GEOLOGICAL SOCIETY OF MINNESOTA

N E W S

FALL 1997
VOLUME LI, NO. 3

CONTENTS

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ANNUAL MEETING
MONDAY
SEPTEMBER 22, 1997

OLD COUNTRY BUFFET
3000 White Bear Avenue
Maplewood, Minnesota

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The 1997 Annual Meeting is scheduled for September 22 (not 23 as indicated in the last newsletter.)

GSM Directors for 1998 will be elected at this meeting. The nominating committee has been busy seeking out candidates for these very important positions. Three people have agreed to fill the upcoming vacant spots. They are Paul Lemke, David Christianson and Bruce Goetteman. Nominations will also be accepted from the floor at the meeting.

Members of the board whose terms continue are:

Charles Brennecke	Dick Heglund
Sylvia Huppler	Pat Johnson
Maryls Lowe	Don Mattsson

GSM Directors may serve two 2-year terms but must be elected each term.

Retiring board members are Doug Zbikowski, Don Swensrud and Alex Lowe. They deserve a huge thank you for a job well done.

We will also be voting on the revised By-Laws at the meeting.

Last but not least, Galen O'Connor will review the summer field trips and slides will be shown.

Judy Hamilton

ROCKS IN THE BOX PROVIDE LIVELY INTEREST AT STATE FAIR BOOTH

I found it very exciting this year to be a member of the "gang" who worked the State Fair Booth. I talked to more people than in any previous year and truly enjoyed myself. I've heard the same comments from others.

The interest in rocks shown by the children was very satisfying. Several times I joined a child with the magnifying glass and learned a thing or two myself. They were especially interested in the rock box with the accompanying slides on a small light table, identifying the rocks in the box.

Thanks to the Fair Committee for all their hard work. That Committee includes: Dick Heglund, Doug Zbikowski, Daryl Lukas, Tom Lonsky, Tom Schoenecker, Alex Lowe, and Conrad Nelson. Without that all important committee, we could not have a fair booth and would not attract all the wonderful people that we welcome into the Society each year.

Then, of course, are all those great folks who staffed the booth throughout the 10 days. They are listed below.

A big rock pile of thanks to everyone who contributed time and knowledge to make the 1997 Fair Booth successful.

Judy Hamilton

MEMBERSHIP RENEWAL TIME

October 1 is membership renewal time. Bruce Goetteman is our new membership chairperson and will be happy to accept your check or cash. Stop and see him at the Annual Meeting September 22, and you can renew then. Individual membership is $20.00 and family membership is $30.00.

STAFF

Pat Johnson	Marty Collier(2)
Charles Brennecke	Larry Demark
Dick Heglund(2)	Howard Bergstrom
Rick Hosterman	Jean Hosterman
Alan Smith	Kay Smith
Jay Hutchinson	Val O'Malley
Doug Zbikowski	Gerald Paul
Judy Hamilton	Phil Curtis
Dwight Robinson	William Burt
Roger Willette	Clarence Ooten
Iris VonBargen	Sister Joan Kain
Tracy Westgard	Sharon Guiser
Conrad Nelson(3)	Dee Schmalz
John Bauch	Galen O'Connor
Lee Preece	Deb Preece
Paul Lemke	Tom Lonsky
Eva Selander	Dick Selander
Allen Siekmeier	Warren Fieber
Arlette Siekmeier	Henry Gangl
Richard Thill	Dave Christianson
Alex Lowe	Marlys Lowe
Margaret Rodina	Gary Joselyn
Dorothy Kuether	Bruce Goetteman
Paul Larson	Karen Larson
Sylvia Huppler	Don Swensrud(2)
Everett Luhmann	Doris Luhmann
Tom Schoenecker	Nancy Wiens
Orell Jenson(2)	Fran Corcoran
John Bussard	Bonnie Comer
Bob Gunville	Macie Gunville
Lorraine Cook	Martha Mayou
Nora Mattsson	Don Mattsson
Lisa Peters	David Peters

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LIFE ON MARS?

