



# News

*Volunteer opportunities, field trips, lectures, and public service, since 1938*



GSM President, Dave Wilhelm

## From the President's Desk...

It has been a great summer for GSM, with a number of deluxe **field trips** already completed, and more to come. Read about them later in this issue.

August in Minnesota of course means **State Fair**. Thanks to **Dan Japuntich** and the rest of the State Fair Committee for getting our booth in the Education Building ready and staffed. And thanks to all of you who have volunteered for one or more shifts. The State Fair is one of the main venues through which we attract new members each year. If you attend the Fair this summer, stop by and say hi to those in the booth, and see the wonderful selection of specimens we have displayed there.

The 2018-2019 lecture program will start with the **Fall Banquet** at U Garden Restaurant on **Monday, September 17** and continue every other Monday until early December, before the year-end break and resumption in late January. **Steve Erickson** has once again put together an interesting, diverse program. The full schedule is included with this issue of the Newsletter, and is posted on our web site. If you have an idea for a lecture or lab, or know of a possible presenter, contact Steve with the information, or submit it using the contact form on our web site. Steve can never have too many ideas.

Besides great food and our first lecture of the season, the Fall Banquet also includes our **Annual Meeting** of the full membership of GSM. The meeting will be short, as the only order of business this year is election of three new members to our **Board of Directors** for 2019-2020. These openings occur since three current Board have served their maximum of 4 consecutive years. (Our bylaws have this provision so that we periodically get fresh perspectives on the Board.) You can find our bylaws and the duties of Board members on our web site. If you think Board membership is a way you could give back to GSM, please contact me before the banquet.

September also means that our new fiscal year has started, and continuing memberships are up for renewal. The easiest way to renew is at the Fall Banquet or one of our lectures, when Membership Chair **Joanie Furlong** and Treasurer **Dave Kelso** will accept new and renewing memberships. To speed the process, print a membership form from our web site beforehand. Be sure to enter your e-mail address exactly right, as e-mail is our primary means to reach you. Of course, we also accept memberships sent by U.S. mail. Your membership fees are what keep our organization going fiscally, especially providing the fine speakers who educate

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*from the GSM archives:  
Mn North Shore, Sept. 1939*



us each year.

**Becky Galkiewicz and Alan Smith** have done great work making the locations and other information about the **GSM Markers** throughout the state available online. See Becky’s article in this issue, then go online and give it a test drive. Thank you, Alan & Becky.

On the weekend of **October 20 & 21**, the **Minnesota Mineral Club** (<https://minnesotamineralclub.org/>) will conduct their 2018 show, featuring agates, minerals, gems, & fossils. As in past years, it will be held at the National Guard Training & Community Center, 8180 Belden Blvd, Cottage Grove. See their web site for specifics. As she did last year, **Kate Clover** is organizing a GSM booth for this show, which will be similar to our booth at the State Fair, with shorter shifts. This show provides us another great opportunity to contact prospective members, since the people attending the show are already rock hounds. If you might like to take a shift in the booth, contact Kate.

May the rocks be with you!  
Dave Wilhelm

**GSM**

**Officers:**

- Dave Wilhelm, President
- Deborah Naffziger, Vice President
- Dave Kelso, Treasurer
- Dave Kelso, Secretary

**Board Members:** Dick Bottenberg; Kate Clover, Dan Japuntich, John Jensen; Theresa Tweet, Joe Newberg

**Editors:** Theresa Tweet; Mark Ryan; Harvey Thorleifson; Rich Lively

**Programs/Lectures/Labs:** Steve Erickson

**State Fair:** Dan Japuntich

**Newsletter:** Theresa Tweet/Mark Ryan

**Video Library:** David Wilhelm

**Webmaster:** Alan Smith

**Membership:** Joanie Furlong

**Field Trip Coordinator:** David Wilhelm

**GSM Outreach:** Theresa Tweet

**Geological Markers:** Rebecca Galkiewicz

**Lecture Recording:** Joe Wright

**Web Site:** [gsmn.org](http://gsmn.org)

The Geological Society of Minnesota is a 501(c)3 nonprofit organization. The purpose of this newsletter is to inform members and friends of activities of interest to the Geological Society of Minnesota.

**Please note the GSM change of address:** Send all GSM membership dues, change of address cards, and renewals to: Joanie Furlong, GSM Membership Chair, P.O. Box 141065, Minneapolis, MN 55414-6065; Membership dues are: \$10 Full-time students; \$20 Individuals; \$30 Families GSM News is published four times a Year during the months of February, May, August and November. Deadline for article submission is the first of the month, before the date of publication. Newsletter contributions welcomed.

**Newsletter contributions welcomed**

Of interest to our GSM enthusiasts: While out and about enjoying your vacation time – when you visit a site that you find interesting, please consider sharing your experiences with us by writing up a few words and sending it to Theresa Tweet at [phoenix8185@gmail.com](mailto:phoenix8185@gmail.com). Thank you in advance!

