COLLECTING AND PROCESSING VICTORIA LAND METEORITES

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Abstract: Since 1977, the meteorites found in Victoria Land, Antarctica, have been carefully collected to preserve them in an uncontaminated state. The specimens are returned frozen to the Johnson Space Center in Houston for processing and curating in a manner similar to lunar samples. These methods have reduced chemical weathering and have provided researchers with a supply of clean meteorites for analysis.

1. Introduction

The first concerted search for meteorites in Victoria Land along the Trans-Antarctic Mountains was conducted by a joint U.S.-Japanese team and occurred during the 1976–77 austral summer. The party found 11 specimens (CASSIDY *et al.*, 1977) in that region which is the sixth locality where meteorites have been found in Antarctica.

The Victoria Land meteorites were found in bare ice areas on the plateau side of the Trans-Antarctic Mountains. These bare ice areas are similar to, but smaller than, the Meteorite Ice Field near the Yamato Mountains where Japanese parties have found thousands of specimens (YOSHIDA *et al.*, 1971; SHIRAISHI *et al.*, 1976; YANAI, 1976, 1978; MATSUMOTO, 1978). The most productive bare ice field (about 700 specimens in three seasons) has been a region near the Allan Hills which is located about 230 kilometers northwest of McMurdo. This ice field is about 50 km^2 in area and exhibits a step-like topography on the plateau side of the Allan Hills (NISHIO and ANNEXSTAD, 1979). The majority of the specimens have been found on the lower level where the ice upwelling rate appears to be in equilibrium with the rate of ablation.

The discovery of large numbers of meteorites in the cold, dust-free environment of Antarctica prompted personnel from the Curator's Branch, Johnson Space Center, National Aeronautics and Space Administration, to offer to the National Science Foundation their specialized facilities for special handling and curation of the specimens. This offer resulted in an inter-agency agreement among NASA, the National Science Foundation and the Smithsonian Institution, which provided a mechanism for the collection, curation, and allocation of Antarctic meteorites. To this end, the Curator's Branch, Johnson Space Center, has supplied field parties with clean collecting materials since 1977 and specialized personnel assistance since 1978.

2. Collection Techniques

No special care was taken in the collecting or handling of the 11 specimens found during the 1976–77 summer season. The meteorites were allowed to thaw at McMurdo where the larger specimens were divided by sawing with an ordinary rock saw. The samples were subjected to contamination by handling, cutting, shipping, and exposure to the environment at McMurdo.

Since 1977, however, the collection and handling of meteorites found in Victoria Land has been a carefully controlled process aimed at protecting them against terrestrial contamination and chemical weathering and negating the possibility of them being mishandled. Field parties are supplied with collection materials cleaned to lunar sample specifications (JSC 03243, 1978) such as stainless steel cans, teflon bags, aluminum sheets, polyethylene bags, teflon overgloves, teflon tape, stainless steel scissors, and number tags. Additional equipment supplied includes number/ measuring devices for field identification of specimens, Hasselblad camera sets for

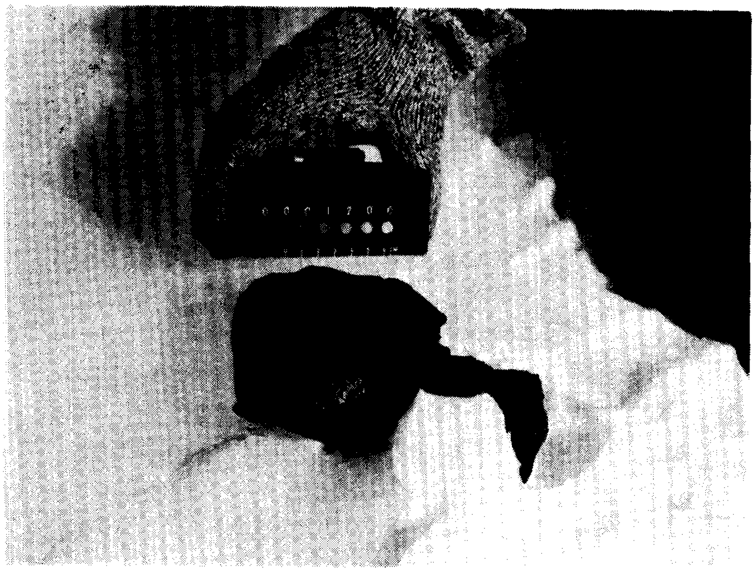

Fig. 1. Weathered chondrite #1200 (field number) on ice field near Reckling Peak, Victoria Land, Antarctica.

photography and locked steel cases for the transport and storage of meteorites.