A summary of articles authored by NASA's team of scientists and downloaded from the internet.

The discovery of the first organic molecules ever seen in a Martian rock is being hailed as startling and compelling evidence that microbial life existed on Mars long ago, when the planet was warmer and wetter. About 15 million years ago, scientists estimate, a huge asteroid collided with Mars, gouging many pieces of rock from beneath the surface with enough force to escape the planet and scattering them into space. For millions of years, based on cosmic ray exposure data, the chunk of rock floated through space. It encountered Earth's atmosphere 13,000 years ago and fell on the icy Allen Hills in Antarctica as a meteorite.

Found in 1984 by an annual expedition of the National Science Foundation's Antarctic Meteorite Program, it was preserved for study and its possible Martian origin was not recognized until 1993. The meteorite, called ALH84001, is one of only 12 meteorites identified so far that match the unique Martian chemistry of Martian surface materials as measured by the Viking spacecraft that landed on Mars in 1976. The Viking project landed two robotic craft on the cold, arid surface in 1976 and conducted weeks of tests, sampling the soil for any trace of biological activity and testing the atmospheric composition.

The igneous rock in the 4.2-pound, potato-sized meteorite has been age-dated to about 4.5 billion years, the period when the planet Mars formed. The rock is believed to have been extensively fractured by impacts as meteorites bombarded the planets in the early inner solar system. Between 3.6 billion and 4 billion years ago, a time when it is generally thought that the planet was warmer and wetter, water is believed to have penetrated fractures in the subsurface rock, possibly forming an underground water system.

The water was saturated with carbon dioxide from the Martian atmosphere and carbonate minerals were deposited in the fractures. The NASA team's findings indicate living organisms may have assisted in the formation of the carbonate, and some remains of the microscopic organisms may have become fossilized, in a fashion similar to the formation of fossils in limestone on Earth.

The team of researchers consists of those with a wide variety of expertise in microbiology, mineralogy, analytical techniques, geochemistry and organic chemistry. Many of the scientist's findings were made possible only because of very recent technological advances in high-resolution scanning electron microscopy and laser mass spectrometry. Only a few years ago, many of the features that can be reported now were undetectable. Although past studies of this meteorite and others of Martian origin had failed to detect evidence of past life, they were generally performed using lower levels of magnification without the benefit of the technology used in this research. The recent discovery of extremely small bacteria on Earth, called

nanobacteria, prompted the team to perform this work at a much finer scale than past efforts.

Organic molecules are the requisite building blocks of life, and the scientists looked for signs of such molecules and other mineralogical and textural indications of past life within the pore space and fractures of the meteorite. The compounds found have been identified as polycyclic aromatic hydrocarbons, called PAHs. PAHs can form inorganically (non-biologically), or biologically, through the activity of bacteria or other living organisms or their degradation. When microorganisms die, the complex organic molecules that they contain frequently degrade into PAHs. In addition, carbonate globules were found, with dark rims of embedded grains of magnetite and iron sulfide. Under most conditions these iron compounds would not coexist, but certain bacteria on Earth, particularly anaerobic strains, synthesize them simultaneously with relative ease. The carbonates formed within the rock fissures, about 3.6 billion years ago, and are younger than the rock itself.

On Earth, PAHs are abundant as fossil molecules in ancient sedimentary rocks, and in coal and petroleum, the result of chemical changes that occurred to the remains of dead marine plankton and early plant life. They also occur during partial combustion, such as when a candle burns, or food is grilled, or in diesel exhaust, and they can be common air pollutants. The PAHs, the carbonate globules and their associated secondary mineral phases and textures could be fossil remains of a past Martian biota, the researchers concluded. The meteorite contained evidence that Mars had water early in its history and that this environment, with liquid water and organic molecules, was one where life could have existed.