**New GSM Members!**

- Jim Maas, Columbia Heights
- Olivia Hanson, Ramsey
- Richard Bokovoy, Shoreview
- Gaby Sasseville, Bloomington
- Sara Huffman, Brooklyn Center
- Marilyn Johnson, Minneapolis
- Kate Kleiter, Lilydale
- Brent Silvis, Bemidji

**GSM Board Membership**

The GSM Board consists of members who have a special interest in advancing the goals of our society, including lectures, field trips, and community outreach. The Board currently has nine members. Our bylaws limit the terms of Board members to four years, to encourage a turnover of perspectives and ideas. The Board typically meets quarterly, on the second Thursdays of February, May, August, and November, or a different date if conflicts arise. We typically meet from 7 to 9 PM at the Minnesota Geological Survey at 2609 W Territorial Rd, St. Paul MN 55114.

Board meetings are open to all members of GSM. So, whether you are

a new member of GSM or have been a member for many years, if Board membership is something that might interest you, or you are just curious to see what our Board does and how it works, we encourage you to attend a meeting. And, if you have a topic you would like the Board to consider, please contact Theresa Tweet at [phoenix8185@gmail.com](mailto:phoenix8185@gmail.com).

### **\*\*2018 GSM Holiday Gathering\*\***

Ed and Sandy Steffner will again be opening their doors to the GSM clan. The Steffners will welcome guests on Saturday, December 8th, at 3:30 PM for appetizers, and 5 PM for Pot Luck Dinner; for food plans and the address please contact Sandy at [ssteffner41@gmail.com](mailto:ssteffner41@gmail.com)

### **Member Spotlight; Joanie Furlong**



1. **How long have you been a GSM member?** I joined in 2003 with Randy Strobel. Randy studied geology at the U of M and has always had a keen interest in how the Earth changes over time.
2. **How did you get interested in geology?** I've always liked science and the outdoors. Randy and I went on Rich Uthe's field trip to the Badlands and Black Hills of South Dakota and the Bighorn Mountains, Devils Tower and the Coal fields of Wyoming. I saw ancient submarine landslides that turned into schist, contact areas between rock formations that spoke of endless time, and found out what a "Leaverite" was, it was cool. After that trip I was hooked.
3. **What do you dig about the GSM?** I love being around the women of the GSM; they are smart, independent and some major risk takers. Through the Lectures and Field trips, I've met some of the best!

### **Next Seminar and Fall Banquet: Monday, September 17, 2018:**

#### **Caves of Minnesota, Greg Brick, Ph.D., Minnesota Department of Natural Resources**

The first meeting of the Geological Society of Minnesota for 2018-2019 is the **Fall Banquet at U Garden Restaurant** (<http://www.ugardenrestaurant.com/>), 2725 University Ave SE, Minneapolis, MN 55414, 612-378-1255, near the East Bank U of MN campus. This is the same location as the Spring Banquet held in April, 2018. The restaurant is on the north side of University Ave SE, east of 27th Ave SE ([Map](#)). There is a parking lot behind the restaurant.

The banquet starts at 5:00 PM. No reservation or registration is needed. We recommend the buffet, which is priced at \$11.95 + tax & tip. Hot tea and other beverages (except water) are extra. Ordering from the menu at the posted price is also an option. To make payment easy, *we encourage everyone to plan to pay using cash.* The restaurant does not accept checks.

You may come for just the lecture, skipping the meal if you wish; however we encourage you to enjoy the meal also, as the restaurant appreciates our business in return for hosting this event. During the banquet, the Video Library will be open for returns and rentals as usual. Following the banquet, starting at 6:45 PM, is our annual meeting, where we elect new members of the GSM Board. Following that, starting around 7:00 PM, is our first lecture of the year. As with all GSM lectures, this lecture is free and open to the public.

**MINNESOTA CAVES HISTORY AND LORE** (Arcadia Publishing, 2017) is Greg's third book on caves and the first book on this exact topic in 50 years. Greg's PowerPoint tour of Minnesota caves will highlight the caves with significant narrative history, illustrated with historic images, never before published, from the National Cave Museum in Kentucky. While most of the caves still exist, many are not publicly accessible, and some never did exist except in the minds of explorers. Copies of the book will be available for purchase.

**Biography:** Greg was employed as a hydrogeologist at several environmental consulting firms, has taught geology at local colleges and universities, and now works on the Minnesota Spring Inventory at the Department of Natural Resources. He has edited the *Journal of Spelean History* since 2003, published more than 100 articles about caves, and was the recipient of the 2005 Cave History Award from the National Speleological Society. His first book, *Iowa Underground: A Guide to the State's Subterranean Treasures*, was published by Trails Media Group in 2004. His second book, *Subterranean Twin Cities*, published by the University of Minnesota Press in 2009, won an award from the American Institute of Architects. His work has been featured in *National Geographic Adventure* magazine as well as on the History Channel. He has led guided tours of caves for the Minnesota Historical Society and the University of Minnesota's College of Continuing Education.

