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Promoting public interest and educational support in the geological sciences

The Geological Society of Minnesota News

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

From the President's Desk…

As I write this, we are at midsummer, and what a contrast from last year. Instead of heat and drought, we have not yet reached 90 degrees and are experiencing ample rain with flooding.

Midsummer means that the great Minnesota Get-Together is coming right up. GSM started meeting with fairgoers way back in 1970, and since then, we have only missed pandemic years. As he has done the past few years, Patrick Pfundstein is organizing our presence in the Education Building, and you will be hearing from him. We depend on you, our members, to staff our booth, and if you have not signed up for a shift or two, it's not too late. The Fair is one of the primary ways that GSM reaches out to and educates the public, as well as a way that we have attracted many new members. It is always a great time interacting with visitors of all ages, such as youngsters coaxing their parents over, and promoting GSM's lectures and field trips. And of course, it is fun to talk about our collection of rocks on the table.

The approaching end of summer also means the resumption of GSM lectures. For Fall 2024, Steve Erickson has once again put together a great array of topics and speakers, which appear in this Newsletter and are posted on our website. As has become our practice, two of these lectures each semester are online via Zoom, allowing us to tap expertise that would not otherwise be available. It also allows members who have difficulty getting to in-person lectures a chance to participate. Those in-person lectures will be on the U of Minnesota campus; we'll let you know the building and room when it is assigned in September.

As always, our first lecture is our Fall Banquet, on Sept. 16, once again at U Garden Restaurant, with its great food and service. In addition to the banquet and lecture by Jared Trost of the USGS, we will conduct our Annual Meeting, where we elect new members to our nine-person Board of Directors. As you know, we limit Board members to two consecutive terms (4 years), to encourage individuals with new perspectives to join. This year, we likely will have only one position open (usually two). Non-officer positions on the Board do not involve a great time commitment – just four two-hour meetings per year, plus some prep time before each meeting. I encourage you to contact me (dewilhelm53@msn.com) if you might be interested.

GSM President, David Wilhelm

As I write this, we have firm plans for only one field trip, fossil hunting in northern Iowa, led by Steve Willging and Roger Benepe, as mentioned in this issue. Joe Newberg and I are always looking for new destinations for field trips; contact us with your ideas.

Fall means it is membership renewal time. Joanie Furlong will be accepting membership renewals at the Sept.16th banquet and also at fall lectures. See the renewal form in this issue in case you want to mail in your renewal.

As always, I thank Kate Clover, Mark Ryan, Harvey Thorleifson, and Rich Lively for their great job of compiling and editing the GSM News. But editors need content; this publication

Upper photograph, Mark Ryan

Inside this issue:

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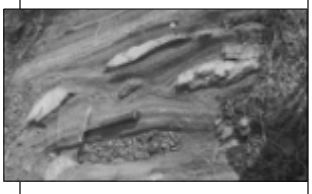
GSM Field Trip to Denham, Mn, Sept. 1946. Quartz lenses in schist. On top of "Soo" R.R., Cut, West Side



is by GSM members for GSM members, and it is a permanent record for our society. Consider submitting an article about something you read, a place you visited, a geological experience from your childhood, or whatever you think might interest your fellow enthusiasts. And thanks to all who have contributed articles to this issue.

Enjoy the next few months out-of-doors, with typically some of the best weather of the year. May your travels be fun and educational, however near or far afield you venture.

David Wilhelm

GSM

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The Geological Society of Minnesota is a 501(c)3 nonprofit organization.

GSM Mail 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 categories and dues:

Student (full time)	$10
Individual	$20
Family	$30
Sustaining	$50
Supporting	$100
Guarantor	$250

Individual and Family memberships can be renewed for 1, 2, or 3 years. Members donating at the Sustaining, Supporting or Guarantor levels will have their names highlighted in the GSM membership directory.

GSM News: The purpose of this newsletter is to inform members and friends of activities of interest to the Geological Society of Minnesota. GSM News is published four times a year during the months of February, May, August and November.

Newsletter contributions welcome:
GSM enthusiasts: Have you seen interesting geology while traveling? If so, please consider sharing your experiences with others through our GSM Newsletter. Write a short article, add a photo or two and send it in. Deadline for submission is the first of the month before the publication date. Send your story to newsletter editor: Kate Clover, kclover@fastmail.fm Thank you in advance.

GSM Board Membership:

The GSM Board consists of members who have a special interest in advancing the goals of the society, including lectures, field trips, and community outreach. The Board currently has ten members, and our bylaws limit terms to four years to encourage turnover, and a change of perspectives and ideas.

The Board meets quarterly, on the second Thursdays of February, May, August, and November, or on a different date if conflicts arise. In-person and Zoom meetings are from 7 - 9 pm. Meeting location will be announced close to the meeting date. Board meetings are open to all GSM members. If you are a new or long-time member and Board membership is of interest to you, please consider attending a meeting. If you have a topic you would like the Board to consider, please contact David Wilhelm, dewilhelm53@msn.com

Welcome New Members!

