MINERALOGICAL INVESTIGATIONS OF LUNAR SAMPLES AND METEORITES

Grant NAG 9-29

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For the period 1 February 1984 through 31 January 1985

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Lunar Petrology

North Ray Crater Breccia 67015: Electron microprobe analyses by Marvin and instrumental neutron activation analyses by Marilyn Lindstrom of Washington University were completed on the final round of samples allocated to members of the consortium, led by Marvin, to study this breccia. Magnetization measurements by Naoji Sugiura, at the University of Toronto, and Ar/Ar dates by Frank Podosek, at Washington University, are still pending. Marvin and Lindstrom found new clast types among these samples, and additional data on the dominant clast types. An abstract outlining their results was submitted for the 16th annual Lunar and Planetary Science Conference in March, 1985.

Apollo 12 Troctolite 130-9: A collaborative study, with David Walker of Lamont-Doherty Geological Observatory, of the melting history of this lunar troctolite and of experimentally-produced analogues, was carried out as a contribution to the Lunar Regolith Initiative. The mineralogy and texture of the troctolite indicated that it formed and recrystallized at depths of about 10 kilometers in the lunar highlands crust. Subsequently, it was partially remelted and projected to the regolith on Oceanus Procellarum. A major impact event seemed the only possible explanation for the excavation and remelting of the troctolite and its displacement to a mare site. In a manuscript accepted for publication in the Proceedings of the 15th Lunar and Planetary Science Conference, Marvin and Walker proposed that the troctolite is ejecta from the Crater Copernicus.

Meteorite Studies

Vaca Muerta Mesosiderite: A search by G.J. Wasserburg and D.A. Papanastassiou, of the California Institute of Technology, for ^{26}Mg in anorthite grains recovered from this meteorite and sent to them by Marvin, yielded negative results. This shows that ^{26}Al was not the heat source for differentiation of the parent body of this mesosiderite, nor was it of any other differentiated meteorite thus far examined. The significance of this finding was discussed at the Meteoritical Society meeting in September, 1984.

Meteorite Pairing at the Allan Hills Main Icefield, Antarctica: Marvin plotted find locations of each class of meteorites collected at the Allan Hills main icefield from the 1976 to the 1981 seasons. The results show that distributions alone are almost never significant as indicators of pairing. In several instances, meteorites of the same class found side by side have been shown by isotopic or chemical analyses to belong to different falls. Maps and overlays illustrating the distributions were presented at the Meteoritical Society meeting and at a meeting of the Antarctic Meteorite Working Group.

The Allende Meteorite: Electron microprobe analyses were made of several Ca-Al-rich inclusions and of 12 ordinary chondrules from Allende. Samples of a single very large CAI were shared with Stein Jacobsen, of Harvard University, and Robin Brett, of the U.S. Geological Survey, who wish to do isotopic and oxidation studies, respectively.

Sampling the K/T Boundary at Seymour Island, Antarctica: Considerable time was spent making preparations to join an expedition to Antarctica and sample the only continental site where the K/T boundary occurs in sediments rather than volcanics. The opportunity arose in late February, 1984, and the expedition will take place in February and March of 1985. Marvin assembled equipment for a small laboratory to be set up in a tent on-site to monitor progress in finding marker clays, spherules, or other evidence of impact. Radiochemical analyses of promising samples will be made in the laboratory of John T. Wasson at U.C.L.A.

Publications

1984 Field and Laboratory Investigations of Meteorites from Victoria Land, Antarctica. (with Brian Mason, coeditor). Smithsonian Contributions to the Earth Sciences, Number 26, 134 pages.

1984 A Meteorite from the Moon. (In Marvin and Mason, Smithsonian Contributions to the Earth Sciences, Number 26, pp 95 to 104).

1984 Meteorites on Ice. The Planetary Report, Volume IV, Number 2, pp 12-14.

In Press A Transient Heating Event in the History of a Highlands Troctolite from Apollo 12 Soil 12033. (with David Walker). Proceedings Lunar and Planetary Science Conference 15th, Journal of Geophysical Research.

In Press The Environmental Movement: its Legacy from Project Apollo. The Environmental Professional, Ames, Iowa.

Abstracts

1984

LPSC A Transient Heating Event in the History of a Highlands Troctolite from Apollo 12 Soil 12033. (with David Walker). Lunar and Planetary Science XV, LPI/USRA, pp 513-514.

MS An Approach to the Meteorite Pairing Problem at the Allan Hills, Antarctica. Meteoritics, 47 Annual Meeting, Albuquerque, p O-3

MS Absence of Excess ^{26}Mg in Anorthite from the Vaca Muerta Mesosiderite (with D.A. Papanastassiou and G.J. Wasserburg). Meteoritics, 47th Annual Meeting, Albuquerque, p T-5.

1985

LPSC Geochemistry and Petrology of Clasts from North Ray Crater Breccia 67015. (with Marilyn Lindstrom). Lunar and Planetary Science XVI (in press).

Manuscripts in Preparation

Meteorites, the Moon, and the History of Geology. Invited contribution to book to be published by the National Association of Geology Teachers. (About 35 pages; first draft to editor in October, 1984).

Field and Laboratory Investigations of Meteorites from Victoria Land and the Thiel Mountains, Antarctica. (with Glen MacPherson, coeditor). Smithsonian Contributions to the Earth Sciences. Submission of draft to SI Press planned for summer, 1985.