Celebrating Thirty Seasons of Antarctic Meteorites: Johnson Space Center Antarctic Meteorite Laboratory

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In the winter of 1976, several scientists from the U.S. and Japan took part in a University of Pittsburgh expedition led by Dr. W. Cassidy that headed out from McMurdo Station Antarctica on the first Antarctic Search for Meteorites (ANSMET) to recover nine new meteorites. The U.S. team has returned every year (except for a cancelled season in 1990) to various locations within the Transantarctic Mountains (figure 1). These annual expeditions have resulted in a collection totaling approximately 17,000 meteorite samples. Three agencies – the Johnson Space Center (JSC), the National Science Foundation Office of Polar Programs (Arlington, Va.), and the Division of Mineral Sciences at the Smithsonian Institution (Washington, D.C.) – have been involved in this program since its initiation, each sharing different duties. Our role has been to serve as curators in the Antarctic meteorite group, a responsibility that entails receiving the samples, which are frozen on their return to the U.S.; keeping the samples in a controlled, stable, and contamination-free environment; performing initial characterization of new samples; announcing the arrival of new samples in a newsletter so the scientific community can make sample requests; and allocating samples to the scientific community after requests are peer-reviewed by a committee of experts assembled specifically for this process. Together with groups in our partner organizations, members of the JSC Antarctic meteorite group are celebrating 30 seasons of ANSMET meteorite samples. It is this 30-year milestone that has given the group time to reflect on how the collection of ANSMET meteorite samples has impacted the scientific community. Indeed, over the last 30 years the Antarctic meteorite group at JSC has published nearly 70 newsletters reporting new samples that are available for study by scientists, received more than 2,500 requests for samples, and prepared and sent out in excess of 14,000 individual samples in response to those requests.

Fig. 1. *Map of ANSMET collection sites in the Transantarctic Mountains (left). Image of Bill Cassidy (top right) and Ralph Harvey (bottom right) on ANSMET collections trips from the 1970s and 2000s, respectively.*

Highlights of the collection include: ALH A81005, which is the first recognized meteorite from the moon; EETA79001, which is a basaltic meteorite from Mars that contains trapped gases that match the martian atmospheric composition measured by the Viking spacecraft in 1976; and ALH 84001, which is a martian meteorite reported to contain evidence of fossil life. The U.S. Antarctic meteorite collection includes 19 lunar meteorites, nine martian meteorites, nearly 400 pieces of what scientists think are samples of the asteroid 4 Vesta (the howardite, eucrite, and diogenite meteorites), and hundreds of meteorites from asteroids and other small bodies. In addition to these well-characterized and well-understood samples,

the collection contains many examples of meteorites from unknown places that record conditions in the early solar system, illustrating the diversity of materials that were present in the early solar system (figure 2).

The U.S. Antarctic meteorite collection provides the link between some other NASA sample collections, including comets, solar wind, cosmic dust, and lunar samples. For example, ALH 85085 is a carbonaceous chondrite that contains similar and rare minerals (e.g., osbornite) that have also been found in the material returned by the Stardust mission. Chondrites and achondrites (figure 3) define oxygen isotopic variation in the solar system; this provided part of the impetus for the Genesis Discovery mission. Pre-solar grains, which are found in several ordinary, enstatite, and carbonaceous unequilibrated chondrites, record isotopic anomalies from stellar processes. Finally, as mentioned already, nearly 20 lunar meteorites enhance and complement our understanding of the moon provided by Apollo and lunar samples.

The future of this program is very bright, and is providing scientific support in several ways. First, research and curation of martian and chondritic meteorites continues to inform planning efforts for Mars and asteroid sample return. Second, instrumentation employed on many current and future missions can be tested and calibrated using these astromaterials (e.g., the Mars exploration rover, Dawn, which will study the 1 Ceres and 4 Vesta asteroids; and SMART-1 [Small Missions for Advanced Research in Technology-1], a European Space Agency project for the moon). Finally, we expect that the number of new meteorites will grow as collection efforts continue, and that the collection itself will grow with each new field season, thereby yielding interesting new astromaterials for study.

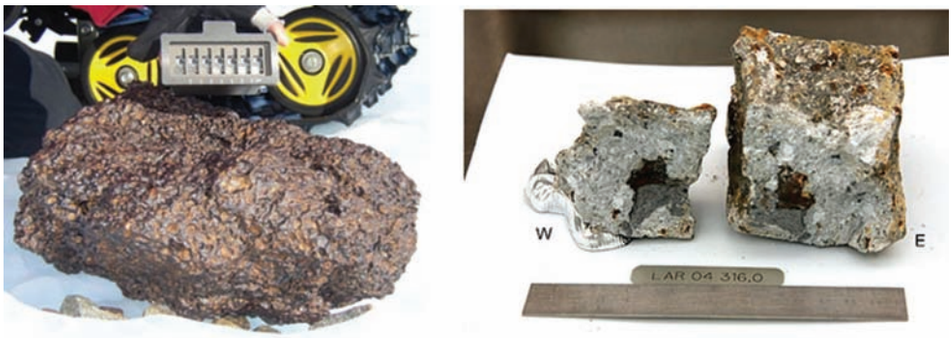

Fig. 2. *Photograph of pallasite (left) and aubrite (right) meteorites recovered in 2004-2005 ANSMET season.*

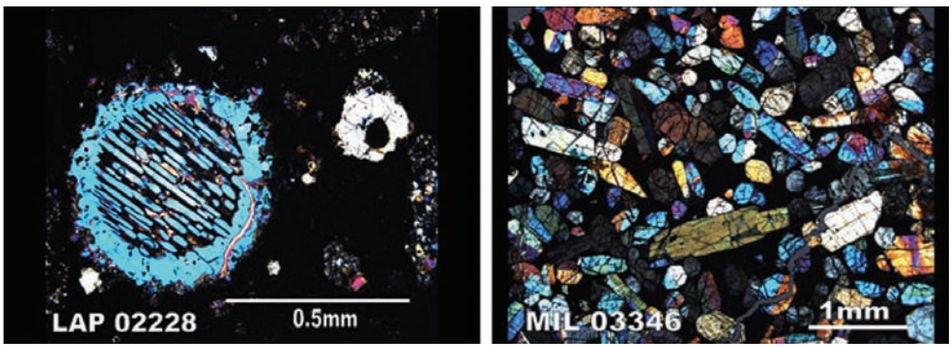

Fig. 3. *Photomicrographs of carbonaceous chondrite (left) and nakhlite (right) meteorites in cross-polarized light.*

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