Steve Bright, Eden Prairie
Katy Shaver, Rochester
Carol Langer, Inver Grove Heights

Notes from the Past

From the Fall and Winter 1964 edition of The Minnesota Geologist, Official Bulletin of the Geological Society of Minnesota

The exhibit of the Geological Society of Minnesota, which was made in the windows of the Northwestern National Bank of Minneapolis from September 8-22,

created quite a bit of favorable comment, which we hope will have a long range effect in stimulating interest in the study of Geology. Three panels 4′ by 8′ each formed the background; the first with a graphic illustration of the geological strata along the Mississippi River at the Twin City Brick Plant near Cherokee Park, the central panel with a geological map of Minnesota with key, and the third panel with a geologic time scale of the world. The display consisted of various Minnesota rocks in the first section, polished Minnesota granites and agates in the middle section, and fossils of the different periods of the world in the third section. It gave a comprehensive picture of the interesting features of geologic strata and rock formation.

Member Profile: Deb Naffziger

Deb doing a "lick test" of a rock while sitting on the 45th parallel, marked by a glacial erratic at the SE corner of Theodore Wirth Parkway and Golden Valley Road

When I retired in 2013, I started attending Minnesota Mineral Club Meetings. They were great, and I also longed for more. At one meeting Deb Preece approached me and mentioned GSM and their meetings at the U. I had known about GSM for years by seeing the booth at the Fair, and every year I made a point of coming by and petting the rocks. Now I was retired and had evenings free, so I went to the U and attended GSM lectures. THIS was what I was hungry for, college level talks about geological matters. And not all about fossils. I was in heaven, I joined, and I started using the DVD library. And the rest is history…

I have been on the board for several years and am in my third term as vice-president. My big achievement has been reviewing, revising, and updating GSM's operations manual which was designed to allow people to do any job that became vacant. Like if we were all hit by a meteor, we could reconstruct the board and the society by following the directions in the manual. It was a tough slog to get it going, but now it's self-perpetuating and that makes me feel good.

I love the field trips and also the talks. They keep my interest in geology strong, and I have an outlet for writing in the newsletter.

Mom tells a story of when I was little, she saw my fist was clenched around something. She pried my fingers open, saw a white pebble (likely quartz), and she asked me what it was, and I replied "oooh big chone!" Later we had a neighbor who had a long gravel driveway. Every spring he would have it re-graveled. We kids would sit and watch, and when the trucks left, we would swarm and pick through the rocks, hunting for agates. I no longer have that jar of agates (they disappeared in one of our many moves), but I still fondly remember picking agates in the summer. I've read rock books and looked at jewelry and rocks all my life. Then when I went to the U (in Minneapolis), I took geology as my lab science. That led to many geology courses (they wouldn't let people take minors in those days) until the Arab Oil Embargo, when geology courses increased their focus on petroleum. I had my fill of salt domes in Louisiana, and gave up on geology courses. Since then, I have read books and followed things on the web, like Lovelock's Gaia Hypothesis. Then I found GSM and life got even better.

My favorite area of geology is anything greater than 539 million years ago. My favorite eons are the Archean and Proterozoic. The deep time old stuff. Morton gneiss is a favorite of mine. So are banded iron formations and Tiger Iron. Those stromatolites ruined it for everyone! One thing I treasure is how much new stuff has been discovered in my lifetime. I remember mom showing me an article in Time magazine about sea floor spreading and the beginnings of plate tectonics. New stuff is happening all the time, and that is what makes it so interesting. I love the talks with people presenting new research.

My favorite geological place is like millions of cats, there are so many, how can I choose? I love Craters of the Moon National Park; Soudan mine, and the Iron Range in general; caves of every type, even the badly managed commercial ones; northern New Jersey and their mineralogical diversity; Ohio and their sedimentary history; Arkansas and the crystal mines (way better than the diamonds); the Black Hills and all they have to offer (especially their School of Mines Museum); Michigan's Upper Peninsula and all they have to offer. There are more favorite places, but you get the idea. I have most every edition of the Roadside Geology series as well as Geology Underfoot (I love Mountain Press). They travel with me when I go anywhere new. I went to Ontario and looked at a whole bunch of good geological stuff. I LOVED the Morton Gneiss tour. The eclipse and subsequent travels in Nebraska were wonderful. Read all about the field trips I have taken in the Newsletter.

Robert Hazen is a mineralogist who focuses on the history of earth that I'm interested in. My favorite book of his is The Story of Earth, closely followed by Symphony in C—all about deep carbon research. And his DVD course is wonderful. Otherwise, I like narrative books that tell a story. And strangely, one word title books: Salt, Cod, Coal, Uranium etc.

I was an engineer in Broadcasting (hence no evenings free) for 33+ years. I operated the machines that put TV in your set, in many ways and permutations. I have been a sciencey-type person all my life, and enjoy astronomy, geology and other sciences as they interact and correlate. I love jewelry and gems and their mineralogy and such. I do sell stuff at conventions and the like, so please stop by!

Rockford Iowa Field Trip Announcement

Roger Benepe and Stephen Willging will lead a GSM

Floyd County Fossil and Prairie Park. Rockford, Iowa

field trip to the Floyd County Fossil and Prairie Park near Rockford IA on Saturday Sept. 7th. We have visited this great Devonian fossil site a few times in the past. In case the weather does not cooperate, Sat. Sept 14th is an alternative date.

