OUT OF THIS WORLD!

Stephen W. Carmichael,[1] Mayo Clinic

If you have been hibernating for several weeks you may have missed the headlines and magazine covers exclaiming about "Life on Mars!" The basis for all of this excitement is an article in *Science* by Dr. David S. McKay of the Lyndon B. Johnson Space Center in Houston and eight of his colleagues from several academic institutions.[2] The reader of this column will not be surprised by the fact that microscopes were used to detect evidence of life on a meteorite from Mars.

The first consideration was whether or not the meteorite was in fact a fragment of the martian surface. The specimen, known as ALH84001, is from a class of meteorites that appear to have resulted from impacts on Mars, some of the specimens landing in Antarctica where this one was recovered. Trapped gases (in glass droplets and stringers) in several of the family of meteorites closely match the martian atmosphere for several gases over 8 orders of magnitude range in abundance. Whereas ALH84001 did not contain such trapped atmospheric gases, its elemental and isotopic composition closely resemble the meteorites that do. Oxygen isotope composition is particularly diagnostic, and the 12 martian meteorites form a tight group that is significantly different from the earth, the moon, and any other type of meteorite. There appears to be no question that ALH84001 is martian in origin.

McKay *et al.* used high-resolution scanning (SEM) and transmission electron microscopy (TEM) to examine surface texture and internal structure of ALH84001. Freshly broken but preexisting fracture surfaces displayed carbonate globules. The globules were discoid, probably because they formed within a fracture plane. A globule about 50 mm in diameter was studied extensively with TEM, back-scattered electron imaging, and energy dispersive spectroscopy. Calcium, iron, magnesium, and sulfur were found in patterns that were consistent with an organic formation. High resolution SEM showed ovoid and elongate features that could be fossils of bacteria-like organisms. These are the images that have been prominently displayed in the media.

Another important tool that was used was a microprobe two-step laser mass spectrometer referred to as mL^2MS. This instrument revealed the existence of organic molecules of polycyclic aromatic hydrocarbons (PAHs) in concentrations and distribution within the specimen that indicated they had been part of its original composition, rather than a contaminant. Actually, this team of scientists went to great lengths to rule out terrestrial contamination during the 13,000 years that ALH84001 spent in Antarctica, or contamination introduced during any phase of analysis. They carefully controlled for artifacts that may occur during preparation of a specimen for microscopy, even using a lunar sample for comparison.

McKay *et al.* pointed out that they were undertaking a difficult task from the beginning. They were looking for lifeforms that had at least some resemblance to terrestrial lifeforms, because they (and we) wouldn't know what a martian lifeform looked like. They did compile an impressive amount of data that they summarized with five points: 1) ALH84001 was an igneous Martian rock that was penetrated by a fluid along fracture and pore spaces, which then became sites of secondary mineral formation and possible biogenic activity, 2) a formation age for the carbonate globules younger than the age of the igneous rock, 3) SEM and TEM micrographs of carbonate globules and features resembling terrestrial microorganisms, terrestrial biogenic carbonate structures, or microfossils, 4) magnetite and iron sulfide particles that could have resulted from oxidation and reduction reactions known to be important in terrestrial microorganisms, and 5) the presence of PAHs associated with surfaces rich in carbonate globules. Taken together, this is compelling evidence that organic life, at least similar if not identical to that on Earth, has existed on Mars. ■

1 The author gratefully acknowledges Dr. David S. McKay for reviewing this article.

2. D.S. McKay, E.K. Gibson, Jr., K.L. Thomas-Keprta, H. Vali, C.S. Romanek, S.J. Clemett, X.D.F. Chillier, C.R. Maechling, and R.N. Zare, Search for past life on Mars: Possible relic biogenic activity in martian meteoritte ALH84001, *Science* 273:924-930, 1996.

Front Page Image

Electron Interaction Volume Modeled with Electron Flight Simulator

This model shows electron scatter in a sample by color vs. energy. The scattered electrons change color for each 10% drop in energy. Samples that can be modeled include bulk, thin films (up to 5 layers), films on a substrate, particles, inclusions, and cross sections. X-ray volume, intensity, and spectra can also be modeled and data exported to spreadsheets. Electron Flight Simulator lets you try out, in software, a wide range of analysis conditions before running the real sample. The software is designed for any SEM or TEM lab doing EDS or WDS X-ray analysis.