The unique composition of the meteorite's PAHs is consistent with what the scientists expect from the fossilization of very primitive microorganisms. On Earth, PAHs occur in thousands of forms, but, in the meteorite they are dominated by only about a half-dozen different compounds. The compounds were found in locations directly associated with the fossil-like structures and carbonate globules in the meteorite. The textures of the carbonate globules are similar to bacterially induced carbonate crystal precipitates produced in the laboratory and in freshwater ponds on Earth. On the basis of these observations, the scientists interpreted that the carbonate globules had a biogenic origin and were likely formed at low temperatures. Extreme conditions, - conditions very unlikely to have been encountered by the meteorite, - would have been required to produce these compounds in close proximity to one another if life were not involved. The isotopic composition of the carbonates, and the data on the magnetite and iron-sulfide particles, imply a temperature range cool enough for life between zero degrees and eighty degrees centigrade. Also, gregite is present within the carbonates. Gregite decomposes at 250 degrees C. If the temperature was above 250 degrees C, the gregite would not be present. And if the organic molecules had been heated to above 400

GEOLOGICAL SOCIETY OF MINNESOTA

1997-98 Program

Free Lectures & Labs held at 7:30 P.M. Mon. on the Minneapolis Campus of the Univ. of Minnesota. See map on reverse side. For weather cancellations or more info. call (612) 724-2101

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22 Sep 97 **Fall Annual Meeting** - Slide program of this past summer's field trips.
Dinner at 5 P.M. / Meeting at 7 P.M. - the Old Country Buffet, Maplewood *(612) 779-1957*

Lecture Theme: **MINNESOTA'S GEOLOGIC HERITAGE**

6 Oct 97 #1 **Origin of Our Solar System** (about 4600 Ma [4,600 million years ago]) - Room B-75 in Amundson Hall. E. Calvin Alexander, Jr., Ph.D. *(Geology & Geophysics Dept. - U of MN)*

20 Oct 97 #2 **Minnesota's Geology: A Window into Early Planetary Evolution During the Hadean Eon** (4600 Ma - 4000 Ma) - Room B-75 in Amundson Hall. Paul Weiblen, Ph.D. *(Geology & Geophysics Dept. - Univ. of MN)*

3 Nov 97 #3 **Archean Eon: Southern Gneiss Terrane** (3800 Ma - 2800 Ma) - Room B-75 in Amundson Hall. Dave Southwick, Ph.D. *(Minnesota Geological Survey)*

17 Nov 97 #4 **Archean Eon: Northern Greenstone - Granite Terrane** (2750 Ma - 2600 Ma) - Room B-75 in Amundson Hall. Mark Jirsa, M.S. *(Minnesota Geological Survey)*

24 Nov 97 **LABORATORY: Microscopic (Petrographic) Study of Minnesota's Igneous Rocks and Their Metamorphic Progeny** - Room 125 in Pillsbury Hall.
Jim Miller, Ph.D. *(Minnesota Geological Survey)*

1 Dec 97 #5 **Minnesota's Mineral Resources** - Room B-75 in Amundson Hall.
James Welsh, Ph.D. *(Geology Dept. - Gustavus Adolphus College)*

12 Jan 98 #6 **Proterozoic Eon: Animikie Basin and Souix Quartzite** (2300 Ma - 1650 Ma) - Room to be announced. G. B. Morey, Ph.D. *(Minnesota Geological Survey)*

26 Jan 98 #7 **Proterozoic Eon: Keweenawan (Midcontinent) Rift** (1100 Ma - 900 Ma) - Room to be announced. Jim Miller, Ph.D. *(Minnesota Geological Survey)*

9 Feb 98 #8 **Phanerozoic Eon: Early Paleozoic Seas** (540 Ma - 360 Ma) - Room to be announced. Anthony Runkel, Ph.D. *(Minnesota Geological Survey)*