We will meet at the Park near the picnic building at 11 am and stay until 4 pm. The park is a 2.5 - 3 hr. drive from the Twin Cities. You can get directions by entering Floyd County Fossil Park in Google Maps. Carpooling is recommended. Between 11 am and 11:30 am, Stephen will give a brief introduction to the park and show some of the fossils you can find.

We recommend that you bring good hiking shoes/boots, a bag/container in which to carry your finds, sun protection, and a walking stick to help with balance in some of the steeper areas. We also suggest you bring some "clean shoes" to wear home as the clay in the pits will cake on your shoes. It is also recommended to pack a lunch as access to food in nearby Rockford or Nora Springs, IA is limited. There are several restaurants and convenience stores at the I-35 exit 194 for Clear Lake/ Mason City, IA about 30 minutes from the park.

If you might be interested, please let Steve Willging (skw2ed@yahoo.com) and/or David Wilhelm (dewilhelm53@msn.com) know, and mention how many will be in your party. This is not a commitment; we are just trying to get an approximate count. Closer to the date, we will send another announcement which we will use as a means to coordinate participants.

Here's a link to a couple park web pages:

https://www.mycountyparks.com/County/Floyd/Park/Fossil-Prairie-Park-Preserve-and-Center.aspx

For additional information about the park and its fossils, see the attachment ,"Floyd County Fossil and Prairie Park" in Dave Wilhelm's July 9, 2024 email. Also, see the article about the May 2022 trip to Rockford in the August 2022 GSM News, Volume 76, No. 3 (see link).

https://www.gsmn.org/sites/default/files/News%20Letter/PDF/2022%203%20GSM%20News%20August%202022.pdf

Fall 2024 GSM Seminars

NOTE: Seminars are at 7 pm on the University of Minnesota Minneapolis campus. Please try to arrive early as the U locks all exterior doors at 6:30, but someone will be at the door to let you in. At this point we do not have confirmation of a room for our lectures. Watch your email for a notice of the room assignment, any schedule changes, and links for Zoom lectures.

Fall Banquet 2024, September 16, 2024: U Garden Restaurant, 2725 University Ave. SE. Minneapolis. Dinner is at 5-7 pm. Annual Meeting at 6:30. Lecture at 7 pm. "Pearl Harbor." *Jared Trost*, M.Sc., Hydrologist, USGS Upper Midwest Water Science Center.

September 30, 2024: "Plan, Core, Scan, Store: Facilitating Core Research." *Kat Cantor*, M.Sc., Science and Outreach Coordinator for the Continental Scientific Drilling Facility at the University of Minnesota.

October 14, 2024 (Zoom Lecture): "Earthquake hazards in Oklahoma." *Jacob Walter*, Ph.D., State Seismologist, Oklahoma Geological Survey.

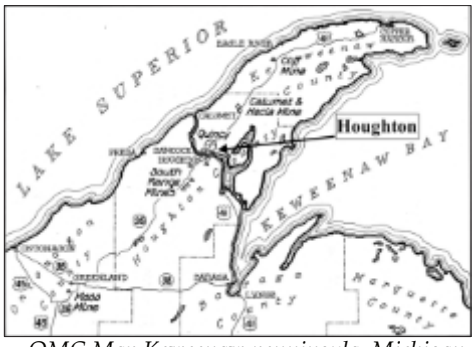
October 28, 2024: "Groundwater Governance in the Great Lakes States—from well-cobbled to equitable and sustainable?" *Carrie Jennings*, Ph.D., Research and Policy Director, Freshwater Society.

November 11, 2024: "Geological Mapping." *Harvey Thorleifson*, Ph.D., Professor, Department of Earth & Environmental Sciences, University of Minnesota.

November 25, 2024 (Zoom Lecture): "Shale in a Nutshell: An Overview of Shale Oil and Gas in the U.S. and Texas." *Tim McMahon*, Ph.D., Project Manager and Principal Investigator for the Tight Oil Resource Assessment (TORA) Consortium.

December 9, 2024: Topic - TBD. *Stephan Delong*, Ph.D., Supervisory Research Geologist, Earthquake Science Center, USGS.

Happy 70th Institute for Lake Superior Geology!



QMC Map Keweenaw penninsula, Michigan, source-Library of Congress

The Institute for Lake Superior Geology (ILSG) held its 70th annual conference on May 15-18, 2024 in Houghton, Michigan, home of Michigan Technological University (MTU), the birthplace of professional hockey, and the location of some of the richest copper mines in the world. The conference was an excellent learning opportunity with talks, posters, excellent field trips, and socializing with fellow geologists, enthusiasts, and friends. The weather was pleasant, for which we were grateful. The black flies and mosquitos hadn't really emerged yet, and I didn't hear of too many ticks either.

ILSG was started in 1955, to focus on exciting research topics in the Lake Superior region, an area that

showcases 3-billion years of Earth's history, ancient volcanic systems, and more recent glacial deposits. The conference brought together geologists from industry, academia, and government, along with students and amateurs. The 150 attendees were mostly from Ontario, Quebec, Wisconsin, Michigan, Ohio, Iowa, Minnesota and the Dakotas.

