# GEOLOGICAL SOCIETY OF MINNESOTA

# NEWS

SPRING 2001
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http://www.geo.umn.edu/orgs/gsm/

*"Geology is a capital science to begin with as it requires nothing but a little reading, thinking and hammering."*

*–Charles Darwin* 1835

**Monday, May 7**
is the date of this spring's
**Kimball Memorial Banquet**
at the
Maplewood Old Country Buffet,
3000 White Bear Ave, Maplewood.
Dinner starts about 5:00 PM
lecture at 7:00 PM.
The topic is
**North America and the Great Ice Age: Glacial Cycles and Causes of Glaciation.**
The speaker is Charles Matsch, PhD, of the Geology Department, University of Minnesota, Duluth

## Geological Survey Takes Budget Hit

The Minnesota Geological Survey is among the agencies facing a funding shortfall in Gov. Jesse Ventura's effort to cut back the University of Minnesota's budget.

The Governor's budget proposal, sent to the Legislature in late January, provided less than half of the increase university officials sought just to "stand still" in the face of inflation in the coming two years. For the Geological Survey, UM officials sought a $27,000 increase - 3 percent - in funding for items other than salaries. The MGS would also have shared in a 3 percent salary funding increase system wide. The Governor provided only a 2 percent salary increase and no additional non-salary funding for 2002-03.

According to university and legislative budget analysts, the Governor's budget proposal de-emphasized education and other spending programs to make room for costs involved in his tax-overhaul plan. His proposal for the U of M won't even cover the increase in employee health insurance costs, meaning it would require reductions in all areas of the university if enacted. The Minnesota Legislature will spend the next three months working on the state budget, including the budget for the U of M and MGS.

While there seems to be bipartisan agreement on a new tax rebate and widespread support for reducing the sales tax rates, Ventura's other tax-reform proposals are encountering difficulty - not least because many lawmakers believe he shortchanged the U of M and other areas, including K-12 schools, transportation and environmental protection.

How that will work out is not yet clear. Lawmakers will receive a new forecast of state revenues from the Minnesota Department of Finance by the end of February, and that forecast will be used in setting budget targets. It is expected that the slowing economy will cause the Finance Department to reduce the size of the predicted state budget surplus from the $3 billion figure issued last November.

*–Tom Smalec*

## Announcements

The speaker for one lecture and title for two lectures have changed

12 March, 2001
"Madagascar Dinosaurs"
**Kristi Curry Rogers,**
Assistant Curator,
Science Museum of Minnesota

2 April, 2001
"Relative Time: Sequencing Events in Earth's History and Fossils as Indicators of Age and Environment"
**Ray Rogers, PhD**
Geology Department,
Macalester College

**Next Newsletter Deadline: MAY 1, 2001**


**GSM *NEWS***

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The purpose of this newsletter is to inform the members and friends of the activities of the Geological Society of Minnesota. GSM *News* is published four times a year: February 15, May 15, August 15, and November 15. It welcomes unsolicited Geology and Earth Science related articles and photographs. Deadline for article submission is three weeks before the date of publication. Send all material for GSM *NEWS* to: Geological Society of Minnesota c/o Katy Paul, 6901 West 84th Street, Bloomington, MN 55438. Phone: as listed above, or e-mail: again, as listed above.

Officers: William Robbins, *President;* (Vacant) *Vice President;* Steve Erickson, *Treasurer;* Judy Hamilton, *Secretary.*

Directors : In addition to the officers listed above; David Christianson; Paul Lemke; Rose Mary O'Donovan; Gail Marshall; Katy Paul.

