



**GEOLOGICAL
SOCIETY OF
MINNESOTA**

NEWS

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<http://www.gsmn.org>

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Please thank these members for their service to the organization when you speak with them.

Outreach News



Girl Scouts at Lilydale Brickyards

In September, twenty-four eighth-grade Cadette Girl Scouts from Maple Grove participated in a day of activities at Lilydale Brickyards in St. Paul. The girls earned the *Digging in the Past* interest patch by learning about rock formations present in the park, the tools used in excavating fossils, careers in Earth science, and the education needed for a career in science. The girls dug, collected, and identified fossils at the site.

Kirk Carter, Mona of Warner Nature Center, and Sara Wilson from Association of Women Geoscientists as well as Megan Jones, geology professor at North Hennepin Community College, provided the expert instruction for the field experience. The GSM Outreach Committee facilitated the link between the Girl Scout leader/coordinator Pam Dominick and two of those who led the field work.

ANNOUNCEMENTS

Correction to list of lectures:

Feb. 27 Peter Hudleston, "Geology Tour of the British Islands"

Mar. 6 Carrie Jennings, "Geology Along the Ring Road in Iceland"

Mar. 27 Al Pekarek, "A Challenging Future for Petroleum"

April 17, Harvey Thorjefson, "The Search for Diamonds in Canada"

Place lectures are held:

EE/Csci 3-230 at the University of Minnesota East Bank campus, Minneapolis. Building is at the corner of Union and Washington. Parking ramp is adjacent across Union. For map, go to the website: www.gsmn.org, click on Winter Lectures, and then "Map to Lecture."

GSM NEWS

Editor:

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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 (up to 500 words long) and photographs.

Deadline for article submission is three weeks before the date of publication. Contact the editor if you have something to submit.

OFFICERS:

Roger Benepe, *President*
Janet Hopper, *Vice President*
Dorothy Kuether, *Secretary*
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Directors in addition to the officers listed above: Cindy Demers, Bill Farquhar, Kate Hintz, Gerald Paul, and Sandy Steffner.

Send all GSM membership dues, change-of-address cards, and renewals to:

Gail Marshall, *GSM Membership Chair*
12232 Allen Drive, Burnsville, MN 55337
phone: (952) 894-2961

GSM is a 501(c)3 nonprofit organization. Membership levels are:

\$10 Full-Time Students;
\$20 Individuals,
\$30 Families

website: <http://www.gsmn.org>
Additional donations are always appreciated!

FROM THE DESK OF THE PRESIDENT

Hello all,

We are in the second half of this year's lecture series. The first half went very well with great attendance. I expect that the second half will go as well as the first half did.

The field trip committee recently met and has proposed several wonderful trips.

The first field trip is to the North Shore, to be led by Professor Ojakangas. This will take place on the 19th - 21st of May, 2006. For further information, contact Bill Robbins.

The second will be a half-day trip to the Lilydale Brickyards, the former site of the St. Paul Brick Company along the riverflats in St. Paul. There, we will be looking at recent history and ancient history. This trip will be lead by Steve Erickson and myself. The permit will allow collection of fossils at the site. Children accompanied by an adult are welcome to attend, so plan to bring the family.

The third trip is to northeastern Iowa. Details are still in the works for this one; possible dates are late August to early September.

We are still in the planning stages for next year's lectures, so if there is something special that you would like to hear, please let myself or Steve Erickson know.

Looking forward to seeing all of you at the next lecture,

Roger Benepe
President, GSM

New Editor...

More words cannot express our gratitude to outgoing editor Katy Paul for her consistent, timely, and dedicated work on the newsletter over the course of many years. Katy will still write some articles, and will assist me as I get oriented to my new job these first few times, but she is free of the major responsibility which is what she wanted. I will keep things much the same, and then gradually add a few new features. Ideas are welcomed.