The conference included two days of technical talks, with many focused on the Midcontinent Rift and related mineralization – iron, nickel, and copper plus precious metals found around the region. The posters provided opportunities to chat one-on-one with presenters about their research. There is a lot of amazing research going on!

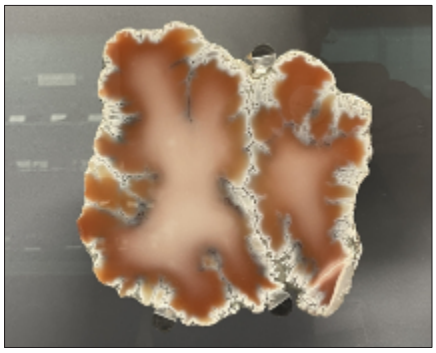
Robert Hazen gave the keynote talk at the Thursday night banquet. He is Senior Staff Scientist, Earth and Planets Laboratory at the Carnegie Institute for Science in Washington DC. His talk was titled "Mineral Informatics: A New Frontier in Understanding Earth." It was a mind-blowing talk that left us all questioning the evolution of minerals – "Mineralogy in the Fourth Dimension." He says, "Every mineral specimen is a time capsule waiting to be opened – waiting to tell its story." He proposes that the Earth's mineralogical diversity has increased through 10 stages. The lecture explored "some of the advanced data analytical and visualization methods that are shining new light on the old field of mineralogy, while revealing in ever greater clarity the co-evolution of the geosphere and biosphere." Curious? Do a web search for Robert Hazen, and you will find YouTubes to watch and papers to read, such as: https://www.youtube.com/watch?v=nTTTy7Wtz3E

Additionally, we had free entry into the A. E. Seaman Mineral Museum, a world-class mineral museum that showcases hundreds of magnificent specimens from the region and around the world. It's easy to spend hours there. I urge you to visit in person, or see the A.E. Seaman Mineral Museum Specimen Picture Gallery here: https://museum.mtu.edu/collections/aesmm-collection/gallery

You can also visit the Mineralogical Society of America virtual field trip to the Keweenaw Peninsula, Michigan: http://www.minsocam.org/msa/collectors_corner/vft/mi4c.htm

Cut and polished porcelain-like datolite nodules at Michigan Tech, Seaman Mineral Museum. Most are white, and also blue, red, orange, mauve and black, or brown and yellow. Seaman Mineral Museum, photo by K. Clover

Full-day field trips book-ended the technical sessions, offering opportunities to learn about the Keweenaw's in-your-face geology and geoheritage. Seven trips were offered to explore the copper deposits, mining history, the Keweenaw fault system, a nearby granitoid complex, and landslides. Another field trip focused on the geoheritage of Buffalo Reef in Lake Superior, where finely-crushed stamp sands are the environmental legacy of a former mill. I would have attended every trip, but had to select one for each day.



Datolite, one of my favorite accessory minerals in the mine dumps, is found as massive, finely crystalline nodules that are recognizable by their surface texture like cauliflower. Seaman Mineral Museum, photo by K. Clover

The Museum showcases mining artifacts, such as a miner's lamp and a stock certificate. Copper ingots were stamped with mining company name. QMC was Quincy Mining Company, and P was Pewabic Mining Co. The anchor signifies Lake Superior Transit Company. Seaman Mineral Museum, photo by K. Clover

I chose the two tours that focused on copper mining: Quincy Mine in Hancock and the Adventure Mine in Greenland - a 40-minute drive from Houghton. The Quincy Mine field trip included tours of the mine, the shaft/rock and hoist houses, mill sites, and the smelter. The Adventure Mine trip included a mine tour, a mineral processing operation, and a climb up the steps to an upper level of the Champion Mine #4 Shaft/Rock House.

People have lived and mined copper in and around the Keweenaw Peninsula on the shores of Lake Superior for thousands of years. Most recently, the copper mines were active from the 1840s to 1960s, with multiple stops and starts.

The period after 1920 saw the mines decline. After the First World War, there was dumping of copper onto the market, and demand went down. Plus, open pit mining elsewhere was cheaper. And, costs rose while the highest grades were depleted. It became viable for the mines to reprocess tailings. Mines and reprocessing operations were active until the 1960's. However, when the price of copper declined, the mining operations would slow and some mines closed, never to reopen.

The Quincy Mine in Hancock, in operation from 1851 to 1967, was the 4th largest copper mine in the Keweenaw Peninsula. It produced 424 million tons of refined copper from 9 shafts sunk along the top of the Pewabic basaltic lava flows. The field trip included an underground tour, and visits to the shaft/rock house and hoist house, plus visits to a mill site and the smelter.

Quincy Tour – Underground: For the Quincy Mine underground tour, we donned hardhats and headlamps

and entered via the 7th level adit (a mine entryway) on a hillside 107 feet downhill from the hoist and shaft/rock house on Quincy Hill. Underground, we explored the geology along about 2300 ft of the 7th level, and saw mineralized amygdaloidal zones in the tops of the lava flows, and faults. We also saw lava flows with ropy pahoehoe structure. The temperature was 45°, and it would have been warmer deeper down.