Send all GSM membership dues, change of address cards, and renewals to the GSM Membership Chair: c/o Gail Marshall, 12232 Allen Drive, Burnsville, MN 55337. Phone: (952) 894-2961. Membership levels are: $10 for full-time Students, $20 for Individuals, or $30 for Families


# PRESIDENT'S PAGE

The lecture series for this season, "Earth Dynamics: Basic and Catastrophic" is proceeding well, with good turnout. The lecture series next season may bring out even greater crowds with its title: "Forming and Finding Earth's Hidden Treasures". The field trips planned for this summer include the following: The long field trip this year is to eastern Utah and the four corners area, starting on Tuesday June 12 and ending on Thursday, June 24. Rick Uthe and Walt Blowers are leading the trip, and there will be two pre-trip meetings, important for those thinking of going on the long field trip. For more details, see the Utah Field Trip article in this newsletter. Also planned is a two-day field trip to the Mankato area, and trips to both the Taylor's Falls area and River Falls, Wisconsin area. More detail will be provided on these shorter field trips in the next newsletter.

I would like to thank Bruce Goetteman for his service to the Geological Society of Minnesota over the years, first as membership chair, then treasurer, and finally vice-president. Bruce has chosen to resign his position as vice president and board member due to time constraints, a circumstance with which I sympathize.

Thanks are also due to Mrs. Gunnard P. Cronk, who donated approximately one hundred agates to the GSM outreach program. These go into rock boxes that are then distributed to schools when outreach presentations are given.

Nora and Don Mattsson have made an additional contribution to GSM, above that mentioned in the previous newsletter.

Again, thank you all very much. —*Bill Robbins,*
President

Due to an unavoidable delay, Part Two of Doug Zbikowsky's article, **Markers Through Time,** along with the status of our holdings, and the marker construction planned for next spring, will not be featured in this edition of the GSM News. We are hopeful that we will be able to publish the continuation of this theme in the next Newsletter edition (May 2001).
—Editor

# GEOINDICATORS

Geoindicators are measures (magnitudes, frequencies, rates, and trends) of geological processes and phenomena occurring at or near the Earth's surface and are significant in understanding environmental change over periods of 100 years or less. They do not apply to important earth processes that generally take place more slowly, such as diagenesis, metamorphism and deformation, and plate tectonic movements. Geoindicators can be used to monitor and assess changes in fluvial, coastal, desert, mountain and other terrestrial areas. They can also be used through paleoenvironmental research to unravel trends over the past few centuries and longer, thereby providing important baselines against which human-induced and natural stresses can be better understood.

Geoindicators describe processes and environmental parameters that are capable of changing without human interference, though human activities can accelerate, slow or divert natural changes. Humans are certainly an integral part of nature and the environment, but it is essential to recognize that nature and the environment are ever changing, whether or not people are present. Geoindicators focus on abiotic components of the landscape and the associated physical and chemical processes. However, biological and geological systems interact intimately in time and space, so that it is not possible to ignore living organisms. This is especially so when dealing with corals, deposits of organic origin such as peat and soil, the influence of animals and plants on weathering, erosion and deposition, or the role of microbiota which can play a mediating role in groundwater chemistry and karst processes.

Certain geoindicators can be regarded as 'high-level' or 'integrative' (indicators that group related but independent measures.) Other geoindicators are 'proxy' indicators that represent a myriad of other parameters on which they depend. Shoreline position is an example of a geoindicator that can act as a proxy for local sea level, coastal subsidence, or wave climate. Seismicity may be taken as a proxy for the release of earth stresses. An example of a 'high-level' geoindicator is frozen ground activity. This groups many important soil and surface processes and changes in permafrost areas, including frost heaving, thermokarst, and active layer thickness.

Some geoindicators have the capacity to record and store evidence of environmental changes. Examples include speleothem growth patterns (karst activity), ice layers, subsurface temperature regimes, lake sediment geochemistry, and corals. Though their main value is as paleoclimatic archives, they have an important application to long-term monitoring of environments where it is not possible, for reasons of cost, personnel or remoteness, to install recording instruments. Such geoindicators provide 'automatic recording stations' that can be invaluable as registers of contemporary environmental change, for they function without human intervention. Such natural recording stations can be sampled at intervals to determine how their environment has changed.