Meteorite search has been accomplished by the use of helicopters flying slowly at low level (CASSIDY *et al.*, 1977), personnel on foot (YANAI *et al.*, 1978), and snowmobiles during the 1978–79 (NISHIO and ANNEXSTAD, 1979) and 1979–80 seasons. Searching by snowmobile appears to be the best compromise between covering large areas by helicopter with the risk of overlooking small specimens and the closer scrutiny of a region by foot parties who are limited in the extent of their coverage. An additional advantage gained by snowmobile use is that a field team of two persons can carry all the specialized equipment needed for careful collection, documentation, storage and transportation of specimens. The snow machines are parked downwind from meteorites to reduce the possibility of exhaust contamination of the specimens during the collection process.

When a meteorite is found, the collection process begins with the selection of an identifying number and corresponding aluminum tag. Fig. 1 shows a large chondrite found near Reckling Peak during the 1979–80 season with field number 1200 visible on the counter. The counter contains a grey scale directly below the numbers and a centimeter scale etched along the bottom edge.

When photography is complete, the meteorite is collected by lowering a clean teflon bag over it so that the specimen is handled only through the surrounding bag. If a meteorite must be touched, the collector uses a clean teflon glove to handle the specimen. Smaller specimens that might be difficult to grasp are picked up by using clean stainless steel scissors as forceps. The bag opening is taped shut with teflon tape and then the bagged meteorite and the aluminum tag are inserted into, and sealed in, a second bag of either polyethyelene or teflon. The tag which contains the field number is left visible for identification purposes. Extremely rare and friable specimens such as carbonaceous chondrites are wrapped in aluminum foil and packed in sealed stainless steel cans to further preserve them in their pristine state.

Bagged meteorites are carried in covered boxes on the rear decks of snowmobiles because experience has shown that meteorites wrapped in teflon will begin to thaw if exposed to the sun (YANAI *et al.*, 1978). At camp, the meteorites are stored in steel boxes which are used for transporting them to McMurdo and subsequently to the United States.

At McMurdo, a season's collection is stored in a freezer where the specimens are inventoried and repacked for shipment. The meteorites travel in a ship's freezer to Port Hueneme, California, where they are re-inventoried, repacked with dry ice and sent by air express to the Johnson Space Center, Houston, Texas, for curation.

Meteorites are assigned a three or four digit number in the field for identification purposes until they are documented in Houston. All relevant information pertaining to the find such as field number, classification (preliminary), physical location, and other comments are recorded in a field notebook.

3. Meteorite Processing

The Johnson Space Center (JSC) utilizes large walk-in freezers maintained at −40°C for meteorite storage. A small upright freezer maintained at −20°C is used for staging a few specimens at a time before processing begins.

The formal processing of meteorites begins with unpacking and unwrapping the specimens and transferring them to clean containers. This initial staging is accomplished on a class 100 clean bench (NASA SP-5045, 1967). The meteorites are put into large stainless steel containers that are cooled by liquid nitrogen so they remain frozen while the bagging is removed. The specimens are identified according to field notes, numbers, and photographs and then each meteorite is assigned a permanent five digit number preceded by a three letter location designation which abbreviates the place name. In addition to a number assignment, each specimen is given a data pack which contains its processing information.

The nomenclature committee of the Meteoritical Society ruled (The Meteoritical Bulletin, 57, 1980) that Antarctic meteorites should be named for the geological feature nearest the find, be assigned a letter to identify the expedition that collected it, and be given a five digit number, of which the first two digits represent the December year of the expedition. Therefore, a find from the Allan Hills region by group "A" during the 1978–79 season would be designated Allan Hills A78xxx. This has been shortened to ALHA78xxx for ease of inclusion in computer programs.

