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Features
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Fossils Blowing in the Wind: More Contamination of Antarctic Meteorites

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One of the difficulties in searching for fossil life in Martian meteorites is deciding whether the meteorites have been contaminated since arriving on Earth. Lloyd Burckle (Lamont-Doherty Earth Observatory) and Jeremy Delaney (Rutgers University) have found dramatic new evidence for contamination in Antarctic meteorites. They removed dust from cracks in metamorphosed ordinary chondrites, which are meteorites that were heated to several hundred degrees Celsius in asteroids and are completely devoid of life. The dust contained identifiable microorganisms 5 to 40 micrometers across, from both ocean and land environments. Burckle and Delaney suggest that the fossils were transported to Antarctica by wind, along with dust, and eventually deposited in small cracks in the meteorites. They conclude that contamination with micrometer-sized organisms might be a ubiquitous process in Antarctica. This presents a big problem for scientists searching for fossil extraterrestrial life in an Antarctic meteorite.

Reference:

Burckle, L. H. and J. S. Delaney, 1999, Terrestrial microfossils in Antarctic ordinary chondrites, *Meteoritics and Planetary Science,* vol. 34, p. 475-478.

(Photo by Everett Gibson, NASA JSC photo S80-36583.)

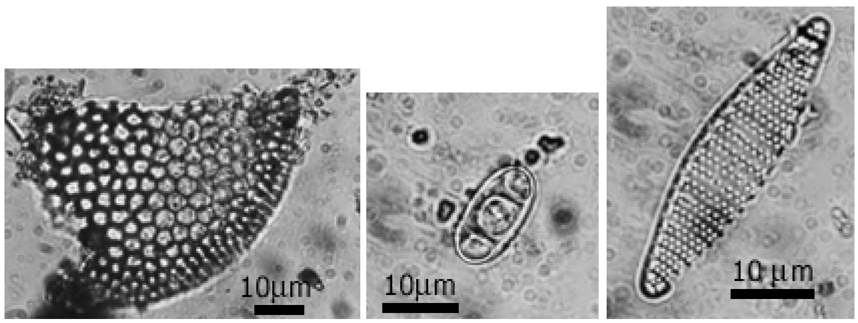
Polar tents on a windy, Antarctic day. (From the *Exploring Meteorite Mysteries* slide set, ES-1997-08-001-HQ.)

Collecting the Samples

Burckle and Delaney wanted to be sure they did not contaminate their samples in the curatorial facility at the Johnson Space Center (JSC), where Antarctic meteorites are actively stored, sliced, and diced, or at Lamont-Doherty. To accomplish this, they chose samples that had remained in their sealed sample bags and removed them only under ultraclean conditions at Lamont. They removed dust from cracks by immersing the samples in double-distilled (hence dust-free) water and buzzed them in an ultrasonic vibrator. This loosened and freed the micrometer-sized material from cracks. They examined the extracted dust with a conventional light microscope.

Numerous microfossils

The extracted dust contained a menagerie of microfossils, almost all of which were identifiable to Burckle's experienced eye. Most are diatoms, which are microscopic algae with cell walls composed of silica (SiO_2). These are abundant in the oceans and lakes, and form an important source of food for many kinds of marine life. Burckle and Delaney also found an opal phytolith. These are microscopic bodies of noncrystalline silica (opal) that are secreted by plants. When the plants die and decay or burn, the phytoliths are released into the atmosphere. With a few exceptions the species are not extinct, so these microfossils would also yield organic compounds, another line of evidence for the presence of fossils in a rock--but these organic compounds would be from the Earth, not another planet. Fossil diatoms have also been found in cracks in terrestrial rocks in Antarctica, further substantiating the role of wind in their deposition.



(Courtesy of Lloyd Burckle, Lamont-Doherty Earth Observatory.)

Photomicrographs of microfossils from Antarctic meteorites.
Left: *Coscinodiscus marginatus.* Middle: *Denticulopsis dimorpha.*
Right: *Fragilariopsis kerguelensis.*

Ubiquitous contamination

This study shows that scientists cannot assume that Antarctica is the place to find pristine extraterrestrial samples free of terrestrial organic contamination. This has also been shown by studies of organic compounds in Martian meteorites found in Antarctica [see **PSRD** articles: Martian Organic Matter in ALH84001? and Organic Compounds in Martian Meteorites May be Terrestrial Contaminants]. The study does not bear directly on the possible occurrence of nanofossils (fossils substantially smaller than 1 micrometer) in ALH 84001 (the meteorite claimed by a group at the Johnson Space Center to harbor fossil life [see **PSRD** article Life on Mars?]. Nevertheless, it raises the possibility that even the tiniest microorganism can contaminate a sample after it has arrived on Earth. The issue of contamination continues to confuse the search for life in Martian meteorites [see **PSRD** article: 30th Lunar and Planetary Science Conference: Some Highlights]. This study has an interesting side benefit to understanding global climate change on Earth. The presence of diatoms in glacial deposits has been used to argue that the West Antarctic ice sheet decreased in size and was then renewed during the past few hundred thousand years. However, the presence of microfossils in rocks, meteorites, and glacial deposits in Antarctica, some of which must be deposited by the wind, suggests that scientists should be cautious when trying to unravel the past history of ice sheets.

Additional Resources

Burckle, L. H. and J. S. Delaney, 1999, Terrestrial microfossils in Antarctic ordinary chondrites, *Meteoritics and Planetary Science,* vol. 34, p. 475-478.

Jull, A. J. T. "Organic Compounds in Martian Meteorites May Be Terrestrial Contaminants" *PSR Discoveries.* Feb 1998. <http://www.psrd.hawaii.edu/Feb98/OrganicsALH84001.html>.

McKay, David S., and others, 1996, Search for Past Life on Mars: Possible Relic Biogenic Activity in Martian Meteorite ALH84001, Science, vol. 273, p. 924-930.

Pepin, R.O., 1985, Evidence of Martian Origins, *Nature,* vol. 317, p. 473-475.

Taylor, G. Jeffrey "Life on Mars?" *PSR Discoveries.* Oct 1996. <http://www.psrd.hawaii.edu/Oct96/LifeonMars.html>.

Taylor, G. Jeffrey "30th Lunar and Planetary Science Conference: Some Highlights " *PSR Discoveries.* April 1999. <http://www.psrd.hawaii.edu/April99/lpsc30.html>.

Taylor, G. Jeffrey "Martian Organic Matter in ALH84001?" *PSR Discoveries.* June 1999. <http://www.psrd.hawaii.edu/June99/organicsBecker.html >.

The Antarctic Search for Meteorites.

The Diatom Collection of the California Academy of Sciences: taxonomic information, images, records of collections, and references pertaining to diatoms.

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