable to those of previously analyzed lunar meteorites and Apollo lunar samples and distinct from those of eucrites.
Macroscopic Description: V.F. Buchwald and R.S. Clarke, Jr.
The meteorite was found by a research group under the direction of Dr. Charles Swithinbank on the blue ice field at Mt. Howe, Antarctica. It is blocky in shape with smoothly rounded edges, and its surfaces are dark brown in color with a slightly reddish tinge. The surface is unusual in appearance, having a texture of densely spaced pin holes due to selective corrosion and interior structure. Flow structure is present in the fusion crust suggesting that the domed or most rounded surface was the anterior surface during atmospheric entry.

Polished Section Description: V.F. Buchwald and R.S. Clarke, Jr.
A polished section of 20 cm² was prepared from a slice that was taken perpendicular to the long axis of the specimen and ~15 mm from its smaller end. The appearance of this surface suggests a metal-sulfide eutectic, with ~2/3 metal and ~1/3 sulfide. It is a fine grained structure with individual sulfide cells ranging around 0.3 mm across. A thin fusion crust is present, underlain by a 2-3 mm heat-altered zone. The metal matrix is ataxitic, decomposing into a very fine grained mixture of taenite and kamacite with abundant small schreibersites. Troilite is surrounded by discontinuous rims of schreibersite, and an occasional chromite was observed in the sulfide. The specimen is an anomalous sulfide-rich ataxite.

Macroscopic Description: Roberta Score
This angular stone is completely covered with polished black fusion crust. The interior is heavily oxidized, masking any structure present.

Thin Section (3) Description: Brian Mason
The section shows abundant chondrules and chondrule fragments, up to 1.5 mm across, in a minor amount of finely granular matrix containing considerable nickel-iron and lesser troilite. A variety of chondrule types is present, mostly porphyritic and granular olivine and olivine-pyroxene, but some cryptocrystalline and radiating pyroxene chondrules were seen. Weathering is extensive, with brown limonitic staining throughout the section. Microprobe analyses show olivine and pyroxene of variable composition: olivine, Fo₆-23, mean Fa₁₇ (CV FeO is 26); pyroxene, Fs₂-18. The meteorite is classified as an H3 chondrite, estimated H3.7.

Macroscopic Description: Cecilia Satterwhite
Both specimens are covered with weathered fusion crust. The interior of both fragments is reddish-brown. Light colored chondrules are visible in LEW85437.

Thin Section (LEW85434; LEW85437) Description: Brian Mason
These sections are very similar, and the same description applies to both; they are probably paired. They show a close-packed aggregate of chondrules and chondrule fragments, up to 1.8 mm across, in a small amount of dark matrix containing a little troilite and nickel-iron. Chondrule types include granular and porphyritic olivine and olivine-pyroxene, barred olivine, and fine-grained radiating pyroxene. Weathering is extensive, with brown limonitic staining pervading the
sections. Olivine and pyroxene show a wide range in composition: olivine, Fa1-23, mean Fa10 (CV FeO is 76); pyroxene, Fs2-11. This range of compositions indicates type 3, and the small amount of nickel-iron suggests L group; the meteorite is therefore classed as an L3 chondrite (estimated L3.4).

Sample No: LEW85452
Dimensions (cm): 2x1.5x0.5
Weight (g): 9.2
Meteorite Type: L3 chondrite

Macroscopic Description: Cecilia Satterwhite
Black fusion crust completely covers LEW85452. The interior structure has been obliterated by oxidation.

Thin Section (3) Description: Brian Mason
The section shows a close-packed aggregate of chondrules and chondrule fragments, up to 2.4 mm across, in a finely granular matrix containing some troilite and nickel-iron. Chondrule types include granular and porphyritic olivine and olivine-pyroxene, and fine-grained to cryptocrystalline pyroxene. Olivine and pyroxene show a wide range in composition: olivine, Fa5-23, mean Fa15 (CV FeO is 35); pyroxene, Fs2-18. This range of compositions indicates type 3, and the small amount of nickel-iron suggests L group; the meteorite is therefore classed as an L3 chondrite (estimated L3.6).