More detailed information and a demo disk are available from our web site at: **http://members.aol.com/smworld100/index.htm**

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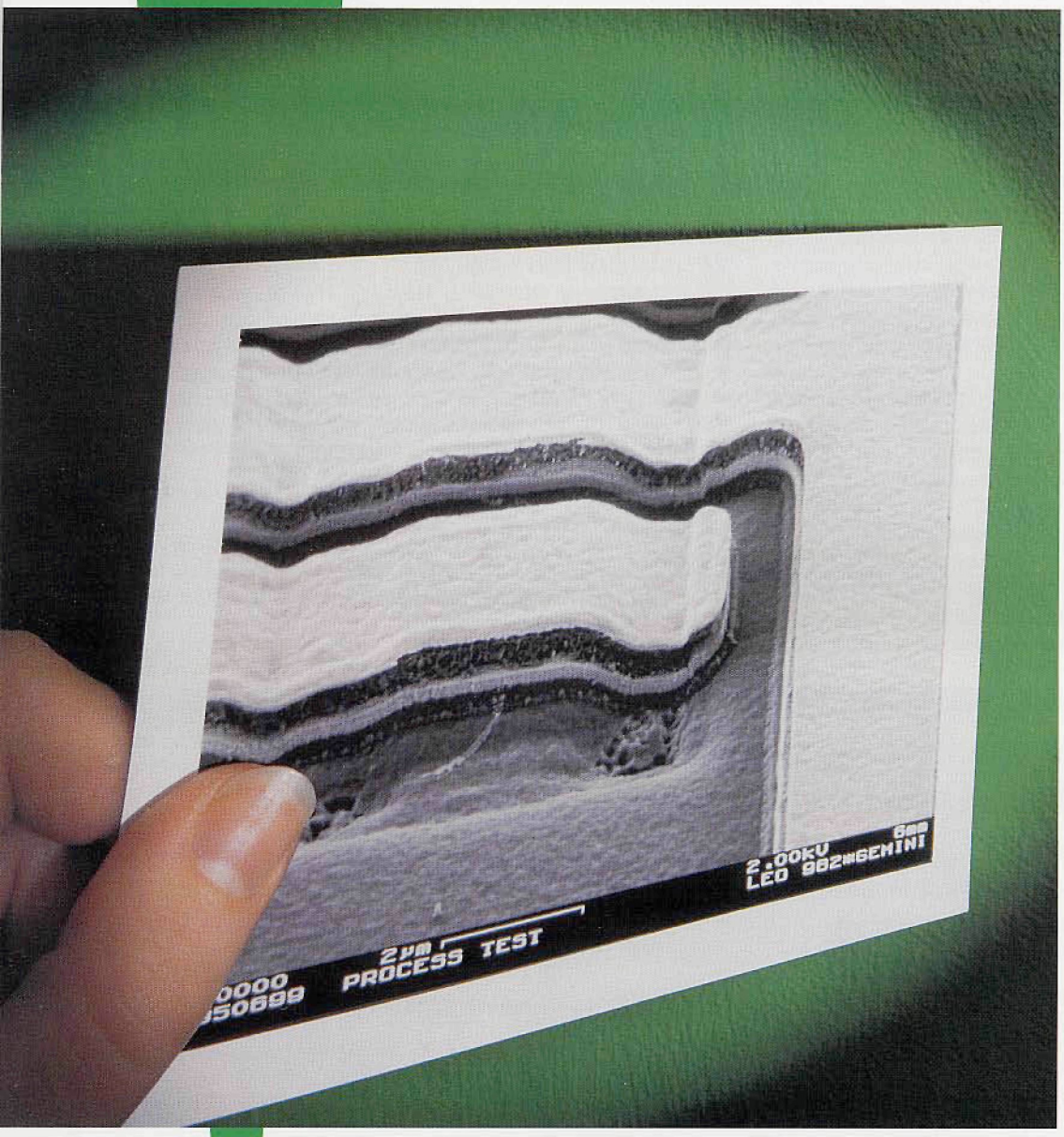
Don Grimes, Editor

Electron microscopy – the future is clear



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Circle Reader Inquiry #5

Congress OKs FY 97 Science Funding

As the 104th Congress recently wrapped up its work, agencies that fund and carry out research and development fared fairly well in this year's budget-setting process.

