GEOLOGICAL SOCIETY OF MINNESOTA

N E W S

SUMMER 2002
VOLUME LVII NO. 2
http://www.geo.umn.edu/orgs/gsm/

2002 FIELD TRIPS

The Field Trip committee has been busy! They have scheduled three 2-day field trips, and one 1-day field trip for 2002. The first trip is coming up on May 18th. Everyone should have already received the notice in the mail. Complete details, times, meeting points, etc. are always mailed to members a couple of weeks before the trip. Check out the back cover for the lineup. And watch your mailbox for details as the scheduled dates draw near. Mark your calendars!

FASCINATING GEOLOGY OF MINNESOTA: FROM Agates TO Zeolites

Just wait until you see the outstanding Lecture Series we have coming up for the 2002-2003 season! The Program Lectures and Labs committee has put together a lineup of presenters that reads like a "Who's Who of Minnesota Geology". If you have not been in the habit of attending lectures in the past, you may want to pay close attention to this series. It is not to be missed.

The Lecture Series Schedule will be published in the next issue of GSM News (Aug. 15th), so you'll have to wait until then. But here's a tiny hint: if you've ever read works by Richard Ojakangas or John Green, and wished you could ask questions in person, you are going to be pleasantly surprised.

AGATE CENTER CONSTRUCTION BEGINS

Moose Lake State Park broke ground on Saturday, April 6, for a summer-long project that began the construction of the Moose Lake Agate/Geological Center, which is expected to be completed this fall.

The 4,500-square-foot Agate/Geological Center will include interpretive displays, a multi-purpose classroom, nature store gift shop, park offices, a resource workroom, restrooms and an exhibition hall that will showcase Minnesota's gemstone, the agate. When completed, visitors will be able to view exhibits and attend programs that focus on the rocks, minerals and geology of Minnesota.

A centerpiece of the new facility will be an entrance area floor inlay that will be fashioned in the shape of the state of Minnesota. Stone inlays will be set in geographic areas of the state that reflect the type of rock indigenous to the area.

Moose Lake State Park, and the future Agate/Geological Center can be found by exiting I-35 at Exit 214; then head east on County Road 137 to the park entrance.~

Announcements

May 18th – Field Trip, Rochester Area

June 15-16 – Field Trip, Wis. South Shore

July 27-28 – Field Trip, SW Minnesota

Aug. 4-11 – Keweenaw Week, Houghton, MI

Aug. 22 – State Fair Begins

Sept. 7-8 – Field Trip, Minnesota No. Shore

GSM *NEWS*
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The purpose of this newsletter is to inform 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. GSM *NEWS* 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:* GSM c/o Katy Paul, 6901 West 84th St., #351, Bloomington, MN 55438, phone/e-mail listed above.

Officers: Steve Erickson, *President*; Paul Martin, *Vice President*; Ted Chura, *Treasurer*; Judy Hamilton, *Secretary*.

Directors: In addition to the officers listed above: Gail Marshall; Rose Mary O'Donovan; Katy Paul; Bill Robbins, Nina Ward

Send all GSM membership dues, change of address cards, and renewals to the GSM Membership Chair: Gail Marshall, 12232 Allen Drive, Burnsville, MN 55337 phone 952-894-2961. Membership levels are: $10 Full-Time Students; $20 Individuals, $30 Families

News from the Board…

Greetings!

I am very pleased at the end of this lecture set, for the year 2001-2002. This had started with something of a disaster, with the State Employees strike, causing some quick reworking of the schedule. We had to cancel one lecture due to bad weather, but still, we managed to cover a lot of very interesting topics this year. I am pleased with the turnout to the lectures, but, I still don't think we are reaching all the people who would have liked to have heard these seminars. The board has talked repeatedly about how to get the message out to the general public about our mission and our activities. I am always open to suggestions. One of the most important points of contact with the general public is our booth at the Minnesota State Fair. We need volunteers to man the booth. You do not need to be a geologist to do this. We do not attempt to be the source of "Geo-wisdom" at the fair. All the volunteers do is promote the organization. Please call me if you are interested in participating in meeting the public and/or setting up the booth. When I first did this, I thought it might be boring to stay in one space for a four hour shift. It turned out to be a lot of fun, and I met some old friends who walked by.

This summer looks like we will have a great set of field trips. My thanks to the members of the field trip committee for all their hard work. I hope all of you can get away for as many of these trips as you can. Please be prepared to team up with other members of the group to car pool. This is a great way to meet new people and this makes the trip operate more smoothly.