16 Feb 98 **LABORATORY: Microscopic (Petrographic) Study of Minnesota's Sedimentary Rocks and their Metamorphic Progeny** - Room 125 in Pillsbury Hall. Jim Miller, Ph.D. *(Minnesota Geological Survey)*

23 Feb 98 #9 **Phanerozoic Eon: Cretaceous Seas** (145 Ma - 65 Ma) - Room to be announced. Dale Setterholm, B.S. *(Minnesota Geological Survey)*

9 Mar 98 #10 **Pleistocene Epoch: Glaciers Cover Minnesota** (2 Ma - 10 ka [10,000 years ago]) - Room to be announced. Mark Johnson, Ph.D. *(Geology Dept. - Gustavus Adolphus College)*

16 Mar 98 **LABORATORY: Minnesota's Fossils** - Room to be announced.
Christine Schneider *(Geology & Geophysics Dept. - Univ. of MN)*

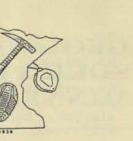
30 Mar 98 #11 **Pleistocene Epoch: Glacial Geology & Landscape of Twin Cities** (2 Ma - 10 ka) - Room to be announced. Carrie Patterson, Ph.D. *(Minnesota Geological Survey)*

13 Apr 98 #12 **Holocene Epoch: Minnesota's Soil Resources** (10 ka - present) - Room to be announced. Dick Paulson, B.S. *(Natural Resources Conservation Service, ret.)*

27 Apr 98 **Kimball Memorial Banquet** - Location to be announced.
Ten Thousand Years and Fifty Miles - A Minnesota Odyssey
John R. Tester, Ph.D. *(Dept. of Ecology, Evolution, and Behavior - Univ. of MN)*

GEOLOGICAL SOCIETY OF MINNESOTA

Supporting and Promoting Public Interest in the Geological Sciences since 1938.



Want to Learn More About Geology and Earth Science?

The ***Geological Society of Minnesota*** is a public-spirited, nonprofit educational organization that sponsors an annual program of stimulating lectures, labs, and field trips. ***These enriching activities may all provide CEUs for teachers.***

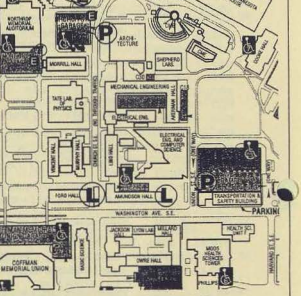
Winter Lectures and Labs -

GSM's exciting, illustrated **lectures** are presented by leading professionals in their fields of Geology or Earth Science. These engaging talks are ***free and open to the public,*** and are especially valuable for enthusiastic learners from secondary school students to adults. A question and answer opportunity is always included. *Where else can you enjoy an intriguing exchange with a leading scientist or educator?*

Our novice-friendly **labs,** demonstrate at a comfortable pace, the ideas and principles of Geology and Earth Science. They allow an involved, hands-on learning experience for beginners, or a helpful refresher for the seasoned enthusiast. These instructive sessions are also ***free and open to the public.*** *Where else can you actively practice science, under expert guidance, for free?*

Summer Field Trips -

During the months of May through October, GSM conducts a series of professionally-guided, statewide and regional ***field trips.*** These are one to three day excursions made to points of geologic interest not usually experienced by the casual traveler. They afford a very memorable and satisfying learning experience as there are always plenty of hands-on and question-answering opportunities. A comradery with enthusiastic learners and people curious about their natural environment is always a reward in itself. There is a small charge for any shared expense, and a liability waiver must be signed for each participant.



U of MN - Minneapolis East Bank Campus
L = Locations of Lectures & Labs
P = Convenient Parking

School Classroom Presentations & Materials -

Classroom presentations for Metro area elementary schools are available through the *Public Service Committee* to help enrich the education of young learners, particularly the 2nd to 4th grade levels. A collection of Minnesota's rocks and minerals and a companion slide set taken of the same rocks in thin-section is available as a follow-up reward, when the students submit letters describing: *Two new things I learned today about rocks and/or fossils.* Alternatively, the collection and/or slide set may be purchased at cost plus shipping, by any Minnesota school without receiving a presentation. Supplies are limited.