### Notes from the Past

Excerpt from the **SUMMER 1955** edition of the GSM News

#### **Geological Marker Project** by Lawrence W. King

The second stage of the marker project which the Society started in 1949 is nearing completion. It consists of the 20 tablets obtained with the grant of the Hill Family Foundation, which followed the first 8 tablets purchased by the Society. The Flour City Ornamental Iron Co. has promised delivery of the 12 tablets, that constitute the 1955 work, early in June. The Minnesota Highway Department has a schedule of installations prepared and fully expects to have all work completed for the coming tourist season. The tablets for Lake Harriet, Redwing, Hibbing and Whitewater State Park will be delivered last. The society may be asked to participate in a presentation ceremony at Alexander Ramsey State Park near Redwood Falls. It is the opinion of U. W. Hella, Superintendent of State Parks, that such an affair, if it can be arranged, will create interest in the work being done by the Division of Parks.

The interest of public officials in the project is in no way diminished. The difficulty confronted by the Society is not lack of cooperation by others, but rather its own inability to find other suitable locations of geological interest and prepare texts for them against the time when money is available to continue the construction part of the program.

#### **GSM "Minnesota Geology Tour"**

As every GSM member knows, State Fair is a special event for our Society. Sixty-plus of our members volunteer will be at the booth to meet thousands of fun-loving Minnesotans and neighbors. Many people come later to the lectures and become GSM members as a direct result of our contact with them at State Fair.

This year, the State Fair provides an opportunity to introduce Minnesotans to our new Geology Tour. The Marker Committee has produced a brochure describing the Tour as a way to learn the state's geological history over the past 3 billion years. The GSM web site contains the Geology Tour Home Page.

Over 60 markers have been installed around the state. Up to now, Minnesotans might find a couple of markers on their travels but not realize that there's a whole network available. Now, for every marker, the Minnesota Geology Tour gives people driving directions, GPS coordinates, scientific explanations, photos, Google maps, and a chance to find other markers close by.

In the coming months and years, the Marker Committee will look for ways to encourage more Minnesotans to take the Geology Tour.

When you visit State Fair this year, be sure to stop by the GSM booth and pick up a Geology Tour brochure, and it is included with this newsletter. Volunteers at the booth can talk about the Tour to our visitors. Or you can

go to the GSM website and click on the Geology Tour icon. Enjoy your Tour!

Any time Minnesotans have an opportunity to learn more about geology, this is good for geology, good for science, and good for the state.

Becky Galkiewicz

### TIME FOR THE STATE FAIR!

#### **Please Volunteer for the 2018 Fair!**

State Fair Booth staffing is nearly complete, but family and health cancelations do occur, so please watch for an email update on booth volunteering, or contact [danjap7@gmail.com](mailto:danjap7@gmail.com). Many thanks to those who have signed up already!

#### **Two New Committee Members Needed:**

The State Fair Committee would like to thank Deb and Ly Preece for their contributions to the committee over the years. We could not have pulled it off without their hard work and skills.

With Deb and Ly leaving the committee, we would like to invite GSM members to join the State Fair Committee. The responsibilities are one planning meeting and to assist in the set up and the take-down of the booth at the Fairgrounds before and after the Fair.

#### **Win a Fabulous Collection of Rock Specimens!!**

One of our members who is also celebrating his 80th birthday this year has prepared an 18 compartment clear plastic rock box (1 7/8" x 7" x 11") with as many specimens; some of which have probably never been seen by any of our members. This rock box will be given away at the Fall Banquet to one of our members volunteering at our Minnesota State Fair booth this year.

#### **Win a Copy of the Book: Minnesota Caves by Greg Brick, PhD!!**

This book will be given away at the Fall Banquet to one of our members volunteering at our Minnesota State Fair booth this year.

Please remember that the State Fair is a significant source of funding for our lecture series through new membership.

#### **State Fair Volunteer Info:**

- The State Fair dates are Thursday, August 23 to Labor Day, September 3.
- Shift times for two people each are 9 AM- 1 PM, 1 PM- 5 PM and 5 PM- 9 PM in the Education Building.
- GSM does not pay for Fair entrance fee.
- Volunteers hand out our 2018-2019 Lecture Series handouts and chat about our Lectures, our Field Trips, and our "MN Rocks".
- Instructions will be provided!

Dan Japuntich, GSM State Fair Committee Chair

### GSM Field Trips and Tours

GSM arranged two tours of the **St. Paul Water Treatment Plant** on Wednesday, May 23. Look for **Deborah Naffziger's** report elsewhere in this issue.

**Erika Vye, Bill Rose, and Stephen Roblee** led a field trip to **Isle Royale National Park** during the third week of June. Seventeen GSM members participated. This trip left on the Ranger III from Houghton, MI, spent 3 full days on Isle Royale, returning on the fifth day. While on Isle Royale, the Michigan Tech research vessel *Agassiz* took participants to many scenic and geologically interesting sites, allowing them to see the beauty and geology of Isle Royale from both land and water. Participant **Matthew Schaut** wrote an article which appears in this issue.

**Mary Kay Arthur and Deborah Naffziger** organized a field trip in the **Thunder Bay, Ontario** area during July, 2018, led by members of the Ontario Geological Survey. 29 GSM members and guests participated. The OGS crew showed us the highlights of geology in that area, and there was much to see:

On July 19, we visited two amethyst mines, **Diamond Willow** in the morning and **Panorama** in the afternoon. Although only a few kilometers apart, the mines were quite different. Diamond Willow was geared more to pure collecting, and a few of us hauled home quite a bit. At Panorama, the owner and his assistants gave us a very comprehensive, hands-on tour of their pit and the geology of amethysts. We ended by collecting specimens from material hauled up from the mine.