Sample No: LEW88001; LEW88002; LEW88003
Dimensions (cm): 4.7x3.5x2.5; 2.7x1.5x1.3; 1.5x1.2x1.4
Weight (g): 44.9; 7.2; 1.7
Meteorite Type: C2 chondrite

Macroscopic Description: Robbie Marlow
Dull black and brown fusion crust covers 95% of these 3 carbonaceous chondrites. Evaporite deposit was noted on the exteriors of LEW88001 and 88002. The interior of LEW88001 is dark gray and contains numerous "rusty" inclusions. Evaporites prevail this specimen. LEW88002 and 88003 are less weathered and contain numerous submillimeter sized white inclusions.

Thin Section (LEW88001.4; LEW88002.3; LEW88003.3) Description: Brian Mason
These meteorites are C2 carbonaceous chondrites, and are so similar that a single description will suffice. The sections show numerous small (up to 0.6 mm across) chondrules and mineral grains in a black matrix. Chondrules consist largely of olivine, with minor pyroxene; mineral grains are olivine, pyroxene, and a little calcite. Microprobe analyses show that most of the olivine has composition close to Mg2SiO4, but with a few more iron-rich grains; pyroxene is clinoenstatite, with composition range Fs1.7.

Sample No: LEW88006
Dimensions (cm): 3x2.5x2
Weight (g): 27.0
Meteorite Type: Ureilite

Macroscopic Description: Roberta Score
LEW88006 is semi-rounded with fusion crust covering 95% of the exterior surfaces. Fusion crust is generally shiny black, but is frothy and pitted on the bottom surface. Breaking this specimen revealed an interior typical of ureilites that is brownish in color and crystalline with many grains showing crystal faces.
Thin Section (.4) Description: Brian Mason
The section shows an aggregate of olivine and pyroxene, as rounded to subhedral grains 0.1-3.0 mm in maximum dimension. The grains are rimmed with black carbonaceous material, which contains trace amounts of nickel-iron and troilite. Microprobe analyses show olivine and pyroxene of uniform composition: olivine, Fa18 (CaO 0.35%, Cr2O3 0.70%); pyroxene, Wo8Fs16 (Cr2O3 1.2%). The meteorite is a ureilite; it appears to be essentially unshocked.

Sample No: LEW88007
Dimensions (cm): 2.6x2x1.5
Weight (g): 8.4
Meteorite Type: Monomict Eucrite

Macroscopic Description: Robbie Marlow
Seventy-five percent of the exterior of this achondrite is covered with shiny and dull fusion crust. The interior shows an even distribution of mafic and nonmafic minerals. No individual clasts were noted. Small areas of oxidation are present.

Thin Section (.5) Description: Brian Mason
The section shows an ophitic intergrowth of pigeonite and plagioclase, with trace amounts of opaque minerals. The grain size and texture vary considerably within the section, suggesting a recrystallized breccia. Microprobe analyses show pyroxene ranging in composition from Wo2Fs60 to Wo4Fs26, with relatively uniform En content. Plagioclase ranges in composition from An85 to An91, with a mean of An90. The meteorite is a monomict eucrite.

Sample No: LEW88008
Dimensions (cm): 2.8x2.5x2
Weight (g): 17.9
Meteorite Type: Diogenite

Macroscopic Description: Robbie Marlow
This meteorite fragment has a greenish-yellow color whose exterior surface is partially covered with patchy dull black fusion crust. Clasts ranging from 1 to 4 mm were revealed when this achondrite was broken.

Thin Section (.6) Description: Brian Mason
The section shows a cataclastic texture, with pyroxene clasts up to 4 mm across in a matrix consisting of comminuted pyroxene with a little plagioclase and chromite. Microprobe analyses show pyroxene of uniform composition, Wo4Fs30; plagioclase composition is An96. The meteorite is a diogenite.

Sample No: LEW88009
Dimensions (cm): 2.5x2.5x1.5
Weight (g): 11.7
Meteorite Type: Unbrecciated Eucrite

Macroscopic Description: Robbie Marlow
Three-quarters of the exterior of this angular stone has fusion crust. The interior is light gray and has a massive texture. Oxidation is very light.