Please consider contributing articles on geological topics. These ideas are not meant to be limiting:

- *Areas/topics of interest to you
- *Descriptions (and photos) of field trips
- *Locations of geological significance to members
- *Trips you have taken to other countries/geological features there

As always, the editor reserves the right to edit or reserve the article for future use. Send submissions to me via e-mail at: ahler002@umn.edu

-Kathy Ahlers

Hints of natural gas reserves make Minnesota a potential future target for gas exploration

Contributed by Harvey Thorleifson,
Minnesota Geological Survey

The State of Minnesota is encouraging the growth of economically significant and environmentally responsible resource industries in the State. The Minnesota Minerals Coordinating Committee therefore is promoting awareness of the potential for natural gas production from the Midcontinent Rift in Minnesota. Although there has previously been speculative and unsuccessful exploration for oil and gas in the Phanerozoic rocks of the State, this play would target older Precambrian rocks of southeastern Minnesota. Recent world-class natural gas discoveries in Siberia have demonstrated the potential in a similar setting.

The 1995 USGS National Oil and Gas Assessment (Palacas, 1995) indicates that the hypothetical Precambrian Midcontinent Rift System Play consists of possible oil and gas accumulations in structural and stratigraphic traps within the 800 mile long Midcontinent Rift System. Gravity and magnetic surveys indicate that this middle Proterozoic, 1.1 billion year-old rift extends from Kansas to Lake Superior, and south to Michigan. Broad, transverse-faulted medial volcanic horsts are bounded by high-angle faults and flanked by asymmetric sedimentary basins up to 30,000' thick, while basins up to 6500' thick occur atop the horsts.

Structural and stratigraphic traps may have formed by crustal extension and sedimentary facies distribution, while tectonic inversion late in rift development likely produced compressional and wrench structures. Primary targets would be fluvial, deltaic, and shoreline sandstones of the Nonesuch Formation and the underlying upper Copper Harbor Conglomerate, both with porosities up to 13%. Fractured shales also occur in the Nonesuch Formation, and sandstones with porosities up to 18% occur in the overlying Freda Sandstone.

Nonesuch Formation shales up to 700' thick contains up to 3% total organic carbon (TOC) by weight, and live oil seeps in the White Pine Copper Mine in Michigan confirm that liquid hydrocarbons have been generated. Kerogens are type II and type I, and moderately mature T_{max} values of 435-440°C have been determined. Although the organic matter is oil prone, gas is the more likely target due to the typical degree of thermal maturity.

During extensional tectonism, the Nonesuch Formation and equivalents may have generated oil and

gas, especially in the deeper portions of the basins, prior to compressional tectonism. In the shallower portions of flanking basins, a second phase of oil and gas generation probably occurred following deposition of Paleozoic sediments. In addition, hydrocarbons that might have accumulated during initial rifting may have re-migrated into structures formed during compression.

Dual stages of tectonism would have produced a broad range of trapping conditions, with varying styles of fault-related structures. Tectonic inversion may also have created structural features of varying scale that could contain giant accumulations of hydrocarbons. In Minnesota, seismic reflection has documented large anticlinal features, while drag folds against reverse faulting offer multiple reservoir possibilities. Stratigraphic traps also likely occur. Probable seals include shales of the Nonesuch Formation, as well as tight horizons in the overlying Freda Sandstone and Bayfield Group. Fault gouge may also account for some seals.

Only five wells have penetrated the lower Keweenaw Supergroup rocks that have the highest potential for hydrocarbon reserves. No commercial oil or gas accumulations have been confirmed. Drilling in the 1980s at sites from Kansas to Michigan was stimulated by increasing awareness of source rock potential and oil seeps; as well as improved knowledge of large reserves in other rift basins such as the North Sea, Gulf of Suez, and Pripyat Basin, as well other Precambrian terranes such as the Lena-Tunguska Petroleum Province of Eastern Siberia, the Sichuan Basin of southern China, and the Upper Proterozoic Huqf Group of Oman.