## Pre-Trip Organizational Meetings for Summer Utah Field Trip

There will be two pre-trip organizational meetings for this coming summer's two-week GSM field trip to the eastern Colorado Plateau country of Utah and Colorado. Meeting #1 will be held at 7 P.M. on Saturday, 17 March, 2001, at the home of Marlys and Alex Lowe, 2206 Caroline Lane, South Saint Paul, Minnesota. Meeting #2 will be held at 7 P.M. on Saturday, 12 May, 2001, at the same location.

Meeting #1 will include an introduction to the field trip, trip logistics and organization, a slide presentation, and distribution of a detailed list of suggested motels and campgrounds, along with selected state and city highway maps. (A nominal $2 is requested for duplication of this lodging directory.) Orders will be taken for those attendees who wish to purchase the more extensive field trip guidebook to be written by the trip co-leaders; guidebooks will be distributed at Meeting #2. The guidebook probably will cost somewhere between $15 and $20. Also, one or two publications will be suggested for field trippers to purchase individually. In addition, there will be a representative selection of other publications which trip participants may peruse and order on their own. Those attending the meeting will be encouraged to discuss possible car-pooling for the trip, since the field trip is run using private automobiles. Besides individual costs of food, transportation, lodging or camping, and the guidebook, there are no other costs for participating in the field trip for GSM members. (Non-members have a small additional charge.)

Meeting #2 will be devoted to distributing guidebooks previously ordered and answering any questions participants might have. (Note that Meeting #2 occurs about one month before the field trip itself, which is scheduled from Tuesday, 12 June, 2001, through Thursday, 21 June, 2001.)

You do NOT have to attend either pre-trip meeting to participate in the field trip. If you cannot attend either meeting, but still wish to go on the trip, please call either co-leader-Walt Blowers (651-645-3553) or Rick Uthe (763-522-5029).

Radon is a gas produced by the radioactive decay of the element radium. Radioactive decay is a natural, spontaneous process in which an atom of one element decays or breaks down to form another element by losing atomic particles (protons, neutrons, or electrons). When solid radium decays to form radon gas, it loses two protons and two neutrons. These two protons and two neutrons are called an alpha particle, which is a type of radiation. Radon itself also decays, losing an alpha particle and forming the element polonium.

Elements that are naturally radioactive include uranium, thorium, carbon, and potassium, as well as radon and radium. Uranium is the first element in a long series of decay that produces radium and radon. Uranium is referred to as the parent element, and radium and radon are called daughters. Radium and radon also form daughter elements as they decay.

The decay of each radioactive element occurs at a very specific rate. How fast an element decays is measured in terms of the element "half-life", or the amount of time for one half of a given amount of the element to decay. Uranium has a half-life of 4.4 billion years, so a 4.4-billion-year-old rock has only half of the uranium with which it started. The half-life of radon is only 3.8 days. If a jar was filled with radon, in 3.8 days only half of the radon would be left. But the newly made daughter products of radon would also be in the jar, including polonium, bismuth, and lead. Polonium is also radioactive - it is this element, which is produced by radon in the air and in people's lungs, that can hurt lung tissue and cause lung cancer.

**Uranium: The source**

All rocks contain some uranium, although most contain just a small amount - between 1 and 3 parts per million (ppm) of uranium. In general, the uranium content of a soil will be about the same as the uranium content of the rock from which the soil was derived.

Some types of rocks have higher than average uranium contents. These include light-colored volcanic rocks, granites, dark shales, sedimentary rocks that contain phosphate, and metamorphic rocks derived from these rocks. These rocks and their soils may contain as much as 100 ppm uranium. Layers of these rocks underlie various parts of the United States.

The higher the uranium level is in an area, the greater the chances are that houses in the area have high levels of indoor radon. But some houses in areas with lots of uranium in the soil have low levels of indoor radon, and other houses on uranium-poor soils have high levels of indoor radon. Clearly, the amount of radon in a house is affected by factors in addition to the presence of uranium in the underlying soil.