Thin Section (.7) Description: Brian Mason
This meteorite is a fine-grained aggregate of pyroxene and plagioclase (average grain size 0.1 mm). Microprobe analyses show pyroxene composition ranging from Wo2Fs58 to Wo4Fs25; plagioclase composition ranges from An82 to An94. The meteorite is an unbreciated eucrite.
Sample No: LEW88010  
Dimensions (cm): 3x1.5x1.3  
Weight (g): 7.1  
Meteorite Type: Unbrecciated Eucrite  

Macroscopic Description: Robbie Marlow  
Flowlines are visible in the fusion crust which covers this oblong eucrite. The interior shows an even distribution of mafic and non-mafic minerals. No individual clasts were revealed.

Thin Section (.3) Description: Brian Mason  
The section shows an ophitic intergrowth of pyroxene and plagioclase, with grain size 0.6-1.2 mm. Microprobe analyses show pyroxene compositions ranging from Wo1Fs55 to Wo30Fs33, with relatively uniform En content. Plagioclase composition ranges from An76 to An86, with a mean of An82. The meteorite is an unbrecciated eucrite.

Sample No: LEW88011  
Dimensions (cm): 1.5x1x6  
Weight (g): 2.0  
Meteorite Type: Diogenite  

Macroscopic Description: Roberta Score  
Thin shiny fusion crust covers 40% of the exterior of LEW88011. Flow lines are present on the bottom surface. The interior of LEW88011 contains black and white inclusions that are ~0.5 mm in length. No oxidation is visible.

Thin Section (.3) Description: Brian Mason  
The section has a cataclastic texture, and consists almost entirely of pyroxene, in grains up to 0.9 mm in maximum dimension; a little plagioclase and chromite are also present. Microprobe analyses show pyroxene of uniform composition, Wo3Fs24; plagioclase composition is An90. The meteorite is a diogenite.

Sample No: LEW88012  
Dimensions (cm): 1.9x1.5x1  
Weight (g): 3.8  
Meteorite Type: Ureilite  

Macroscopic Description: Robbie Marlow  
LEW88012 has dull brownish-black fusion crust covering 75% of the exterior. Heavy oxidation and abundant mineral grains showing crystal faces are characteristic of this ureilite.

Thin Section (.3) Description: Brian Mason  
The section shows an aggregate of olivine and pyroxene, as rounded to subhedral grains 0.3-1.5 mm in maximum dimension. The grains are rimmed with black carbonaceous material, which contains trace amounts of nickel-iron and troilite. Microprobe analyses show olivine and pyroxene of uniform composition: olivine, Fa9 (CaO 0.35%, Cr2O3 0.55%); pyroxene, Wo5Fs8. One grain of augite, Wo36Fs25, was analysed. The meteorite is an ureilite, and is relatively unshocked. It is very similar in texture and mineral compositions to LEW 85440, and the possibility of pairing should be considered.
Sample No: MAC88101
Dimensions (cm): 4.2x3x2
Weight (g): 20.9
Meteorite Type: C2 chondrite

MacAlpine Hills
Field Number: 5483

Macrosopic Description: Robbie Marlow
Eighty percent of the fusion crust on this carbonaceous chondrite has been plucked off. The fusion crust remaining is thick and dull black. Areas devoid of fusion crust are greenish in color. The interior matrix is black with a greenish-tinge and has no obvious inclusions. Traces of evaporite deposit were noted immediately underneath the fusion crust.

Thin Section (3) Description: Brian Mason
The section shows a few small chondrules and numerous mineral grains in a dark brown to black semi-translucent matrix. The chondrules and mineral grains consist largely of olivine, with minor pyroxene; a few calcite grains were noted. Microprobe analyses show that most of the olivine is near Mg2SiO4 in composition, with a few more iron-rich grains; pyroxene is clinoenstatite, with composition range Fs1.5. The meteorite is a C2 carbonaceous chondrite.