Steve Erickson
President

COLOSSAL CRYSTALS

In April 2000, Eloy and Javier Delgado were blasting a new tunnel, 1,000 feet down in the silver and lead Naica Mine of southern Chihuahua, Mexico. Eloy climbed through a small opening and found a 30- by 60- foot cavern choked with immense gypsum crystals, the length and girth of mature pine trees. He said that the sight was beautiful "…like light reflecting off a broken mirror". The translucent crystals lie pitched atop one another, as though moonbeams suddenly took on weight and substance. One month later, another team of Naica miners found an even larger cavern adjacent to the first one.

Officials of the Penoles Company, which owns the mine, kept the discoveries secret out of concern about vandalism. Not many people, however, would venture inside casually: the temperature hovers at 150 degrees, with 100 percent humidity. A person can stay inside the cave for only six to ten minutes before becoming disoriented.

Geologists conjecture that a chamber of magma, lying two to three miles underneath the mountain, forced mineral-rich fluids upward through a fault into openings in the limestone bedrock near the surface. Over time, this hydrothermal liquid deposited metals such as gold, silver, lead and zinc in the limestone bedrock. These metals have been mined here since prospectors discovered the deposits in 1794 in a small range of hills south of Chihuahua city.

In a few caves the conditions were ideal for formation of a different kind of treasure. Groundwater in these caves, rich with sulfur from the adjacent metal deposits, began dissolving the limestone walls, releasing large quantities of calcium. This calcium, in turn, combined with the sulfur to form crystals on a scale never before seen by humans.

In addition to 4-foot diameter crystal columns 50 feet in length, the cavern contains row upon row of shark-tooth-shaped formations up to 3 feet high, which are set at odd angles throughout. This crystal form of the mineral gypsum, is known as selenite, named after Selene, the Greek goddess of the moon. The superintendent at the Naica mine has speculated that under perfect conditions, the crystals would have taken between 30 to 100 years to grow. Previously, the world's largest examples of selenite crystals came from a nearby cavern discovered in 1910 within the same Naica cave complex. Several examples of these large crystals are exhibited at the Smithsonian Institution's National Museum of Natural History.

Until April 2000, mining officials had restricted exploration on one side of the fault out of concern that any new tunneling might lead to flooding of the rest of the mine. Only after pumping out the mine did the level of water drop sufficiently for exploration. Everyone who knows the area is now anxiously awaiting the possible discovery of new caverns with even more fantastic crystal formations.

~Excerpted from *Smithsonian Magazine*, April 2002

GROUND BREAKING FOR UM EARTHQUAKE TESTING FACILITY

>Wielding shovels to break ground for the U of M's new earthquake testing facility on the Minneapolis campus are: President - Mark Yudof, Vice President for Research - Christine Maziar, Institute of Technology Dean - Ted Davis, and University faculty involved in the research.~

The University of Minnesota began construction in February of a new facility to test structures for their resistance to earthquakes and other high-stress forces. (See GSM News, Summer 2001)

The Multi-Axial Subassemblage Testing (MAST) system was funded by the National Science Foundation through a four-year, $6.5 million grant to the university's civil engineering department. Dr. Catherine French, who conducted a tour of the university's existing testing facilities for GSM members last year, is the principal investigator on the project, along with Dr. Arturo Schultz.

The U of M's MAST facility will become part of the nationwide Network for Earthquake Engineering Simulation (NEES), a network of 12 similar facilities nationwide conducting research on structural components of buildings. The facilities will be linked by the internet, allowing researchers from around the world to obtain data from, or participate in, experiments at any other NEES facility. The goal of the NEES project is to allow earthquake engineering researchers to work on integrated physical models, databases and model-based simulation rather than isolated physical experiments.

The MAST testing system incorporates 10 hydraulic cylinders capable of delivering up to 880,000 pounds of force in both horizontal directions while simultaneously delivering 1.3 million pounds of force vertically. No other testing facility can so closely simulate earthquake forces, according to French and Schultz.

~Tom Smalec

GROUNDWATER – Carver County, Minnesota, Part I in a Series

by Bruce Goetteman

At the time this picture was taken, bedrock was a limiting factor when dipping a well. This 1920s photograph gives literal meaning to the term "confining rock layer". Bedrock type and depth determined, in large part, whether or not a parcel of land was suitable for a homestead. The setting for this photograph is in Stearns County, Minnesota.