**Radon formation**

Just as uranium is present in all rocks and soils, so are radon and radium because they are daughter products formed by the radioactive decay of uranium. Each atom of radium decays by ejecting from its nucleus an alpha particle composed of two neutrons and two protons. As the alpha particle is ejected, the newly formed radon atom recoils in the opposite direction, just as a high-powered rifle recoils when a bullet is fired. Alpha recoil is the most important factor affecting the release of radon from mineral grains

The location of the radium atom in the mineral grain (how close it is to the surface of the grain) and the direction of the recoil of the radon atom (whether it is toward the surface or the interior of the grain) determine whether or not the newly formed radon atom enters the pore space between mineral grains. If a radium atom is deep within a big grain, then regardless of the direction of recoil, it will not free the radon from the grain, and the radon atom will remain embedded in the mineral. Even when a radium atom is near the surface of a grain, the recoil will send the radon atom deeper into the mineral if the direction of recoil is toward the grain's core. However, the recoil of some radon atoms near the surface of a grain is directed toward the grain's surface. When this happens, the newly formed radon leaves the mineral and enters the pore space between the grains or the fractures in the rocks

The recoil of the radon atom is quite strong. Often newly formed radon atoms enter the pore space, cross all the way through the pore space, and become embedded in nearby mineral grains. If water is present in the pore space, however, the moving radon atom slows very quickly and is more likely to stay in the pore space.

For most soils, only 10 to 50 percent of the radon produced actually escapes from the mineral grains and enters the pores.

**Radon movement**

Because radon is a gas, it has much greater mobility than uranium and radium, which are fixed in the solid matter in rocks and soils. Radon can more easily leave the rocks and soils by escaping into fractures and openings in rocks and into the pore spaces between grains of soil.

The ease and efficiency with which radon moves in the pore space or fracture effects how much radon enters a house. If radon is able to move easily in the pore space, then it can travel a great distance before it decays, and it is more likely to collect in high concentrations inside a building.

The method and speed of radon's movement through soils is controlled by the amount of water present in the pore space (the soil moisture content), the percentage of pore space in the soil (the porosity), and the "interconnectedness" of the pore spaces that determines the soil's ability to transmit water and air (called soil permeability).

Radon moves more rapidily through permeable soils, such as coarse sand and gravel, than through impermeable soils, such as clays. Fractures in any soil or rock allow radon to move more quickly.

Radon in water moves slower than radon in air. The distance that radon moves before most of it decays is less than 1 inch in water-saturated rocks or soils, but it can be more than 6 feet, and sometimes tens of feet, through dry rocks or soils. Because water also tends to flow much more slowly through soil pores and rock fractures than does air, radon travels shorter distances in wet soils than in dry soils before it decays.

For these reasons, homes in areas with drier, highly permeable soils and bedrock, such as hill slopes, mouths and bottoms of canyons, coarse glacial deposits, and fractured or cavernous bedrock, may have high levels of indoor radon. Even if the radon content of the air in the soil or fracture is in the "normal" range, the permeability of these areas permits radon-bearing air to move greater distances before it decays, and thus contributes to high indoor radon.

**Radon entry into buildings**

Radon moving through soil pore spaces and rock fractures near the surface of the earth usually escapes into the atmosphere. Where a house is present, however, soil air often flows toward its foundation for three reasons: (1) differences in air pressure between the soil and the house, (2) the presence of openings in the house's foundation, and (3) increases in permeability around the basement (if one is present).

In constructing a house with a basement, a hole is dug, footings are set, and coarse gravel is usually laid down as a base for the basement slab. Then, once the basement walls have been built, the gap between the basement walls and the ground outside is filled with material that often is more permeable than the original ground. This filled gap is called a disturbed zone.