Following initial staging, most meteorites are returned to the large freezer for storage until scheduled for preliminary examination processing. Those meteorites

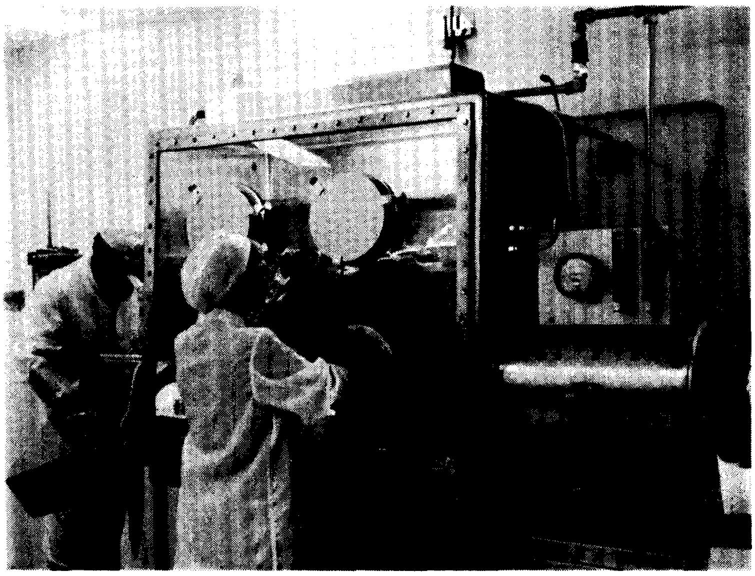

Fig. 2. Meteorite processing cabinet with glove ports and viewing station. Cabinet atmosphere is N_2 at slight positive pressure.

that have been tentatively identified as rare or unusual are those selected first for examination and processing.

The preliminary examination process takes place in biological type cabinetry under a controlled N_2 gaseous environment. The cabinet gas pressure is kept at a slight positive pressure to prevent the entry of aerosol contaminants if a port is opened or a glove develops a leak. Fig. 2 shows a typical cabinet with entry port, neoprene

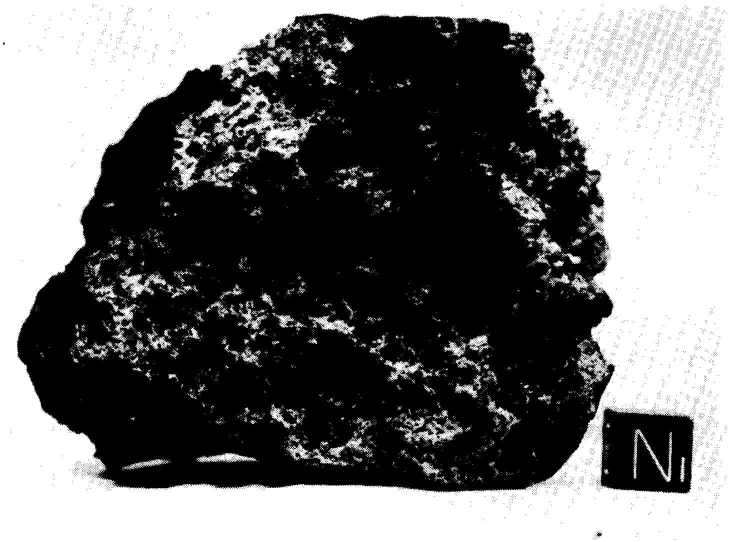

Fig. 3. Laboratory documentation photograph of Allan Hills A78109, an LL5 chondrite. Photo is the north face orientation (arbitrary) of the specimen.