During the early 1970s, parts of the 7th levels were widened to accommodate an MTU mining engineering classroom and research facility (K. Clover)

The ore was blasted, and hoisted to the surface initially for sizing. Large fragments were broken further by steam hammers. Miners also put pieces of native copper into barrels and/or on rail cars, and once on the surface, that was shipped directly to the smelters.

Tom Wright, Quincy Mine Hoist Association, showing a chunk of native copper, beside practice drill holes made by mining students (K. Clover)

Quincy Tour – The Shaft/Rock and Hoist Houses. In the Quincy No. 2 Shaft/Rock House, we saw the hoists, the man car, and the skip car. In the Hoist House, we saw the Norberg Steam Hoist – the largest steam driven mine hoist in the world. Much of the equipment remains, as you will see in this video: https://www.nps.gov/kewe/learn/photosmultimedia/quincy-mine-shaft-rockhouse.htm

Miners in a man car at the Quincy No. 2 Shaft/Rock House, ready to go underground. In 1945, the No 2 shaft had reached 9260 feet, the longest mine shaft in the world at the time. Miners used candles or oil lamps for light underground during this period; later, they used carbide or electric lamps. (Michigan Technological University archives, Copper Country Historical Collections).

Jim DeGraff, MTU professor and trip leader (far left in blue vest), points to a fault zone, in a wide adit that is ideal for public tours, although in places wet and muddy! (K. Clover)

The 5-story Quincy Hoist building housed the cable hoist drum of the 1920 Norberg Steam Hoist. (K. Clover)

Quincy Tour – Stamp Mill and Smelter: Our 3rd stop was a former steam-powered stamp mill on the shore of Torch Lake. Here, equipment and buildings have long since been scrapped; however, one old stamp still stands. At the stamp mill, the broken ore from underground blasting – pieces small enough to pass through a coarse grate - arrived by rail car. The ore was further crushed by the stamps to allow as much rock as possible to be removed from the native copper. The stamp could strike over a hundred blows per minute and process about 7000 tons of ore in a 24-hour period. Following crushing, jigging was used to concentrate the native copper from the tailings. Jigging was accomplished by placing the sand-sized particles on a screen where pulsating water allowed the denser copper particles to settle and the less dense gangue to rise to the top and overflow the screen. Jigging produced a concentrate of copper particles that was sent via rail to the smelter.

The 5-story Quincy Hoist building housed the cable hoist drum of the 1920 Norberg Steam Hoist. (K. Clover)

The man car at the Quincy No. 2 Shaft/Rock House is on the right. The skip car, on the left, was used to haul ore and waste rock to the surface. (K. Clover)

Miners in a man car at the Quincy No. 2 Shaft/Rock House, ready to go underground. In 1945, the No 2 shaft had reached 9260 feet, the longest mine shaft in the world at the time. Miners used candles or oil lamps for light underground during this period; later, they used carbide or electric lamps. (Michigan Technological University archives, Copper Country Historical Collections).

The cable hoist drum of the 1920 Norberg Steam Hoist, at Quincy Mine and housed in a 5-story building, is an enormous spool that held 2.5 miles of 1 5/8 inch diameter steel cable. The spool was a 250 ton, 30-foot-diameter monster - powered by two compound steam engines with cylinders three and five feet in diameter. The cable ran from the Hoist House to the Shaft/Rock House and down the main shaft to the horizontal tunnels. It could raise a 10 ton load at a speed of 36 mph from an inclined depth of 9260 feet (1.5 miles). The hoist was designated a National Historic Mechanical Engineering Landmark in 1984. (K. Clover)

We concluded the visit at the Quincy smelter along the Portage Canal where the copper was melted, and turned into a liquid in a furnace. The molten slag waste was skimmed off. The copper was poured into ingots, bars of copper with as few impurities as possible, ready to be made into copper products. The smelter buildings still stand today, but machinery has been salvaged or scrapped. Standing on the dock, we imagined the stacks

At the stamp mill in Tamarack City, one of the stamps still stands on its massive base on the shore of Torch Lake. We imagined living nearby amid the noise of operation (K. Clover)

of ingots ready to be loaded onto steamboats.

Adventure Mine Tour – This mine in Greenland, 40 miles SW of Houghton, was another great field trip. This was a small native copper mine that operated from 1850 – 1917, yielding about 11 million pounds of refined copper from the tops of five basaltic lava flows. The site has since yielded specimens of native copper and copper minerals for mineral collectors and tourists.

Matt Portfleet, owner of Adventure Mining, mining inspector, and MTU staff, presented a history of the mine before we rode in a Swiss utility transport vehicle called a Pinzgauer to the mine entrance. (That was a first!) Underground, he showed us native copper mineral-ization in the lava flows and explained how miners drilled and blasted and hauled rock to the surface. He also conducted a blast while we were underground to release a chunk of rock that was "stuck." We observed as he set the charge, and then we all moved to a safe area away from the blast site. We all felt the blast more than we heard it. (That was another first!) Once the dust settled, he checked to see if the loose/stuck rock had fallen. Yes, it had fallen, and we had fresh rock to pick through.