Radon moves into the disturbed zone and the gravel bed underneath from the surrounding soil. The backfill material in the disturbed zone is commonly rocks and soil from the foundation site, which also generate and release radon. The amount of radon in the disturbed zone and gravel bed depends on the amount of uranium present in the rock at the site, the type and permeability of soil surrounding the disturbed zone and underneath the gravel bed, and the soil's moisture content.

The air pressure in the ground around most houses is often greater than the air pressure inside the house. Thus, air tends to move from the disturbed zone and gravel bed into the house through openings in the house's foundation. All house foundations have openings such as cracks, utility entries, seams between foundation materials, and uncovered soil in crawl spaces and basements.

Most houses draw less than one percent of their indoor air from the soil; the remainder comes from outdoor air, which is generally quite low in radon. Houses with low indoor air pressures, poorly sealed foundations, and several entry points for soil air, however, may draw as much as 20 percent of their indoor air from the soil. Even if the soil air has only moderate levels of radon, levels inside the house may be very high.

**Radon in water**

Radon can also enter homes through their water systems. Water in rivers and reservoirs usually contains very little radon, because it escapes into the air; so homes that rely on surface water usually do not have a radon problem from their water. In big cities, water processing in large municipal systems aerates the water, which allows radon to escape, and also delays the use of water until most of the remaining radon has decayed.

**Geologic maps**

A geologic map shows the type of rocks and geologic structures in a specific area. Because different types of rocks have different amounts of uranium, a geologic map can indicate to a geologist the general level of uranium or radium to be expected in the rocks and soils of the area. Such maps are especially important in showing where rocks with high levels of uranium occur.

Because radon that enters buildings usually comes from the upper several feet of the earth's surface, knowing the radon levels of the near-surface (surficial) materials is important. Surficial geologic and engineering maps show and describe these surface materials for many parts of the United States. These maps are useful for understanding the physical properties of the materials at the surface, like permeability, but are generally not as useful for determining what the uranium concentrations in the surface materials might be.

## NOTES OF AN ALCHEMIST

**By Loren Eiseley**

Crystals grow under fantastic pressures in the deep crevices and confines of
the earth. They grow by fires, by water trickling slowly in strange solutions
from the walls of caverns.
They form in cubes, rectangles, tetrahedrons,
they may have their own peculiar axes and molecular arrangements
but they, like life, like men,
are twisted by
the places into which they come.

I have only to lift my hands to see the acid scars of old encounters.
In my brain, as in the brains of all mankind, distortions riot
and the serene quartz crystal of tomorrow is
most often marred by black ingredients caught blindly up,
but still, no one knows surely why specific crystals meet in a specific order.
Therefore we grasp two things:
that rarely two slightly different substances will grow
even together but the one added ingredient will transfigure
a colorless transparency to midnight blue or build the rubies' fire.
Further, we know that if one grows a crystal
it should lie under the spell of its own fluid
be kept in a cool cavern
remote
from any violence or intrusion from the dust.

So we, our wise men in their wildernesses have sought to charm to similar translucence
the cloudy crystal of the mind. We must then understand
that order strives against the unmitigated chaos lurking
along the convulsive backbone of the world.
Sometimes I think that we in varying degrees are grown
like the wild crystal, now inert, now flashing red,
but I within my surging molecules
by nature cling to that deep sapphire blue that marks the mind of one
long isolate
who knows and does reflect starred space and midnight,
who conceives therefore that out of order and disorder
perpetually clashing and reclashing
come the worlds.
Thus stands my study from the vials and furnaces
Of universal earth. I leave it here
For Heracleitus if he comes again
In the returnings of the Giant Year.

# IN MEMORIAM

Dr. Kerry Kelts, a researcher and professor in the University of Minnesota's department of geology and geophysics, died Thursday morning, Feb. 8, 2001 after an eight-year battle with Hodgkin's disease. Ke Its, who was 5 5, worked 10 years in the department helping make the University's Linmological Research Center internationally recognized.