Congress provided, and President Clinton agreed to, a $3.27 billion spending level, a modest 2% increase, for the National Science Foundation. Funding for the National Institutes of Health rises 7% to $12.7 billion, and the Department of Defense research program funding is also up 7%, to $37.4 billion.

The Department of Commerce's Advanced Technology Program (ATP), considering that it was nearly eliminated last year, had its budget fall 12% to $225 million.

Lehigh Announces '97 Microscopy Courses

Since 1971, nearly four thousand engineers and scientists from more than 20 countries have attended Lehigh University's short courses on the principles and application of Scanning and Analytical Electron Microscopy. These 4-day and 5-day lecture and lab courses are given by noted experts in this growing field. Course attendees are exposed to an unparalleled array of modern SEMs, AEMs, AFMs and SPMs.

The 1997 schedule is as follows:

SEM and X-ray Microanalysis: June 9-13 1997

Advanced Scanning Electron Microscopy with Digital Image Processing: June 16-19 1997.

Quantitative X-ray Microanalysis of Bulk Specimens and Particles: June 16-19 1997.

Analytical Electron Microscopy (AEM) Analysis Methods for TEM Specimens: June 16-19 1997.

Atomic Force Microscopy and other Scanned Probe Microscopies: June 17-20 1997.

For registration and other information, contact Ms. Sharon Coe, Lehigh University, Department of Materials Science and Engineering, 5 East Packer Ave, Bethlehem, PA 18015-3195; phone: (610)758-5133, Fax: (610)758-4244, or e-mail: interSEM@Lehigh.edu

Cryo-Electron Microscopy Workshop

Purdue University is offering an intensive, four-day workshop in the basics of cryo-electron microscopy from November 3 - 5 1997 which will include theoretical discussions and hands-on demonstrations in preparing vitrified samples of biological and macromolecules. For additional information, see the <WWW site http://bilbo.bio.purdue.edu/~workshop/> or the e-mail site at workshop@bilbo.bio.purdue.edu

Ig Nobel Prizes Make Science A Hoot

CAMBRIDGE, Mass. (AP) — If proving that toast always falls on the buttered side isn't worth a scientific award, what is?

Professor Robert Matthews of Aston University in England went sadly without recognition for his study, "Tumbling Toast, Murphy's Law and the Fundamental Constants."

Until now.

Matthews received the Ig Nobel Prize for Physics on Thursday night in the Sixth First Annual Ig Nobel Prize ceremony at Harvard University.

The awards spoof the real Nobels, being announced now through Oct. 11. Handed out by former winners of the Nobel Prize, the Ig Nobel honor "achievements that cannot or should not be reproduced."

Other winners included Anders Baerheim and Hogne Sandvik of the University of Bergen, Norway, who got the Ig Nobel in Biology for their study of the effect of ale, garlic and sour cream on the appetite of leeches.

George Goble of Purdue University won in Chemistry for lighting a barbecue grill in three seconds using charcoal and liquid oxygen.

And Ellen Kleist of Greenland and Harald Moi of Norway took the Ig Nobel in Public Health for their research into the transmission of gonorrhea through inflatable dolls.

Thanks to them, said Marc Abrahams, organizer of the Ig Nobels, people now know "that when you date an inflatable doll, you've dating everyone who ever dated that inflatable doll.

Despite the humor in the awards, "there's a half-serious point, which is that science is enjoyable," said Abrahams, editor of the tongue-in-cheek scientific journal: Annals of Improbable Research.

XEI Scientific Celebrates 5th Anniversary

Ronald Vane, President of XEI Scientific, advises that he is celebrating his fifth year in business in October by shipping the 100th and 101st SEM-CLEAN systems.

According to Mr. Vane, the SEM-CLEAN system came about five years ago because there was a need for a way to clean Scanning Electron Microscopes without the use of traps or dry vacuum pumps. Homemade Nitrogen purge systems had been used by some microscopists to clean SEMs for some time, but when XEI Scientific was started there was no easy way to install a purge and to make sure it was compatible with the automatic vacuum system on the SEM. Nitrogen purging is good for cleaning a SEM because it doesn't matter where the contamination is coming from - vacuum pumps or sample borne.