The rift is regarded as a high risk play by USGS because few wells have been drilled, potential source rocks are known to be or may be overmature (and hence the gas may largely have been driven off by excessive heat and pressure), and because reservoir porosities in some regions may be unfavorable. However, it seems reasonable to speculate that source rocks may have more favorable levels of thermal maturity if present at shallower depths of burial along the basin flanks. Drilling depths would vary from 3,000' to as much as 25,000'.

It is conceivable that a major hydrocarbon producer may take an interest in Minnesota, and may spend tens of millions of dollars doing so, if the people of Minnesota chose to authorize a go-ahead for exploration through the customary permitting procedure. Many Minnesota residents would be pleased to see the direction of flow in gas pipelines reversed should success ensue!

Reference: Palacas, J.G. 1995. Superior Province. United States Geological Survey National Oil and Gas Assessment;
<http://energy.cr.usgs.gov/oilgas/noga/index.htm>

PRESENTING...

North Shore Field Trip MAY 19 - 21, 2006

Trip Leader:

Professor Richard Ojakangas
University of Minnesota, Duluth, MN

BASIC ITINERARY

Leaving the Twin Cities by bus at 4 p.m., Friday, May 19, traveling to Duluth Lake shore Canal Park Inn and staying over Friday night. Leaving at 8 a.m. and traveling along the North Shore, staying at the Grand Portage Casino Hotel over Saturday night, and returning to the Twin Cities on Sunday evening, May 21.

WHAT WE'LL SEE, HEAR AND DO

We should see many signature "textbook" rock formations, vesicular and amygdaloidal rocks, waterfalls galore, and have a few opportunities for collecting. An extra perk: stories of Ojakangas' life living in Northern Minnesota, from his childhood to the present—growing up on a farm on the Iron Range, his worldly travels, etc. On the Iron Range trip, his personal stories brought out the richness and character of the area. Also, trip participants might bring books written by Prof. Ojakangas to be autographed by him.

COSTS

The total cost will be approximately \$115 to \$120 assuming double occupancy, not including food or tips. (For food, plan on 2 or 3 dinners, 2 lunches, and 2 breakfasts.) Of this, \$50 pays for leader and bus combined, assuming a full bus of 54 people; and \$65 to \$70 per person pays for the two

hotel nights combined, assuming double occupancy.

Not included are food and tips—for the bus driver, for people who serve food (if not a buffet), possibly tips left in rooms, and, for those few who bring or take home the kitchen sink, luggage handlers and rock movers. People could join the trip in Duluth and we might be able to accommodate people wishing to stay in State Parks.

RULES

There will be no smoking nor consumption of alcohol on the bus.

If you are interested in participating, please contact Bill Robbins as soon as possible.

651-739-1146

robbs.wb@comcast.net

SEEK and Ye Shall Find

by Doug Zbikowski

SEEK is Minnesota's web-based interactive directory of environmental resources. ('SEEK' is an acronym for Sharing Environmental Education Knowledge.) GSM, through the Public Service and Publicity Committee, has recently become a partner with SEEK (membership is free). Check out the SEEK web site at: <http://www.seek.state.mn.us>.

From SEEK's home page, if you click on the calendar feature, you will see a chronological list for the near future that includes our upcoming seminars. Just click on an event to get more info. Links are active; try clicking on the vita of one of our speakers. If you want to see a complete list of GSM categories, from the home page, click on partners and then select GSM from the resulting list. Also, SEEK is completely searchable—from the home page, try searching for "geology." As the results show, GSM is a major player in the field.

Presently, SEEK isn't well known (about 2,000 hits/day), but as use increases, it could help to make our activities more accessible to the public.