Sample No: MAC88136
Dimensions (cm): 4x4x2.5
Weight (g): 74.4
Meteorite Type: E3 chondrite

MacAlpine Hills
Field Number: 5726

Macrosopic Description: Carol Schwarz
Rusty, smooth, unfractured fusion crust covers 70% of this chondrite. The interior is black and fine-grained with abundant metal evenly disseminated throughout. One 1 mm chondrule was exposed on the freshly broken surface. Except for one small corner, oxidation appears to be minimal.

Thin Section (3) Description: Brian Mason
Chondrules and chondrule fragments are abundant, ranging up to 2.4 mm across; they consist of granular or cryptocrystalline pyroxene. The matrix consists largely of small pyroxene grains, with some nickel-iron and minor sulfides. One ellipsoid (chondrule?) of metal, 1.1 x 1.5 mm, is present in the section. Microprobe analyses show that the pyroxene is clinoenstatite, with variable but low iron content (FeO 0.1-2.1%); the metal grains show a low and variable silicon content, ranging up to 0.5%. The meteorite is tentatively classified as an E3 enstatite chondrite, but the metal has a lower Si content than is usual for these meteorites. MAC88136 resembles MAC88180 and MAC88184; the possibility of pairing should be considered.

Sample No: MAC88176
Dimensions (cm): 4.5x3x2.5
Weight (g): 37.9
Meteorite Type: C2 chondrite

MacAlpine Hills
Field Number: 5555

Macroscopic Description: Robbie Marlow
Black, polygonally fractured fusion crust covers 75% of this oblong carbonaceous chondrite. The fusion crust is frothy on one surface. Evaporite deposit was exposed when this friable specimen was dissected. Oxidation is light and sub-millimeter sized white inclusions are evenly distributed throughout this meteorite.

Thin Section (3) Description: Brian Mason
The section shows a few small chondrules and numerous mineral grains in a black matrix. Chondrules and mineral grains consist largely of olivine, with a minor amount of pyroxene. Microprobe analyses show that most of the olivine has a composition close to Mg2SiO4, with a few more iron-rich grains; pyroxene is clinoenstatite, composition range Fs1.8. The meteorite is a C2 carbonaceous chondrite.
Sample No: MAC88174  
Location: MacAlpine Hills  
Field Number: 6156  
Dimensions (cm): 6x4x3.2  
Weight (g): 98.4  
Meteorite Type: H3 chondrite

Macroscopic Description: Roberta Score  
Smooth brown fusion crust covers 90% of this unequilibrated chondrite. Large areas of oxidation are present in the clast-rich, dark-gray matrix. Evaporite deposit was noted.

Thin Section (.4) Description: Brian Mason  
The section shows a close-packed aggregate of chondrules and chondrule fragments, up to 1.8 mm across; most of the chondrules are granular or porphyritic olivine and olivine-pyroxene, but a few radiating and cryptocrystalline pyroxene chondrules are present. They are set in a small amount of dark matrix which contains some nickel-iron and troilite, often concentrated as rims to the chondrules. Microprobe analyses show olivine and pyroxene of variable composition: olivine, Fa3-19 (CV FeO is 38); pyroxene, Fs6-13. The variability of olivine and pyroxene compositions indicates type 3, and the amount of metal suggests H group; hence the meteorite is tentatively classified as an H3 chondrite (estimated H3.6).

Sample No: MAC88177  
Location: MacAlpine Hills  
Field Number: 5740  
Dimensions (cm): 4.2x3x1.5  
Weight (g): 35.3  
Meteorite Type: Ureilite

Macroscopic Description: Roberta Score  
MAC88177 is a dome-shaped stone covered with flow-marked black and gray fusion crust on the top and frothy fusion crust on the bottom. The interior of the stone is heavily oxidized and much of it is orange. The less weathered matrix is buff colored. Several thin black veins criss-cross the interior.

Thin Section (.3) Description: Brian Mason  
The section shows an equigranular aggregate of anhedral to subhedral olivine and pyroxene (grains 0.3-0.6 mm across), with minor troilite and accessory amounts of nickel-iron and chromite. Shock effects include undulose extinction in the silicate grains, mosaic structure in troilite, and minor veining. Some weathering is indicated by small areas of brown limonite and limonitic staining along veins. Microprobe analyses show olivine and pyroxene of uniform composition: olivine, Fa13; pyroxene, Wo4Fs12. The meteorite is classified as a ureilite, but it lacks the carbonaceous material characteristic of ureilites, and the olivine contains less than 0.1% Ca and Cr.