The Quincy Smelter, constructed largely of sandstone in 1888 and closed in 1971, still stands, although now empty. In 2007, the NPS assisted in clean-up and stabilization, as the site now is in Keweenaw National Historical Park (K. Clover)

The Adventure Mine is also a Keweenaw Heritage Site of the Keweenaw National Historical Park that welcomes visitors seeking an underground mining experience. The mine offers an easy walking tour, rappelling down mine shafts, and underground drilling and blasting workshops. It also hosts bike races through the mine.

Neoproterozic Jacobsville Sandstone used in the smelter was locally quarried. The red oxidation developed after deposition in relation to fluids. The white spots and layers are high in organic material that prevented oxidation. The cross-bedding and channels indicate a fluvial origin. (K. Clover)

In Painesdale, our 2nd and last stop of the day, we first toured the building where Portfleet preps mineral specimens for sale; yes, lots of native copper and beautiful copper minerals.

Copper ingots being loaded ~1910 in Houghton, onto Steamboat S.S. Juniata, which was launched in 1904 and initially carried passengers and freight between Buffalo and Duluth. The copper ingots were pure enough to be fabricated into copper products such as wire. (Photo displayed at the Copper Range Depot Restaurant in Houghton, Michigan.)

Next door to Portfleet's warehouse, the Painesdale Mine and Shaft Inc. (a non-profit organization) runs the Champion #4 Mine and Shaft House Museum site. Their goal has been to restore and preserve the #4 Shaft/Rock house and numerous industrial buildings, railway equipment, and private homes as a museum and geoheritage site. The #4 Shaft/Rock House is the oldest remaining shaft/rock house in the Copper Country. Mines operated in Painesdale from 1908 to 1967.

The Pinzgauer, a Swiss Military Transport Vehicle, transported us from the office to the mine. (K. Clover)

Restoring the #4 Shaft/Rock House is a worthy undertaking that continues to be a massive project. They have stabilized the floor, repaired stairs, added railings, replaced windows, added barriers, upgraded the electrical, installed new lighting, preserved artifacts, created walking paths, and lots more. The restoration work now allows visitors to climb the steps to the rock crushing floor and see rock chutes and crushers. Only then could I really grasp how the ore was brought to the surface and sorted by size and then further crushed. Ore with copper went one way, waste rock went in other railcars. The size, scale and engineering of the building and machinery was fascinating. If you are into the mechanics of a shaft/rock house and seeing how rock was handled, this is a great place to visit.

The Adventure Mine adit has a grated door that allow bats to come and go. Yes, we saw bats underground. (K. Clover)

Collecting rocks and minerals in the Adventure Mine. (K. Clover)

Looking down a mine adit with a ceiling 3' to 6' high. (K. Clover)

I'll conclude by saying that the 70th ILSG was – in so many ways – an excellent conference. MTU's geologists and the Keweenaw were great hosts. The many interesting talks, the professionally-led field trips to sites with geological and historical interest, plus the Lake Superior shoreline really made for a great few days of intense learning.

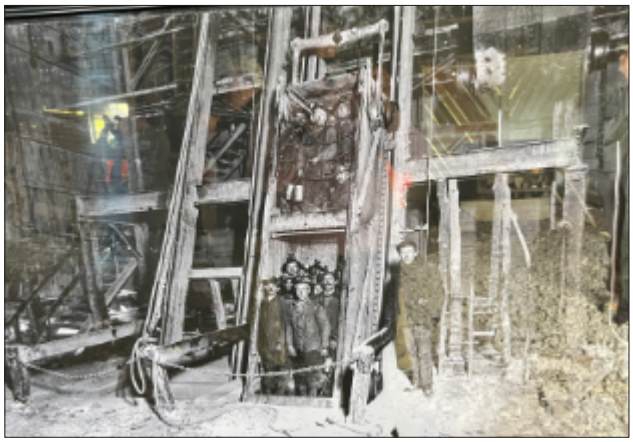
If you missed the conference and the field trips, put the Keweenaw on your list of places to visit. Even without a professional guide, there's plenty to see. Make sure you check out the places designated as part of the Keweenaw National Historical Park which has significantly advanced efforts to preserve and interpret the sites and structures, and rich history of copper mining on the Keweenaw Peninsula.

Epidote is common at the mine (K. Clover)

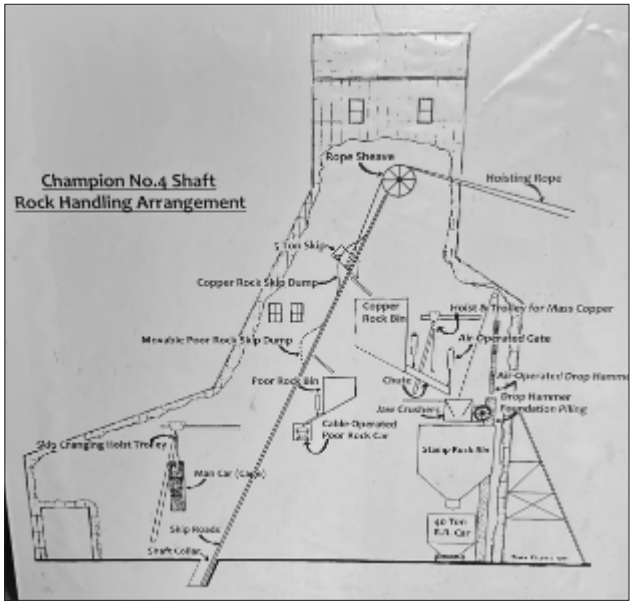
The Champion No. 4 Shaft/Rock House, built in 1902, is the oldest remaining shaft/rock house in the Copper Country. It operated from 1902 to 1928 and again from 1945 until 1967, when the mine ceased operations and the structure was abandoned intact with much of the equipment in position. The shaft was capped in 1995, and a bat door allows access. (K. Clover)