Closer to home, in Carver County, Minnesota, I have had the privilege of contributing to the development of a groundwater protection plan for the County. This experience has allowed me to gain insight and thus be able to provide a general overview of the hydrogeologic structure of Carver County.

The settlement of Carver County in the 1840s & 50s created a demand for water supply which was safer than that found in the rivers and lakes. Wells were needed. While other technology existed, the typical well was constructed by hand digging, and lining the well with brick, stone, or wood. These wells utilized the water table aquifer. Consequently, they were highly susceptible to contamination from any number of sources.

As the supply of water in the water table aquifer was depleted, became contaminated, or was not sufficient to meet demand, deeper wells were constructed using technologies such as cable tool, jetting, hollow rod, and other techniques. These well designs were less likely to become contaminated than the previously dug wells. In addition to deeper wells, the newer technologies permitted a deeper understanding of the geologic structure of the County.

Carver County is part of a geologic structure called the Hollandale Embayment, which formed as a result of erosion, sedimentation, and the rise and fall of ancient seas. In brief, these actions resulted in a sedimentary deposition of rock over 1,000 feet deep that covers older sedimentary and igneous rocks. The significance of this formation for groundwater planning is that, along with the glacial drift, it makes up the groundwater system in Carver County.

The uppermost layer in the system is the glacial drift, which covers the entire county at depths from 100 to over 500 feet. Repeated advances and declines of glaciers over the last two million years deposited drift. The last of these deposits is likely from the Wadena and Des Moines lobe advances that occurred during the Wisconsin glaciation 75,000 to 12,000 years ago. Glacial drift consists of two types of sediment: till and outwash.

Till is unconsolidated (mixed) material consisting of varying portions of clay, silt, sand, gravel, and boulders. The composition of the mixture can affect the transmission of the groundwater through the system. Till that tends to be clayey will transmit water more slowly than till with high percentages of sand and gravel. In some areas of the county, very heavy deposits of clay occur which severely limit the transmissivity of water. While till in an area may be clayey, there will typically be sand and gravel lenses which can greatly affect the flow of water through the drift layer making localized flow of groundwater extremely variable.

Outwash is sand and gravel material that has been deposited by a stream or river. It is highly permeable and will transmit water at a high rate. Areas closer to the Minnesota River show large amounts of outwash deposited from the glacial River Warren. The development where I reside is situated on one such area.

Carver County has more than 4200 homes served by on-site wells. Approximately 3000 of these wells have been constructed since 1975, when the Well Log program was initiated. Examination of the Minnesota Geological Survey and local databases indicated that over 30 percent of the wells are finished in drift. All of the residential wells in my neighborhood are in outwash.

Next time: Part II will explore the Bedrock Strata in Carver County and their relationship to groundwater.

Text of the Geological Marker which will be Located in Fillmore County, within Fountain City Park and adjacent to Highway 52.

GEOLOGY OF SINKHOLES

The surrounding area and much of southeastern Minnesota are karst landscapes. Minnesota's karst landscapes consist of limestone and dolostone bedrock that lies very close to the surface. This carbonate bedrock is often riddled with features eroded by slightly acidic water: sinkholes, passageways, extensive underground water systems, and caves.

Rainwater becomes slightly acidic by absorbing carbon dioxide in the atmosphere, and if it seeps through the soil, by absorbing the carbon dioxide given off by plant roots, bacteria, and other organisms. Over time, this water following bedrock joints, or fractures, dissolves the carbonate rock and gradually enlarges the passageways. A system of underground drainage will develop that bypasses the surface drainage pattern. Sinkholes are inlets to that system.

A sinkhole may begin to develop where joints in the bedrock intersect and the downward flow of water is more rapid. Over time, a funnel-shaped cavity often forms in the rock. Infiltrating surface water erodes the soil and moves it down the hole, thus forming a pronounced depression in the ground. When erosion into the subsurface is slow, sinkhole formation is also a slow, gradual process. When erosion is rapid, a sudden collapse of overlying sediment can occur. Sinkholes sometimes collapse suddenly after heavy rains. A sinkhole may become temporarily closed as newly collapsed sediment clogs the passageway.