Sample No: MAC88180  
Location: MacAlpine Hills  
Field Number: 5547  
Dimensions (cm): 3.8x2.5x2.5  
Weight (g): 26.6  
Meteorite Type: E3 chondrite

Macroscopic Description: Robbie Marlow  
Fusion crust totally covers this extremely weathered and fractured meteorite. The interior structure has been obliterated by oxidation. Only large orange-brown rust spots are visible.
Thin Section (3) Description: Brian Mason

Much of the section is occupied by a single large chondrule, 5 mm across; the remainder of the section consists of small chondrules and chondrule fragments in matrix consisting largely of small pyroxene grains, with some nickel-iron and sulfides. The silicate material appears to be entirely clinoenstatite. Microprobe analyses show the clinoenstatite of slightly variable compositions, with FeO 0.2-0.8% and CaO 0.1-0.4%; the metal grains have a variable Si content, 0.2-2.0%. The meteorite is tentatively identified as an E3 chondrite. It resembles MAC88136 and 88184, and the possibility of pairing should be considered.

Sample No: MAC88184
Dimensions (cm): 4x2.5x1.5
Weight (g): 20.6
Meteorite Type: E3 chondrite
Location: MacAlpine Hills
Field Number: 6670

Macroscopic Description: Robbie Marlow
Brown and black frothy fusion crust covers 95% of MAC88184. Deep cracks penetrate the interior. Oxidation is heavy and has masked any interior structure present.

Thin Section (3) Description: Brian Mason
Chondrules and chondrule fragments are abundant, ranging up to 1.5 mm across; they consist of granular or cryptocrystalline pyroxene. The matrix consists largely of small pyroxene grains, with some nickel-iron and minor sulfides. Microprobe analyses show that the pyroxene is clinoenstatite, with variable but low iron content (FeO 0.4-1.8%); the metal grains show a low and variable silicon content, ranging up to 0.6%. The meteorite is tentatively classified as an E3 enstatite chondrite, probably paired with MAC88136 and 88180.
NATURAL THERMOLUMINESCENCE DATA FOR ANTARCTIC METEORITES

Natural Thermoluminescence (NTL) data obtained by Ben Myers, Hazel Sears, Fouad Hasan, Roberta Score and Derek Sears at the University of Arkansas. The measurements and data reduction methods were described by Hasan et al. (1987, Proc. 17th LPSC E703-E709; 1989, LPS XX, 383-384). Also included are data for the 23 meteorites discussed by Hasan et al. (1987), reduced using our current methods, and some preliminary notes on pairing and other observations. (February 1990 data set).

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<td>ALHA77191</td>
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<td>4.8 +/- 0.1</td>
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<td>65.4 +/- 0.9</td>
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<td>23.4 +/- 0.4</td>
<td>ALHA76008</td>
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<td>10.3 +/- 0.1</td>
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<td>ALHA77258</td>
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<td>48 +/- 1</td>
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<td>ALH 85145</td>
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<td>ALHA78076</td>
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<td>ALH 85032</td>
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<td>70 +/- 2</td>
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<tr>
<td>EET 87581</td>
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<td>69 +/- 2</td>
<td>ALH 85130</td>
<td>H6</td>
<td>0.5 +/- 0.1</td>
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<td>EET 87754</td>
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<td>0.92 +/- 0.05</td>
<td>EET 87592</td>
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<td>48.3 +/- 0.8</td>
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<td>EET 87755</td>
<td>H5</td>
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<td>EET 87820</td>
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<td>META78006</td>
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<td>1.6 +/- 0.2</td>
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The quoted uncertainties are the standard deviations shown by replicate measurements of a single aliquot.