Book Reviews
by Paul Martin

Catastrophic Consequences

A popular take
on geologic catastrophes:
Simon Winchester

Simon Winchester, an Oxford-trained geologist, has written two popular geology books in the last three years. By "popular," I mean that most people who have an interest in geology and its implications for the world will find the books comprehensible and usually engrossing. Professional geologists who want all the technical details will learn much, but may be annoyed by the large number of pages devoted in both books to social-historical background and social implications of these geological events. Both of these books are written for people like members of GSM, and I think you will enjoy them. ~Paul Martin

The books are:

*Krakatoa, The Day the World
Exploded, August 27, 1883* (c. 2003)

Most of us have heard about the great 1883 explosion that leveled the island of Krakatoa in what is now Indonesia. Reading this book gives you the chance to find out how it happened, what people experienced firsthand, and what the immediate and long-term aftermaths were. The book has 384 pages of narrative, plus 31 pages of recommendations for (and in one case, against) extra reading, and an index.

Warning: the second map, showing the eastern side of Sumatra and western edge of Java, is hard to decipher. (I'm being polite.)

A Crack in the Edge of the World
(c. 2005)

This is a comprehensive description of the 1906 San Francisco earthquake and the ensuing fire which destroyed a large part of the city. The book is 385 pages of narrative, plus 80 pages of appendix. It includes brief descriptions of basic and not-so-basic geological jargon: tectonic

plate theory, subduction, and of course strike-slip faults. As in "Krakatoa," Winchester gives us a large measure of the human side of the tragedy. Who were the heroes, and who weren't? How did the quake and fire give an important boost to one of the largest religious movements in the world today, and what did the San Francisco and Californian politicians, and their commercial allies (namely the Southern Pacific Railroad) do to emphasize the importance of the fire rather than of the quake?

The book includes interesting descriptions of the author's trip around the North American tectonic plate, from Iceland to Charleston, South Carolina; New Madrid, Missouri; Alaska; and Yellowstone Park.

After you have read these books you should have pretty good answers to the following questions:

1. People in North America and Europe were able to see results of the Krakatoa explosion. What were those visible results?

2. A large percentage of San Francisco was leveled in 1906. Fortunately the day before the quake, a comprehensive plan for redesigning the city had been delivered to the city fathers by one of the nation's greatest urban planners Daniel Burnham. Burnham was responsible for much of the turn-of-the-last-century enlarging of Washington DC, (extension of the mall, design of Union station, and creation of the Lincoln Monument), and in Chicago he personally designed many of the most impressive buildings constructed to replace those destroyed in the "Great Fire" of 1871. Burnham was anxious to help advise how his or similar grandiose plans could be used to rebuild San Francisco. However, if you compare a map of San Francisco from before the disaster to a modern map, the only significant differences are enlargement and changes due to new highways. One hundred years later, most everything else is unaltered. Why were Burnham's plans never used?

3. Why did many of the politicians and commercial leaders of California down play the importance of the earthquake and imply that the fire was the more important problem?

4. Winchester describes how the eruption frequency of several well-known Yellowstone Park geysers increased significantly in early November 2002. What is the theory as to why that happened? (Incidentally an article by Tom Smalec in our GSM Newsletter, Spring 2003, described Val Chandler's explanation of a

similar cause-and-effect relationship involving Minnesota wells. You can read that article on the GSM website.)

5. How have engineers attempted to reduce the chances that the Alaskan oil pipeline will break due to movement along the "Denali Fault"?

Another recent book by Winchester is: "The Map that Changed the World" c.2001) This study explains how early 19th-century engineer William Smith prepared a surprisingly detailed geological map of England and Wales in 1815 working almost completely alone. This map compares very favorably to similar modern maps, which are of course produced by large groups of professional geologists and cartographers, using modern instruments.

-PM

To the Badlands and beyond June 2005 Field Trip— A Few Highlights By Dick Heglund

It might be described as simply the 3 B's and DT tour. However, that would dismiss some of our country's most interesting scenery and geology. The Badlands of South Dakota, the Black Hills, and the Bighorn Mountains of Wyoming are truly spectacular and a worthy study of geological processes. This region included singular structures such as Bear Butte and Devils Tower which hold deep spiritual meaning to Native Americans.