On July 20, **Mark Puumala** and other geologists from OGS showed us debris-site breccias from the 1850 million-years-ago Sudbury Impact event, the Kaministiquia River Valley and its Kakabeka Falls, evidence of the approach and retreat of the Superior Lobe Glaciation, and Midcontinent Rift Formations.

On July 21, Mark and other OGS geologists led us east to the formations of the **Sibley Peninsula** and its spectacular **Sleeping Giant** Provincial Park.

Many participants also spent a fourth day touring historic **Fort William**, which covers the history of the North American fur trade as a living history trading post set in 1816, with enactors in historically accurate costumes.

A field trip guide is on our web site, as well as photos from the trip. Look for a trip summary by Deborah Naffziger in the November 2018 GSM Newsletter.

It is already August. Does that mean the GSM 2018 field trip season is over? Not at all!

We are planning a field trip to **southern Minnesota and northern Iowa**. As I write this, the dates are not finalized, but the weekends of **September 22 or 29** are most likely. Sites to be toured include Faribault Energy Park; the Fossil and Prairie Center in Rockford, IA;

Niagara Cave and the Karst Interpretative Site in Harmony, MN; Scheck's Mill and Big Spring in Caledonia, MN; and the Pickwick Mill in Winona, MN. When the dates are set, you will be notified by e-mail and web site.

On **Sunday, October 7 at 12 noon**, **Steve Erickson** and **Kate Clover** will conduct 90-minute walking tours of the building stones and architecture of **downtown St. Paul**. The tours will start in the main lobby of the [Science Museum of Minnesota](#), then go out to the deck overlooking the Mississippi River, to describe the setting of St. Paul and big-picture geology. From there, we will cover a leisurely 1½-mile course from the Science Museum to Rice Park, then along St. Peter and Wabasha streets, including stops at St. Paul Library, Landmark Center, Hamms Building, Original Coney Island Bar, Assumption Church, Wells Fargo Building, and Ecolab Building, among others. Our leaders will discuss the geology of the building stones, the architecture of the buildings, and the history of St. Paul and the State of Minnesota. We will see many interesting features found in rocks and discuss how these are formed in geology. A handout will be provided. This tour does not involve paid admission to the Science Museum. The tour is open to the public, so GSM membership is not required and guests are welcome. If the weather appears to be unfavorable on October 7, we will postpone the tour to the following Sunday. Any change will be posted on our web site.

To see other trips GSM is considering, select the "GSM Field Trips" link on the GSM home page and click **2018**. Members will receive e-mail on these possibilities and any others that arise. As always, contact Dave Wilhelm with ideas for other field trips that would interest you. Our past field trips, described on the web site, provide a good way to learn more about what GSM does.

Dave Wilhelm, GSM Field Trip Coordinator

#### St. Paul Water Plant Tour

Water is something that we all need in order to live, and modern society demands clean, pure, good tasting water from our home tap. That doesn't happen automatically, and St. Paul Regional Water Services,



Entrance, St. Paul Water Treatment plant

which serves about one million people in most of Ramsey County and may expand to include Washington County, is the place where water from the Mississippi River is transformed into our good drinking water.

On Wednesday, May 23, GSM members toured the plant in two groups, about 30 of us in all. Our tour guides, Alexis Rossow and Sarah Brown were friendly and knowledgeable. Of course we all asked lots of questions, and they were patient with us.

The campus has many buildings, but most are service or ancillary to the actual water treatment. The main water treatment facility was constructed from 1921-24 and went on line in 1925. It has been improved, upgraded and expanded several times in the intervening years. They are anticipating their 100<sup>th</sup> anniversary and further updating of the plant to be as efficient and modern as it can be. The newest administrative building was built in 2002, and now all Water Service employees work from the campus.

The water they treat mostly comes from the Mississippi River through a chain of lakes to the plant. The water first passes through a set of 60" cast iron pipes after being pumped from the river in Fridley through Charley Lake, Pheasant Lake, Vadnais Lake (which is additionally fed by Vadnais and Lambert Creeks), and then additional water can be added from wells. There are additional conduits between some of the lakes. The pipes are paired to allow for repairs without interruption of service. The source water is pumped up from the river, but all the rest is gravity fed to the plant so it is quite energy efficient. Oxygen is added to Vadnais and Pleasant Lakes to improve water quality, and kill algae. They use the wells twice a year, but they can be brought online anytime should they need that source. Additional lakes are tied into the system, but those lakes are not used at present, due to their water quality.