"Kerry can be considered the father of a field, a new branch of geology called geolimnology," said Tom Johnson, director of the Large Lakes Observatory at the University of MinnesotaDuluth. "He was full of enthusiasm and great ideas on how to advance the science."

Kelts traveled around the world studying lakes in the Middle East, Africa, Europe and South America, analyzing the clues their sediments held. He was probably one of the world's authorities on reconstructing environment and climate by studying lake sediments.

Kelts was born in California and received a bachelor of arts degree in geophysics from Universi of California-Riverside. He earned his master's and PhD. from the Geological Institute of the Swiss Federal Institute of Technology (ETH-Zurich).

Kelts came to the University in 1990 interested in using techniques and methods from ocean study and applying them to lakes.

He helped design a floating drilling platform, allowing scientists to take deeper core samples from lake bottoms.

## How did Geology Get Started?
## Chas Brennecke

Let's summarize what we know today about the beginnings of terrestrial geology. Of course, no one can take a video camera and go back to recapture the actual series of events that formed this planet. But the availability of advanced telescopes and long-base-line interferometers make it possible for us to look at other star systems and observe the stages they pass through. Naturally, each one is unique; but we can at least form a general idea of how it all got started.

We began as a huge cloud made up principally of hydrogen ions, various molecular combinations of carbon, hydrogen, oxygen, sulfur and other trace minerals. Add to this brew "dust," tiny particles left over from the explosions of stars and the debris of collisions of solid bodies; the ashes, if you will, of previous star systems. These clouds, even though they are a thousand times less dense than the finest vacuum we can create here on earth, are enormous—a typical cloud has a mass thousands of times greater that our entire solar system. Think of a cumulus cloud forming over a hot prairie on a summer day and you will have a pretty good approximation of it's appearance. Imagine it being driven through the air by the wind, and shaped by the various thermals it crosses in its travel, and that will help you picture our interstellar cloud being driven by the outpouring of radiation from nearby stars and shaped by the competing forces that interact with it.

One of the most influential of these forces is the shock wave from exploding stars - novae and super-novae. Shock waves transmit large impulses of energy into the cloud; the right combination of injected energy, perturbations already existing in the cloud, and clots of different densities in the cloud may get a vortex started. Take a pan of boiling water on your kitchen range, with the tiny bubbles just beginning to form on the bottom and find their way to the surface. Add energy to it the system by stirring it with a spoon, and see how quickly the little chains of bubbles form vortices.

The vortex forms a concentration of mass and rotational energy, and this concentration attracts other masses - more clumps of cloudlets. Typically, the in-falling material adds angular momentum and the cloud begins to rotate about the largest concentration of mass. Since most star systems are multiples (few are single stars, like the sun) there may be two or more mass concentrations.

There's a lot more! But wse'll get to that later!

# ILSG 2001 ANNUAL MEETING

The 47th Annual Institute on Lake Superior Geology will be held on Thursday May 10 and Friday May 11, 2001 at the Sheraton Madison Hotel, Madison, WI. This two-day technical session (May 10 and 11) will be sandwiched between Pre-(May 9) and Post-meeting (May 12) Field trips.

The Institute on Lake Superior Geology was founded in 1955 "to provide a means whereby geologists in the Great Lakes region may exchange ideas and scientific data; to promote better understanding of the geology of the Lake Superior region, and to plan and conduct geological field trips". Since the founding of the organization, interests of researchers in the region have evolved from Precambrian geology and mineral deposits to include Paleozoic and Pleistocene geology and environmental geochemistry. The 47th Annual Meeting will focus on hydrogeologic aspects of trace elements in groundwater, notably arsenic; completion of acquisition of detailed regional geophysical data; and the nature and occurrence of unique geologic units in the region, notably the Baraboo Quartzite and related units. Other topics of interest to the regional geology will also be covered. Any interested parties, geologist or not, may attend the technical sessions, field trips, or both.

For additional information visit <http://www.ilsgeology.org/2001mtg.html>
or send inquires to:
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