The field trip, under the superb leadership of Rick Uthe, began at the eastern end of Badlands National Park. The Badlands might be best described as a 'wall' which is the north bank of what is now called the White River. The rock layers which are seemingly 'level' are geologically young, most being deposited by slow-flowing streams during the Tertiary Period, 40 Ma to 28

Ma (Ma short for millions of years ago). The weathered sediments came from the Big Horns and Black Hills. Volcanism to the west also contributed to the layers. Among the features we saw were faults (not many), paleosols (buried soil horizons), and stream erosion.

Our tour moved on to Rapid City where we visited the Geology Museum at the South Dakota School of Mines. The museum is open to the public and has excellent displays of rocks, minerals, and fossils from the region. We 'headquartered' in Sturgis for the next five days while Rick Uthe explained the Black Hills. (I cannot give enough credit to Rick and Walt Blowers for their superb preparation of the Field Guide.)



Photos courtesy Gail Marshall

The Black Hills can be described as a dome, elongated north and south and rotated to the east along this north-south axis. Erosion has shaped the upper layers into features called hogbacks or ridges trending north-south. The dome was formed from the stress of compressional forces from the west, on

the crust. Exposed in the center of the Black Hills are crystalline and metamorphic rocks dating from 2500 Ma to 1700 Ma.

Surrounding this 'core' are sedimentary rocks uplifted about the same time as the Rockies. Weathering and erosion have exposed these rocks much like layers of an onion, becoming younger as they are further from the 'core'.



No analysis of an area subjected to crustal forces can be put simply, as we were to discover.

A smaller area of the 'core' called the Lead-Deadwood Dome was deformed, and fluids rich in minerals permeated the rocks creating ores containing gold. Mining of these rocks became the Homestake Operation. After producing millions of ounces of precious metals, the mine is now closed and filling with water.

While much of the doming of the sedimentary rocks of what is now western South Dakota occurred 5 to 10 Ma, the region was subject to scattered intrusive igneous activity about 50 Ma. These resistant bodies are now visible as cutting stocks, dikes, laccoliths, Bear Butte, Devils Tower, and other mountain-like sites.

Unfortunately it was raining when we visited Mt. Rushmore National Memorial. I had not been to the

Memorial since the old visitor's center was there. Now a massive structure is in place along with parking ramps to accommodate the many tourists.

We saw the famous Needles, which are composed of 1760 Ma granite, the same as the Mount Rushmore monument. For a change of pace, we stopped at the Mammoth dig in Hot Springs. This is a commercial site, but well done.

The next day most of the group had a tour of Jewel Cave National Monument. The cavern formed along stress joints in limestone which is older than 300 Ma.

We are now in Wyoming, with very different scenery. The peaks are isolated and uniquely shaped. The most spectacular of them is Devils Tower. One can literally touch the vertical face of the tower. There is some disagreement over the events that led to the formation of the tower; was it an intrusive structure, stalk-like, now exposed by erosion, or was it the remnant of a volcanic neck, the result of 50 Ma of erosion?

Coal is the major fuel source for generating electrical power in our country and Wyoming has enormous reserves of it. We visited the Eagle Butte Coal Mine observation area. Fortunately a mine supervisor saw our caravan and stopped to describe what we were observing.

This is the point at which I departed from the field trip, which went on to explore the Big Horn Mountains



Plan now to attend...

NORTH SHORE FIELD TRIP

May 19 – 21, 2006

Trip Leader: Professor Richard Ojakangas, U of M, Duluth
Reservations Being Taken Now Details on page 4

Kimball Memorial Banquet

May 1, 2006

5 p.m. meal / 6:30 p.m. talk

SAME LOCATION AS LAST YEAR

Grand City Buffet

9812 Highway 7, St. Louis Park

(in strip mall at NE corner of Interstate 169 and Hwy. 7)

952-912-0888

Speaker: John Goode, PhD, University of Minnesota, Duluth
"Under the Ice in Antarctica—Exploring the Last Continental Frontier"



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