In a karst landscape, water flowing into sinkholes bypasses the natural filtering action of a lengthy percolation through thick soil and sediment layers. Once in the bedrock, water can move rapidly through a complex system of passageways at rates as high as several kilometers per day. Using dye to color the water, scientists have shown that water entering this sinkhole emerges in about a day at the headwater springs of Trout Creek, about two kilometers northwest of here.

In karst terrains, bedrock aquifers, a common source for drinking water, are susceptible to rapid contamination from activities on the surface of the land. Likewise, water quality in spring-fed streams, which mark the end point of underground drainage in a karst landscape, may also be affected.

Erected by the Geological Society of Minnesota in partnership with the Minnesota Department of Transportation and the Minnesota Geological Survey
2002
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National Cave and Karst Research Institute

Caves and karst systems support fragile ecosystems, contain mineralogical resources, and are important water supply sources. Improved knowledge of caves and karst systems leading to improved protection and management is important to ecosystem and public health and to sustainable economic development. Several congressional acts have addressed the need for inventories of cave and karst resources and the need to have a scientific basis for cave and karst management.

In October 1998, Congress passed the National Cave and Karst Research Institute Act that mandated the National Park Service to establish and operate the institute. The act stipulated that the institute be located in the vicinity of Carlsbad Caverns National Park in New Mexico (but not inside park boundaries), and that the institute cannot spend federal funds without a match of private funds.

The interim director for the National Cave and Karst Research Institute reported in July 2000 for a two-year period to move forward with National Park Service efforts to establish the institute by defining the purview and scope of operation, designing an organizational structure, forming partnerships, finding funding sources and a physical facility, and defining research needs. The institute will pass through several phases before it fully reaches the capacity to sponsor a wide range of activities. The fully operational phase should be attained by 2006, when the institute becomes a significant and recognized resource in cave and karst research, education, and support of cave and karst management.

SINKHOLE DYNAMICS

Geologists classify sinkholes based on their geometry and how they developed. Understanding sinkhole dynamics is critical to detecting and mitigating damages these karst features can cause.

Collapse sinkholes occur when the bridging material over a subsurface cavern cannot support the overlying material. The cover collapses into the cavern and a large, funnel-shaped depression forms.

Solution sinkholes result from increased groundwater flow into higher porosity zones within the rock, typically through fractures or joints within the rock. An increase of slightly acidic surface water into the subsurface continues the slow dissolution of the rock matrix, resulting in slow subsidence as surface materials fill the voids.

Alluvial sinkholes are older sinkholes that have been partially filled with marine, wetland or soil sediments. These features are common in Florida, where the water table is shallow, and typically appear as shallow lakes, cypress "domes" and wetlands.

Raveling sinkholes form when a thick overburden of sediment over a deep cavern calves into the void and pipes upward toward the surface. As the overlying material or "plug" erodes into the cavern, the void migrates upward until the cover can no longer be supported and then subsidence begins.

Grike: A dissolution groove or trench formed along vertical bedrock fractures beneath soil, commonly wider than a solution fissure. Also known as a cutter, or karren.

FIELD TRIPS – 2002

May 18th — **Hydrogeology of the Rochester and Surrounding Areas**
*Leaders: Tony Runkel and Robert Tipping, Minnesota Geological Survey
The Jordan Sandstone and Prairie du Chien Dolomite bedrock layers will be the focus of this one-day trip. Stops will provide opportunities to examine exposures of these formations. Discussion topics will include groundwater systems, surface water, karst terraines, etc.

June 15-16 — **Wisconsin South Shore Geology**
*Leader: Tom Fitz, Northland College, Ashland, Wis.
This trip will begin in the Superior, Wis. area and work East from there. Several Wisconsin State Parks will be visited.

July 27-28 — **Geologic Highlights of SW Minnesota**
*Leader: Dale Setterholm, Minnesota Geological Survey
The participants in this field trip will examine Precambrian rocks of the Minnesota River valley, the Sioux Quartzite and catlinite (pipestone) beds, and glacial features. Stops will include the Pipestone National Monument and the Jeffers Petroglyphs.

Sept 7-8 — **Minnesota North Shore Geology**
*Leader: Jim Miller, NRRI
The Gunflint Trail has a wonderful cross section of everything – gabbro, mid-continent rift, Mesabi iron formation, Copper-Nickel base of the Duluth complex, and more. We will explore this area on the first day of the trip, beginning in Grand Marais, and will work our way down to Beaver Bay at the end of day 2.

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MINNEAPOLIS, MN PM 13 MAY 2002

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