The plant can produce 100 million gallons of pure drinking water a day, but their average output is about 30 million gallons in the winter and 70 million gallons in the summer. Their output has decreased in the past decades due to conservation. It takes about 143 days for the water to flow from the river into the plant, and about 13-16 hours for 60 million gallons of water to be processed through the plant and released into the water system. The water system after the plant is mostly gravity fed, except for pumps at the end of the plant and also in the neighborhoods on the bluff across the river from downtown St. Paul, where it has to be pumped up to water towers for distribution. The plant has diesel generators for electrical backup, and additionally they go off the grid for a few weeks every summer to conserve electricity for hot weather needs. The treatment facility itself needs no heating or cooling, the massive amounts of water cycling through keep the temperature steady year-round.

The first purification takes place in the lakes where the

water is naturally filtered. In California, the water they drink goes through 7 water treatment plants. Our water comes directly from source, which is a luxury in the US. As the water enters the plant, it is mixed with alum and quicklime for softening, and to cause particulates to clump together to form floc. Next the water passes through the floc basins, and is constantly mixed by paddles to make sure the water is fully mixed and the particles stay in suspension. Here, additional chemicals are added to the water to purify and soften it further, and make sure there are no harmful particles or organisms. There are three sets of floc basins, and each has paddles moving faster than the last to keep the growing particles in suspension, as various chemicals are added to the mix.



*Tour group looking into a floc basin*

One thing we learned is that the basic method for purifying water has not changed since the plant was built. They add more chemicals, the filter composition has been refined, and the testing methods are more efficient and discriminating, but the basic process remains the same, which is why the 1925 plant is still in use. They are making further updates and improving the old plant, beginning with the electrical system. Next they will be checking the integrity of the cement and other infrastructure, but the basic plant and operations are the same.

After the floc basins, the water goes into giant round settling basins for clarifying. As the particulates settle out, they are pushed into the middle of the basin by paddles and eventually pumped out to the dewatering facility where the water is squeezed out, and the solids are used as spent lime for agricultural purposes.

The clarified water flows over the top of the settling basin, and then goes through a re-carbonation basin, where carbon dioxide is pumped through the water to lower the pH to 8.6 and fluoride is added for dental health. Then the water goes through filtration to remove the fine particles not dropped out in the clarifiers. The filters are 36 inches of granulated activated charcoal and 4 inches of sand. Friendly natural bacteria also inhabit the filters and help to further clean the water. These bacteria change with the seasons, and adapt to the

changing quality of the water throughout the year. This is an entirely natural process and is not managed by plant personnel.



Round clarifier tank

Chlorine and then ammonia are added after this step to preserve the helpful bacteria in the filters. The water goes through a maze of baffles to ensure full mixing and distribution of the chlorine and chloramines to kill any residual organisms, harmful or beneficial. The water is treated to keep it safe for drinking throughout the water distribution system. It is continually tested at the plant, and throughout the system to ensure there are no harmful organisms in the water. They also test for nutrients as well as 12 metals including lead, zinc, copper and arsenic. The plant has been awarded the President's Award from the Partnership for Safe Water, and was the first plant in Minnesota to win this award.

After 9/11 the security at the plant was improved, but they still reach out to the public and give tours to schoolchildren and other interested groups. It was a fun and informative tour, and I recommend it for anyone who is interested in infrastructure, and the complexities of operating our cities. For more photos of the tour by Dave Wilhelm, see <https://tinyurl.com/StPaulWater2018>.

Deborah Naffziger

### Report on the GSM 2018 field trip to Isle Royale, June 18 -24, 2018

The main question for those participating in the GSM 2018 field trip to Isle Royale was whether a boat would be needed to get everyone to *THE* boat, the Ranger III, which would take us to Isle Royale on June 19, 2018. Rains of historic proportions just days before had washed out roads, destroyed property, and led to at least one fatality. Long detours were required for many to reach Houghton, Michigan, home of Michigan Technological University and rendezvous point for the trip the evening before departure. Skies cleared that day and all made it safely. The evidence of catastrophe remained in washed out Agate Street, and the significant erosion along and sediment in the channel leading to Lake Superior. The

clear weather of the 18<sup>th</sup> held for the rest of our journey. We had nary a raindrop and only one change of itinerary due to wind and high water. This good fortune extended to the island fauna, as well: the legendary mosquitos and biting flies were most noticeable by their near absence! We were truly fortunate souls!



Agate Street, Houghton, MI

The GSM had sponsored a trip to Isle Royale in 2015, and several GSM members also participated in a trip in 2017. Those occasions were also sponsored by the National Association of Geoscience Teachers in conjunction with Michigan Technological University and were led by the same experts in Isle Royale and Keweenaw geology – Bill Rose and Erika Vye. Stephen Roble, seasoned captain, again steered the MTU research vessel Agassiz and kept everyone safe on the water. An enthusiastic young geologist, named Daniel Lizzadro-McPherson rounded out the leadership contingent and answered everyone's "what kind of rock is this?", "what mineral is that?" and "what happened here?" questions. To inform our minds and help our eyes to see what we'd be looking at, all trip participants were given a copy of *How the Rock Connects Us: A Geoheritage Guide to Michigan's Keweenaw Peninsula and Isle Royale* authored by Bill and Erika with Valerie Marin (© 2017 Isle Royale and Keweenaw Parks Association, ISBN 9780935289213). This book came highly recommended due to its informative text, photographs, and diagrams, which were accompanied by numerous QR codes that afforded many trips down the geological rabbit hole. (Well, snowshoe hare holes.) The book is elegantly designed and generous in spirit, so it's a real gift. Also recommended is *Isle Royale: Keweenaw Rift Geology: Physical Volcanology of Large Lava Flows*, by Bill Rose and Justin Olson.