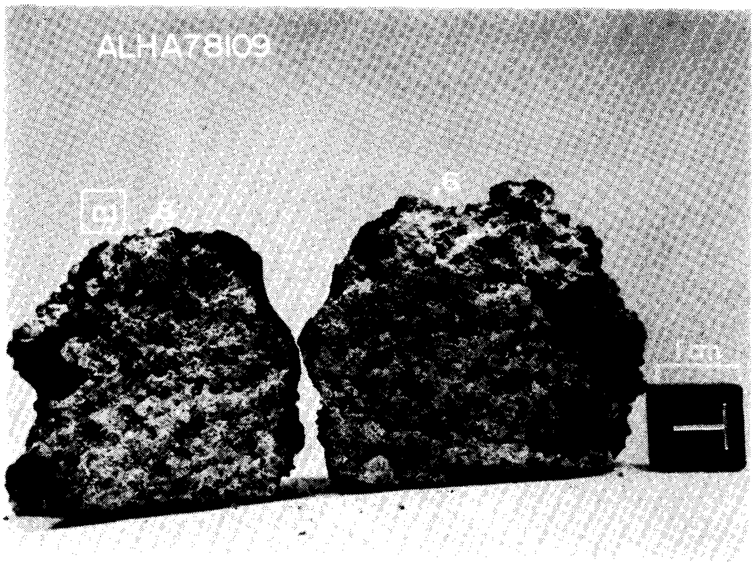

Fig. 4. Documentation photograph of the cleaved halves of Allan Hills A78109. Top view of piece, 6 and bottom view of piece, 8 are shown.

glove access, and a microscope port for surficial examination of the specimens.

The specimens are transferred from the small staging freezer to the processing cabinet. A specially constructed stage, cooled by liquid nitrogen, is used to keep the sample frozen while an initial cold chip is removed from the meteorite. This chip is immediately returned to freezer storage for future experiments when a frozen piece may be required. The parent meteorite is then allowed to warm to ambient temperature naturally in the cabinet's dry N_2 environment. The gaseous N_2 contains $\leqq$ 50 ppm O_2 and H_2O so that a constant flow of N_2 in and out of the cabinet will warm the meteorite and cause it to outgas and lose moisture so quickly that chemical weathering is reduced to a minimum. The warming process continues for about 24 hours to insure complete equilibrium between the specimen and its surroundings.

After the meteorite has reached thermal equilibrium, it is weighed, examined under a binocular microscope, described surficially, chipped for a thin section piece and photographed. Fig. 3 is a photograph of Allan Hills A78109, an LL5 chondrite, showing a broken, partially weathered face. The orientation cube in the lower right-hand corner indicates which one of the six orthogonal photographs is being examined.

Meteorites from the U.S.-Japanese Victoria Land searches during 1976, 1977 and 1978 were shared between the United States and Japan. For this purpose, each meteorite found was either sawed or cleaved in half to provide each country with its piece. Fig. 4 is an example of the two halves of ALHA78109 produced by cleaving. Documentation photography of this type is taken at every step during the disaggregation of meteorite specimens for scientific analysis.

This sections made from the initial chip become part of the libraries maintained at National Institute of Polar Research, Tokyo; JSC, Houston; and Smithsonian Institution, Washington, D. C. The curators at these institutions provide through the Antarctic Meteorite Newsletter a preliminary description of each meteorite based on a petrographic examination of these sections.

4. Conclusions

The collection and careful handling of Antarctic meteorites has produced a large number of uncontaminated specimens which are available for scientific research. The value of such care was demonstrated by CRONIN *et al.* (1979) in the analysis of amino acids in ALHA77306, a type C2 carbonaceous chondrite. The authors found that the hydroxyamino acid serine (SER), the presence of which indicates handling contamination, was noticed in vanishingly small amounts.

The Curator's Branch, NASA, Johnson Space Center, Houston, Texas, is the official U. S. curatorial facility for Antarctic meteorites and specimens recovered from the Antarctic under the sponsorship of the National Science Foundation automatically are sent there for curation. The techniques used for handling, collection, and sampling were developed at JSC for lunar samples and have been altered only slightly to accommodate the Antarctic finds.

Antarctic meteorites are clearly a new and valuable source of extraterrestrial material for the detailed analysis and study of our solar system. The careful collection, documentation, handling and processing of these specimens provides the scientific community with meteoritic material second only to lunar samples in cleanliness.

Acknowledgments

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