Member Benefits also Include:

- ***Extensive Media Library*** - GSM maintains a collection of more than 125 geological videos and a growing number of interactive, multimedia CD-ROMs for both Windows and Macintosh computers. These are available to the members at lectures or through the mail, for a nominal rental fee.
- ***GSM Newsletter*** - A quarterly publication containing: announcements of upcoming activities, interesting and informative articles on the Earth Sciences, GSM project and activity reports, and general club news and notices.
- ***GSM Directory*** - An annual book that is a handy information resource, and makes it easy to access your organization.
- ***Rocky Roots . . . Three Geology Walking Tours of Downtown St. Paul*** - A free copy of this popular guidebook!
- ***The Opportunity to Meet Others*** - of diverse backgrounds, who share an enthusiasm for learning and a curiosity for the natural world around them.
- ***The Rewarding Feeling*** - of supporting a public-spirited, nonprofit organization dedicated to public education.

Join Today! - For a membership application or further information just phone (612) 724-2101, and leave a message; or write: GSM, c/o Bruce Goetteman, 16125 Delarma Drive, Carver, MN 55315-9673 *Do it now! Your adventure awaits!*

degrees, they would have begun to degrade, and no fragments of this has been seen.

The scientists studied the samples further to make sure the organic molecules had originated on Mars, not as the result of terrestrial contamination. One telling piece of evidence was the fact that the concentration of the molecules increased as the analysis moved inward; if those molecules had been the result of contamination, they would have been concentrated on the surface. A variety of contamination checks and control experiments indicated that the organic material was indigenous to the rock and was not the result of terrestrial contamination. The magnetite, iron-sulfide, puritite, and possible gregite particles inside the carbonate globules are chemically, structurally and morphologically similar to particles produced by bacteria on Earth.

High-resolution scanning electron microscopy revealed on the surface of the carbonates small (100-200 nanometers) ovoids and elongated features. (100 nanometers long is 4 millionths of an inch.) The extremely small single celled structures resemble the microscopic fossils of the tiniest bacteria found on Earth. A few of the elongate forms appear to be segmented. Whether this is a microfossil or not can't as yet be determined because there is no data other than the TEM photograph, (transmission electron microscope), but again, it is the interpretation of the NASA team that this and similar features have a high probability of being martial micro-fossils.

In the state of Washington, drill cores a couple of kilometers deep in the Columbia River basalts show subterranean, subsurface bacteria, and some of them are these very small kind of bacteria. Similar textures containing ovoids have been found on the surface of calcite concretions grown from Pleistocene ground water in southern Italy, where they are interpreted as nannobacteria that have assisted the calcite precipitation.

The assumption is that life on Mars would be like life on Earth in its broadest sense: made out of carbon compounds, which we refer to as organic compounds -- carbon, hydrogen, oxygen, nitrogen, sulfur and phosphorus. For it to be alive it must be separated from the exterior by a membrane, a wall, a layer -- some definitive boundary that bounds the outside that is the environment, and the inside, where aqueous chemistry must occur. Liquid water is eddential for all known biology. There is no good evidence as yet of life cycles, or of cell division, or the presence of cell walls, if they are compartmentalized, or if they are composed of organic material

The mere presence of organic matter by itself does not say it's part of life, because it is known that on Earth, prior to the origin of life, organic matter was synthesized non-biologically. With regard to the PAHs, such compounds are found in interstellar dust grains, in interplanetary carbon grains and in other sorts of meteorites, like carbonaceous chondrites "There is not any one finding that leads us to believe that

this is evidence of past life on Mars. Rather, it is a combination of the many things that we have found," McKay of the NASA'S Johnson Space Center said. "They include the detection of an apparently unique pattern of organic molecules, carbon compounds that are the basis of life, and several unusual mineral phases that are known products of primitive microscopic organisms on Earth". Structures that could be microscopic fossils seem to support all of this. Every sand sized chip has most of these kinds of evidence in it. "The relationship of all of these things in terms of location - within a few hundred thousandths of an inch of one another - is the most compelling evidence."