Participants lodged at the Rock Harbor Lodge, in elegant four-person cabins nestled between Rock Harbor and Tobin Harbor. Our guides had generously stocked each unit with more food than any four people could possibly eat. And – big bottles of Keweenaw beer! The trip itinerary threatened that participants would have to

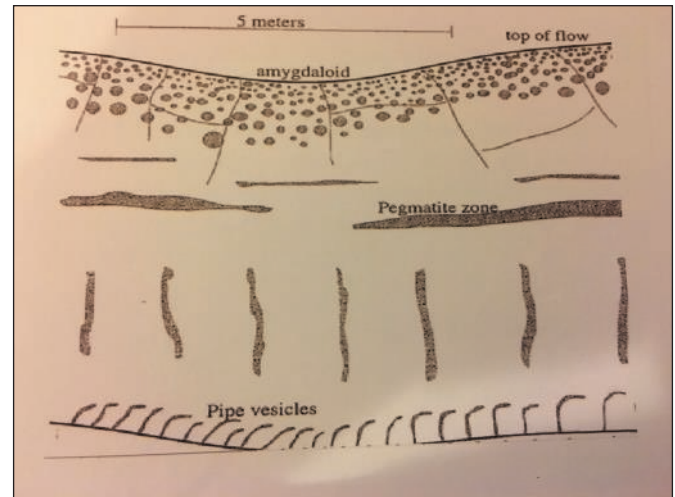
cooperate in preparing the evening meal, but even that horror didn't come to pass. Each night our dinner was catered by Marina and crew from the Greenstone Inn. Honestly, we weren't really roughing it on Isle Royale. We arrived at the island in the afternoon of June 19, after a 6 hour voyage on the Ranger III, on some of the smoothest water possible on Lake Superior. We made a brief stop at the park headquarters on Mott Island, and then a landing at Rock Harbor, where we located our lodgings and parked our belongings. Our longings we kept – for we all desired adventure. There was time for my son, Wren, and I to take our first adventure, a brief hike along the Tobin Harbor Trail, before meeting up with the whole group at the American dock where Bill provided an orientation to Isle Royale geology.



Bill Rose explaining Isle Royale geology on the American Dock, Rock Harbor

The essential point is that the rifting event that occurred about a billion years ago led to the largest known lava deposit on the planet Earth in what is now the Lake Superior basin. At the time, the landmasses of the planet were gathered into the supercontinent Rodinia. Rodinia's large mass prevented heat from the interior from dissipating, leading to the formation of a hot spot/rift zone. Because the area was a basin, instead of flowing away as currently happens in shield volcanoes such as Mauna Loa, the lava formed deep pools. Hundreds of individual lava flows contributed, the Greenstone flow being the largest and the dominant feature on Isle Royale. Due to the weight of the lava, the center sunk, accentuating the bowl shape of the basin. Isle Royale represents one lip of this bowl, and the Keweenaw another; the same individual lava flows can be seen in both places, implying their continuous presence underneath the waters of Lake Superior. Later sedimentary layers filled in the basin. And, of course, glaciers added their most recent input. Because the lavas are so thick, their centers cooled slowly, leading to

unique features rare or unseen in other places. Deciphering these features would tell us if we were standing near the top (amygdaloid), bottom (pipe vesicles), or center (pegmatite, ophitic texture) of a flow.



Anatomy of a lava flow

On June 20 the group boarded the Agassiz to begin our first full day at Isle Royale. Stopping first at Tookers Island to examine closely the starscapes of minerals visible in cobbles and boulders, recognize rhyolite flows, view coalescing amygdaloids (“when vesicle’s connect...”). The poetry in the rocks. We then visited the Edisen fishery, the moose and wolf study site and Rock Harbor light house on the main island at the mouth of Moskey Basin. We viewed a beach replete with Isle Royale greenstone and slickenslides. Following this, a choice – climb the Greenstone Flow from Daisy Farm to the Mount Ojibway lookout, or visit Moskey Basin by boat. The choice was quite difficult, since Erika made them both sound equally wonderful. I chose Mount Ojibway, knowing I'd find the hike invigorating. Physically traversing the valley and ridge topography, climbing the 25 degree slope of the Greenstone (“start seeing triangles!”), other flows, viewing pegmatite



Amygdaloidal basalt



segregation cylinders representing the center of a flow - this was bliss. So were the beaver bogs, alpine meadows, singing winter wrens and twinflowers. We sailed back to Rock Harbor on the Lake Superior side of Mott and Tookers Islands, viewing columnar basalt polygons, and on Shaw and Smithwick Islands, thick veins of calcite.