For those of you planning ahead: ILSG will be held **May 14 - 17, 2025** in Mountain Iron, MN.

Kate Clover



Miners ready to go underground at the #4 shaft, in a double-decked man car that held up to 12 men on each 4' x 4' deck. A chain at the front protected miners as they descended at a steep 70° angle at 10 mph, to the 56 levels at ~ 5,600 feet depth. Photo on display at the shaft/rock house.



Process at the Champion Mine #4 Shaft/Rock House.

Jaw crushers in the Champion Mine Shaft/ Rock House, and in the chute is the last rock mined at the Champion Mine in 1967. (K. Clover)

Thank you from ILSG Eisenbrey 2024 Student Travel Awardee

Editor's Note: GSM donated $400 to the ILSG Student Travel Fund, and we received this letter.

Dear Members of the Geological Society of Minnesota,

I am Zsuzsanna Allerton (Zsu for short), a 4th year PhD candidate at UMN. I presented a poster and talk at the 70th ILSG last week, and received the Eisenbrey Student Travel Award funded by GSM. I would like to thank you for your generous contribution, and give a little insight into the work my research group has been doing for 3.5 years.

Our research objective is to better understand the thermal effect of Proterozoic events, such as the Midcontinent Rift development and other terrain accretion orogenic events in the Archean northeastern Minnesota. The project started at the Soudan Iron Mine, where massive hematite ore bodies were mined until the early 1960s. In the summer of 2021, I visited the mine and became interested in ore forming processes and age. Previous studies concluded ages from Neoarchean to Mesoproterozoic, based on limited observations. Since there was a postulation involving the Midcontinent Rift development, we decided to do a roughly W-E transect from the Keweenawan Duluth Complex, the igneous suite of the rift that is in contact with the Archean Giants Range Batholith, all the way to the mine (~40 km in map view) to sample rocks and find datable accessory minerals that could have documented thermal events.

So far, we have found different hydrothermal signatures in zircon and apatite grains using high temperature U-Pb laser ablation, and Midcontinent Rift ages as far as halfway (~20 km) between the ore bodies and Duluth Complex/Giants Range Batholith contact. These are the results I presented as a poster at ILSG. Additionally, we followed a novel technique developed at Curtin University in Perth, Australia, by Liam Courtney-Davies and Martin Danišik, who we collaborated with, and did U-Pb and (U-Th)/He geochronology on hematite. The analyses yielded 1700-1600 Ma U-Pb dates, which we interpret as hematite mineralization ages as a result of orogenic events (Yavapai and/or Mazatzal) and associated magmatism (dikes), and ~1100 Ma (U-Th)/He dates that are considered to be a thermal overprint of the Midcontinent Rift. These geochronology results together with petrography, a proposed simplified hydrothermal model, and preliminary geochemistry were part of my oral presentation at ILSG.

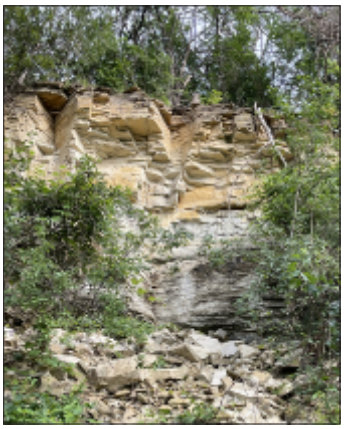
Next steps include dating some dikes in northeastern MN, or host units close to the contact, to clarify the roles of Paleoproterozoic magmatism. We will add low temperature fission track and (U-Th)/He of zircon and apatite to the existing high temperature U-Pb ages to better constrain the thermal history of the area. Additionally, we will do more detailed geochemical analyses of the ore bodies, the host banded iron formations, and adjacent wall rocks, and we plan to continue sampling along the transect to have a more complete picture of thermal overprints.

Again, thank you for helping this project. I am looking forward to presenting at the next ILSG conference in 2025.

Sincerely, Zsu

Take a Hike and Find Some Geology

One of my favorite easy hikes in the Twin Cities with some rocks to examine is on Dakota County's Big Rivers Regional Trail, and between Mendota and the Lilydale Yacht Club (downhill off Hwy 13 at 35E). The paved trail is on an abandoned railroad grade overlooking the Mississippi River and its confluence with the Minnesota River. In addition to river views, and often eagles, the uphill side of the trail has many excellent exposures of Platteville Limestone and St. Peter Sandstone with some Glenwood Shale sandwiched between. It's fascinating to see how the rockface erodes.