We know from the Viking results that Mars, early in its history, did have flowing water on its surface in about the time frame that these carbonates are dated to, and so the conditions seem to have been ripe for early life to perhaps have evolved on that planet. And if in fact it did, then why wouldn't it have evolved also on other places in the early solar system where one might have had liquid water and sources of chemical energy. So the possibility is that life may have actually arisen elsewhere than this solar system as well.

Meanwhile, this meteorite will be studied in much more detail, with plans to concentrate on the micro-fossil objects to get additional data to understand their composition and structure.

At some point in Mars' history, things went bad. The atmosphere mostly disappeared, either into space or it got locked up in carbonate rocks in the subsurface. And the water dried up, and some of that water went into space. Some of it may still be there, as ice, as permafrost, or even as a groundwater system. And it is one view that early life retreated underground, and may still be there, just as the bacteria living at several kilometers under the surface in the state of Washington. Though life cannot live on the surface, there is still the possibility of this kind of life in the subsurface in Mars.

The scientific plans for future missions call for focusing on searches for fossils in regions where water once stood and might still be present in a kind of subsurface permafrost. A new round of international exploration of the red planet may be inaugurated that may eventually entail as many as 20 missions over the next decade or so, if enough money materializes. The main goals of the exploratory push are to find water and life, and especially tiny microbes that may flourish deep underground in the wet and more temperate parts of the planet's hot interior.

Three British scientists announced that a second Martian meteorite, EETA79001, is laced with organic compounds, including some amino acids.

NASA and the National Science Foundation have distributed more samples for new rounds of tests by scientific teams worldwide.

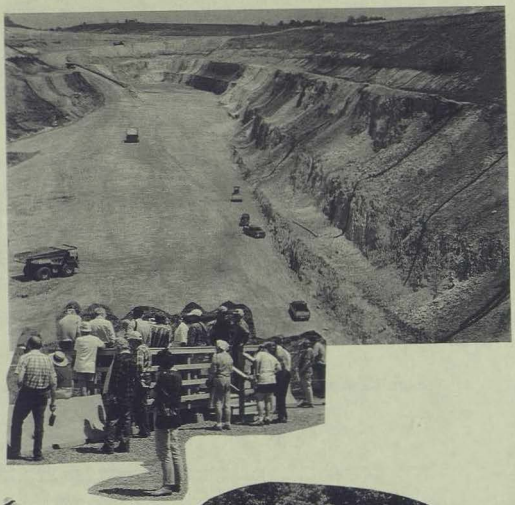
For more information:

http://www.reston.com/astro/exobiol-ogy
http://www.skypub.com/news/marslife
http://www.fas.org/mars/nasa_001.

Sylvia Huppler

Field Trip
Moments

Flambeau Mine - Ladysmith, Wisconsin



Search for Leaf Fossils
Near Mankato

More Next Issue

Nora & Don Mattsson
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Minneapolis, MN 55403

FIRST CLASS

PLEASE FORWARD

The purpose of this newsletter is to inform the members and friends of the activities of the Geological Society of Minnesota. *News* is published four times a year – February 15, May 15, August 15, and November 15. Deadline for article submission is the first day of the month of publication.

YOUR COPY OF THE 97/98 LECTURE SERIES IS ENCLOSED
LECTURES BEGIN OCTOBER 6

NOTICE NOTICE NOTICE NOTICE

(The previous newsletter had an incorrect date for the Annual Meeting)

ANNUAL MEETING
MONDAY SEPTEMBER 22, 1997
OLD COUNTRY BUFFET
MAPLEWOOD, MINNESOTA