June 21 began with a landing at Raspberry Island where we spent a long time examining ophitic basalts, numerous slickensides, vesicle cylinders and toadstools representing the resistant centers of columns. A copper



sheen covered large areas, and the crew discovered a gorgeous subaqueous vein of copper. Raspberry Island was followed by a cruise around Scoville Point into Tobin Harbor. Landing at Hidden Lake offered another



*Erika in a glacial trough on Raspberry Island*

opportunity to view beaver bogs, orchids, and climb the Greenstone Flow, this time to the viewpoint at Lookout Louise. Upon returning to Rock Harbor, the evening included a hike to Scoville Point along the Stoll Trail, treading on ancient beaches and the Edwards flow. The evening was capped off by a gathering to observe the Solstice by the fire in the main Lodge. All were invited to share a haiku, and most did. (I neglected to record who declaimed this. Author, claim your creation!): "Vesicles and bumps/negatives and positives/leading us through time." Dwayne: "Solstice sun rises and sets/Rocks with

fire and ice/Fire in the fireplace."

June 22 began with a sail around Blake Point, northern tip of the main island, allowing the best views of the Greenstone Flow in cross-section. We then sailed the Amygdaloid Channel to McCargoe Cove and the Minong mining district. A hike past a moose and an abundant colony of yellow lady slipper orchids led to the mines, where tremendous slag heaps were indicative of intense labor. Afterwards



*Field of slickensides on Raspberry Island*

some of us climbed to the Pine Mountain Lookout where we were met with wind and sun, and outraged white-throated sparrows appalled by our presence near their nests. But the vista presented an alpine meadow in full blossom (with a flyover loon), and an amazing view of Thunder Bay, Canada. Peak experience!



*Toadstools offshore of Raspberry Island*



*Copper vein*

The ambitious day continued with a stop at Crystal Cove at the northeast tip of Amygdaloid Island. The relic grand hotel was a lot less interesting than what Erika and



*Yellow lady slipper*

Daniel were after – the source vein of a beautiful greenish brecciated rock. They did not find the vein but did



*Ashfall discovery at Crystal Cove, Amygdaloid Island*

Island to view the columnar joints. Bill set the expedition to considering how to explain the odd dip-slope structures near the lighthouse – and we are all, I am sure, still working on that.

July 23, included our departure from Isle Royale, a calm sea voyage back to Houghton, and an evening at the Seaman Mineral Museum where we strolled the boulder garden and had afterhours access to the museum. Wren and I had to take our leave to attend to a family emergency, thereby missing the final day of the trip, a geological romp through the Keweenaw Peninsula. I am certain silver and copper lodes were discovered in abundance, but I am unable to tell you where.

While focused on geology, this trip was enhanced by its participants knowledge on other matters – aquatic microorganisms, the flora (each day saw a progression of



*Mysterious dip slope structure on Passage Island*

new blossom, and the twinflowers from day one were in full bloom by the last day), and bird song. This was an educated and civilized group which appreciated each other’s company and expertise. The trip was a dream come true for me and I continue to luxuriate in the profound sense of well-being I experienced while on Isle Royale. Isle Royale has been little altered from the habitat our bodies and brains evolved within. This makes a difference. I have never drawn a more congruent breath in my life than the breath I took on Isle Royale and I am grateful to the GSM and to Bill, Erika, Stephen, and Daniel, and all my expedition mates for the experience.

Matthew Schaut

### How Agates were Formed

Lake Superior agate is Minnesota’s state gemstone. These beautiful, finely banded specimens formed in basalt that accumulated as lava erupted in the Lake Superior rift. Gases caused cavities to form in the basalt, and subsequently, the cavities were filled as silica and other minerals precipitated from circulating water onto the walls of the cavity. Variations over time in slight mineral impurities in the water, mostly iron, produce the beautiful color banding, in colors such as red and orange. Although the agates formed over one billion years ago, they were hidden until glacier lobes flowing from Lake Superior toward the southwest, during the Ice Age over 10,000 years ago, carried them to places where we can find them.

### Scientists discover the world's oldest colors

Scientists from the Australian National University (ANU) and overseas have discovered the oldest colors in the geological record, 1.1 billion-year-old bright pink pigments extracted from rocks deep beneath the Sahara desert in Africa.

Dr. Nur Gueneli from ANU said the pigments taken from marine black shales of the Taoudeni Basin in Mauritania, West Africa, were more than half a billion years older than previous pigment discoveries. Dr. Gueneli discovered the molecules as part of her PhD studies.

"The bright pink pigments are the molecular fossils of chlorophyll that were produced by ancient photosynthetic organisms inhabiting an ancient ocean that has long since vanished," said Dr. Gueneli from the ANU Research School of Earth Sciences.

The fossils range from blood red to deep purple in their concentrated form, and bright pink when diluted.

ANU led the research with support from Geoscience Australia and researchers in the United States and Japan.

The researchers crushed the billion-year-old rocks to powder, before extracting and analyzing molecules of ancient organisms from them.

"The precise analysis of the ancient pigments confirmed that tiny cyanobacteria dominated the base of the food chain in the oceans a billion years ago, which helps to explain why animals did not exist at the time," Dr. Gueneli said.

Senior lead researcher Associate Professor Jochen Brocks from ANU said that the emergence of large, active organisms was likely to have been restrained by a limited supply of larger food particles, such as algae.

