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Meteorites Linked to Mars and Moon

By WALTER SULLIVAN

WASHINGTON, Nov. 12 — Two pieces of Mars and one piece of the moon may have been found lying on clear blue ice west of McMurdo Sound in Antarctica.

Researchers made the deductions about Mars and about the moon from analysis of three meteorites among thousands found in that region.

The two samples believed Martian belong to a group of rare meteorites, only seven of which have been found elsewhere. Samples of them are now in a number of museums and, from analysis of the Antarctic specimens, it is being argued that all are Martian.

The two specimens have been under intensive study at the Johnson Space Center of the National Aeronautics and Space Administration in Houston since they were found in the last few years. The sample believed to have been hurled from the moon to the earth was found in January and is being studied by Dr. Brian Mason, curator of meteorites at the Smithsonian Institution.

Factors in Martian Theory

The analysts at Houston are Dr. Donald Bogard, curator of the National Repository for Antarctic Meteorites there, and Dr. Lawrence Nyquist. In a telephone interview, Dr. Bogard outlined his reasons for believing the source to be Mars.

Particularly persuasive, he believes, is the inclusion in the sample found at the Elephant Moraine in Antarctica of noble — rare — gases strikingly similar to those of the Martian atmosphere. Noble gases such as helium and argon do not readily react chemically. It appears that both this sample and the other, found at the nearby Allan Hills, were subject to violent shock about 180 million years ago. This could have come from the impact of an asteroid that blasted the Martian material into space. Such an impact, Dr. Bogard said, would tend to drive some of the Martian atmosphere into the sample.

One argument against a Martian origin comes from prior calculations indicating that if objects did break away from a planet they would probably fall back onto it. Some planetary scientists in addition to Drs. Bogard and Nyquist do not believe this argument to be ironclad, however.

Dr. Bogard also said the chemical composition of the samples was like that reported from automated analysis of the Martian surface by the two Viking spacecraft that landed there. The meteorite material seems to have been exposed to oxygen and water and its mix of heavy and light forms of oxygen is unlike that in other meteorites.

Furthermore the samples show the effects of differentiation, the sorting of material under the influence of heat and gravity characteristic of processes on a sizable planet like Mars. Rock of one composition has included another formation in a manner also typical of planetary geology. Unlike other meteorites formed during the birth of the solidified only 1.3 billion years ago, a process that would have occurred in the repeated recycling of materials on a planet with a hot interior.

No single argument is persuasive, Dr. Bogard conceded, but all taken together are impressive.

This viewpoint was echoed by Dr. Bevank French, a specialist in planetary materials at NASA's headquarters here. "If these meteorites do not come from Mars," he said "they are coming from a very, very interesting body."

As Dr. Bogard put it, their source has to have been of planetary dimensions. Venus is a poor candidate because its gravity, which is considerably greater than that of Mars, and its very dense atmosphere would impede ejection of material. Specimens from Venus would also have been altered by the extremely high temperature on its surface.

"I expected a debate" among the scientists specializing in meteorites, he said.

Dr. Mason, for one, is not persuaded that Mars was the source. "You can make a case for it" he said "but it is not very strong." He asked why, if impacts can send fragments of Mars into space, more pieces of the moon are not found among meteorites. The moon is far closer, its gravity is weaker and it has no atmosphere.

Dr. Mason is working on the Antarctic meteorite he believes did come from the moon. It is formed of material fragmented and cemented together with inclusions of anorthosite, rock typical of the lunar highlands as well as of the Adirondack Mountains on earth.

He recalled that when he examined a thin slice microscopically its appearance was unlike any meteorite he had ever seen. His first thought was: "That looks like an Apollo 16 rock." The Apollo 16 astronauts brought back samples from the lunar highlands. No samples have been returned from Mars that could be compared with meteorites suspected of Martian origin.

The latter fall into three classes named for where they were first found, although all are basically similar. One fell at Shergotty, India, in 1865. Another of the Shergotty type was later found at Zagami, Nigeria, and both Antarctic samples are of this classification. Three meteorites are of a type found first at Nakhala, Egypt in 1911 (one of them fell near Lafayette, Ind., in 1931). The third class consists of one found at Chassigny, France, in 1815 and another picked up in 1975 in South Australia.

They are known collectively as the Shergotty-Nakhala-Chassigny or SNC meteorites. When it was discovered in the 1960's that they are alike and all remarkably young, Dr. French said, "we began realising there was something really funny about them."

Perhaps they all came from Mars, Dr. Mason remarked, but he said their origin is still "a jigsaw puzzle with a lot of pieces missing."