**NOTES**

General comments: We suggest meteorites with NTL >100 krad are candidates for an unusual history involving high radiation doses and/or low temperatures. Samples with NTL <5 krad have TL below that which can reasonably be ascribed to long terrestrial ages. Such meteorites have had their TL lowered by heating within the last million years or so (close solar passage, shock heating, atmospheric entry), exacerbated, in the case of certain achondrite classes, by "anomalous fading". For samples whose NTL lies between 5 and 100 krad the natural TL is related, primarily, to terrestrial age.

Pairings: The following are comments on pairings based on the natural TL data above, TL sensitivity, the shape of the induced TL glow curve, classifications, and JSC curatorial staff and Arkansas group unpublished and published sample descriptions. Unless otherwise noted, suggested pairings are considered "probable" as opposed to "possible" or "tentative" by Hazel Sears and Derek Sears.

1. TL data confirm pairings suggested in the Newsletter.
   Euc: LEW85303, LEW88005 (and presumably LEW85300 and LEW85302).

2. TL data do not confirm pairings suggested in the Newsletter.
   How: EET87512 has significantly higher natural TL and may not be paired with the EET87503 group.

3. Additional pairings suggested by the TL data.
   C2: MAC88107 paired with MAC87300/301.
   L5: EET87570, EET87774 (tentative).
   L6: EET87583, EET87536 (tentative).
L6: EET87587, EET87858 and possibly EET87589.
L6: EET87596, EET87635, EET87789.
(The above two groups are tentatively paired with each other).
L6: EET87626, EET87652 (possible).
L6: EET87601, EET87603, EET87613, EET87616, EET87830, EET87855.
L6: EET87589, EET87586, EET87661, EET87807, EET87857.
L6: EET87662, EET87639.
(The above two groups are tentatively paired with each other).
L6: EET87756, EET87817.
L6: EET87594, EET87644.
L6: EET87796, EET87804.

H5: ALH85021, ALH85145 (tentative).
H5: EET87581, EET87840 (possible).

The following pairing was omitted from the September 1989 Newsletter.

L6: EET87502, EET87535, EET87567.


a). The TL data confirm the following pairings.

L6: ALHA77296, ALHA77297.
L6: ALHA78105, ALHA78251 (tentative).
H4: ALHA77004, ALHA77191.

b). The TL data confirm that ALHA78112 is not paired with ALHA78114, and that RKPA79001 is probably not paired with RKPA80202.
# Table 5

## 26Al Activity Data for Antarctic Meteorites

**John F. Wacker**

Battelle, Pacific Northwest Laboratories
P.O. Box 999, Mailstop P7-07
Richland, Washington 99352

<table>
<thead>
<tr>
<th>Specimen Number</th>
<th>Class</th>
<th>26Al Activity (dpm/kg)</th>
<th>Specimen Number</th>
<th>Class</th>
<th>26Al Activity (dpm/kg)</th>
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<tr>
<td>ALHA 80127</td>
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<td>63.9 ±6.3</td>
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<tr>
<td>ALHA 81028</td>
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<td>ALHA 81171</td>
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<tr>
<td>ALHA 81045</td>
<td>H4</td>
<td>47.3 ±3.0</td>
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<tr>
<td>ALHA 81047</td>
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<td>ALHA 81173</td>
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<td>ALHA 81050</td>
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<td>57.4 ±3.2</td>
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<td>ALHA 81052</td>
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Uncertainties are calculated from counting statistics. All data have been corrected for background effects, counting geometry, and specimen geometry. For more information or to request a copy of all the Battelle 26Al data (for over 500 specimens), please contact John Wacker [telephone: (509) 376-1076; FAX: (509) 376-5021].

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**PAIRING OF ANTARCTIC METEORITES BASED ON $^{26}$AL ACTIVITIES**

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The Battelle $^{26}$Al data set contains results for two or more specimens from the following pairings (Antarctic Meteorite Newsletter, 9, no. 2, June, 1986). Starred specimens have $^{26}$Al activities that are $\pm 10$ dpm/kg different from other samples in pairing group, which is inconsistent with these samples belonging to the pairing group. Unstarred samples have similar $^{26}$Al activities, which is consistent with pairing.

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<th>Pairing</th>
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