"Algae, although still microscopic, are a thousand times larger in volume than cyanobacteria, and are a much richer food source," said Dr. Brocks from the ANU Research School of Earth Sciences.

"The cyanobacterial oceans started to vanish about 650 million years ago, when algae began to rapidly spread to provide the burst of energy needed for the evolution of complex ecosystems, where large animals, including humans, could thrive on Earth."

From ScienceDaily, 9 July 2018

### 2018-2019 GSM LECTURE SERIES

Lectures and Labs are free and open to the public

7:00 PM Mondays at the University of Minnesota

The U locks its doors promptly at 7 PM. Please wait, as person will come every five minutes to let in latecomers.

Exact building, room location and last minute changes will be posted on our web site: [www.gsmn.org](http://www.gsmn.org)

2018:

**Sep 17 Caves of Minnesota** Greg Brick, Ph.D., MN DNR: Fall Banquet 5:00, Annual Mtg. 7:00, Lecture ~7:15

Location: U Garden Restaurant, 2725 University Ave. SE, Minneapolis, Map on web site

**Oct 1 The Flambeau Mine, Ladysmith, Wisconsin: Geology, Minerals, Reclamation,** William Cordua, Ph.D., Prof. Emeritus, University of

Wisconsin River Falls

**Oct 15 Medical Geology,** Jennifer McGuire, Ph.D., Professor, St. Thomas University

**Oct 29 Meteorites: Hard Evidence in the Mystery of our Cosmic History,** Craig Zlimen, M.Sc., Essentia Health-St. Mary's Children's Hospital (Duluth)

**Nov 12 Tectonics versus Sea-Level Change in the 21st Century,** Karen Kleinspehn, Ph.D., Prof. Emeritus, University of Minnesota

**Nov 26 Getting to the Core: Understanding Past Climate, Human Impact, and Geological Processes using Lake Sediment Core Samples,** Amy Myrbo, PhD., Research Associate, University of Minnesota

**Dec 10 Life and Death in Ancient Madagascar: Updates on the Spectacular Taphonomy of the Cretaceous Maevarano Formation,** Ray Rogers, Ph.D., Macalester College

2019:

**Jan 28 Nitrate Contamination Problem in SE Minnesota: The Importance of Geologic Controls,** Tony Runkel, Ph.D., Chief Geologist, Minnesota Geological Survey

**Feb 9 Laboratory: Learning How to Identify Minnesota's Fossils,** Conducted by Jeff Thole, M.Sc., Macalester College. The Geology Dept. is in SW area of basement of Olin-Rice Science Center (south end of campus, by tennis courts) at Macalester, building 14 on campus map. See web site for both campus and road map

**Feb 11 The Great Magnet: Paleomagnetism and The Earth's Magnetic Field,** Bruce Moskowitz, Ph.D., Professor and Director, Institute for Rock Magnetism, UMN

**Feb 25 Dinosaurs and the Dawn of Our Modern World,** Kent Kirkby, Ph.D., Associate Professor, University of Minnesota

**Mar 11 Fossils on the Iron Range,** John Westgaard, BA., Hill Annex Paleontology Project, Science Museum of Minnesota

**Mar 25 Lands of Fire and Ice: the 2017 ILSG Trip to Iceland, Insights into Minnesota's Own Rift,** Amy Radakovich, M.Sc., Minnesota Geological Survey

**Apr 8 Does Anybody Really Know What Time It Is? To a Geologist, It Depends on When You Start the Clock,** Karl Wirth, Ph.D., Associate Professor, Macalester College

**Apr 22 The Rover as a Field Geologist: Strategies for Understanding a Planet,** Julie K. Bartley, Ph.D., Associate Professor, Gustavus Adolphus College

**May 6 Geology of the Minnesota Arrowhead,** Mark Jirsa, M.Sc., Minnesota Geological Survey: Spring Banquet & Lecture, 5:00 to 8:30 PM

Location: U Garden Restaurant, 2725 University Ave. SE, Minneapolis, Map on web site.

## MEMBERSHIP RENEWAL REMINDER

Our fall membership renewal is on the horizon. Everybody will be up for renewal this fall when the new lecture series starts. Renew by mail or wait until the lecture series starts and renew in person. The membership year begins September 1. For those newly joining after April 1 and before September 1, membership will be good through September 2019. (New members joining between April 1 and August 31 get those months free!) If you wish to mail in your dues please include the information below. Membership renewal September 1, 2018 to September 1, 2019

Name(s): ---- \_\_\_\_\_

Address: ---- \_\_\_\_\_

Phone: ----- \_\_\_\_\_ E-mail(s): \_\_\_\_\_

Please make check payable to: GSM

Please mail to:

Membership Levels

Geological Society of Minnesota

( ) Student -----\$10

P.O. Box 141065,

( ) Individual---\$20

Minneapolis, MN 55414-6065

( ) Family -----\$30

( ) Sustaining---\$50

( ) Supporting---\$100

\_\_\_\_\_Membership fee

\_\_\_\_\_Tax-deductible contribution (GSM is a 501(c) 3 nonprofit educational organization)

\_\_\_\_\_Total included

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