Recent erosion along the trailside cliff shows the Decorah Shale at top, the Platteville Limestone is the middle gray layer, and the Glenwood Shale is above the talus slope. The St. Peter Sandstone is not visible here, but can be seen downstream.

I park in Mendota at the Post Office. There is also an official trailhead parking lot uphill from the Lilydale Yacht Club, but that's often full.

A St. Peter Sandstone outcrop along the Big Rivers Regional Trail between Mendota and Lilydale.

While in the neighborhood, the overlook at the trailhead park at 1498 Mendota Heights Road, Mendota Heights is worthy of a stop or a picnic to see a sweeping view of the Minnesota River and the MSP airport across the river. Parking is easy. In addition, there are interpretive panels about the Dakota people who know

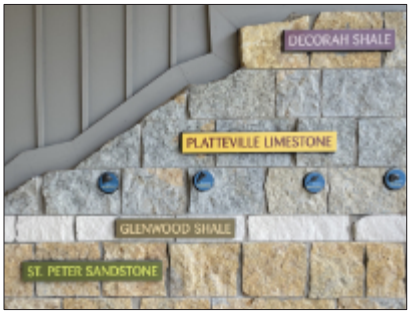
The Dakota people call this area Bdote to signify the confluence of the Mississippi on the right and the Minnesota River on the left. Pike Island, part of Fort Snelling State Park, is the point of land where the rivers meet. Photo was taken during the June/ July 2024 flood.

Monument at the Big Rivers Trailhead installed by the Dakota, explaining the significance of the rivers confluence, the Dakota names for the rivers, and Dakota origin stories.

the confluence area as Bdote – where the waters of Haha Wakpa (the Mississippi River) and the Mni Sota Wakpa (the Minnesota River) meet.

Also of note here is the Works Progress Administration (WPA) era Platteville Limestone wall, and the park pavilion that includes signs about the regional stratigraphy.

For more info, see the Dakota County Parks Page. https://www.co.dakota.mn.us/parks/parksTrails/BigRivers/Pages/default.aspx



Signage at the Big River Trailhead Pavilion in Mendota Height illustrates the local stratigraphy. The four black "dots" are models of fossils found in the Platteville Shale.

Editor's note: Do YOU have a favorite place to hike that includes interesting geology? If so, please contact Newsletter editor Kate Clove at kclover@fastmail.fm

Story and Photos by Kate Clover

GSM at Springbrook Nature Center

Back in mid-March 2024, by way of the "Ask GSM" feature on our website, we received a request from Gabrielle Brounstein, a full-time Naturalist at Springbrook Nature Center in Fridley. She wondered if GSM would be interested in having a table on Saturday, May 18, 2024 at the Anoka County Environmental Fun Fair, a "family-oriented, sustainability-focused event that incorporates education and fun to bring the community together with the common mission of preserving and enjoying natural spaces. Started in 2017, the event was originally launched by a young 4-Her, who aimed to educate families about a wide range of natural science topics: clean energy, geology, entomology, ornithology, botany, aquatic ecosystem health, gardening, pollinators, etc. She thought that GSM would be able to provide the several hundred attendees with exciting, informative, and relevant information on geology, an under-represented topic in science education.

Steve Willging and Mary Kay Arthur at Springbrook Nature Center's Anoka County Environmental Fun Fair.

Steve Willging and Dave Wilhelm representing GSM at Springbrook Nature Center

It sounded like a great idea to me. I was available that day but hoped to have a few others to staff our table, so I put out a call to our membership. I was pleased that Steve Willging, Dan Japuntich, and Mary Kay Arthur answered my request. (Dan later had to decline as a conflict arose.)

Besides us, there were many exhibitors, including MN Herpetological Society, MN Mycological Society, Cedar Creek Reserve (GSM had a field trip there recently), Friends of the BWCA, and many, many more. Our setup was similar to our State Fair booth, with the trays of Minnesota rocks plus educational items from Theresa Tweet and many fossils from Steve's large collection. (If you went to the GSM paleo lab at Macalester this past February, you know of what I speak.) The fair went from 11 until 2, and we had a great time talking to the many kids who stopped by with their parents. They appreciated the hands-on aspect at our table (although perhaps not so much as at the snakes & lizards table!). The youngest ones were fascinated by our spherical magnets, but the older ones appreciated the fossils, iron ore, mica, etc. It was a great success, and I hope we can do it again next year.

Story and photos by Dave Wilhelm

Book Review

Geopedia: A Brief Compendium of Geologic Curiosities by *Marcia Bjornerud.* 2022. Princeton University Press, Woodstock, Oxfordshire (England)

Photo

This little book is fun and chock-full of

geologic information. Author Marcia Bjornerud doesn't cover everything, but the things she does cover manage to contain a great deal of geologic history and science. The language is well chosen, she says a lot in a few words, and she's a great explainer.

"An unconformity is the geologic equivalent of pages missing from a particular copy of a book, an interruption of the narrative of a given place. Fortunately, however, rock sequences at different places—copies kept in other geologic "libraries"—are missing different pages. Since the time of Hutton, the geologic timescale has been pieced together laboriously by combining the fragmentary, unconformity-riddled records from sites around the world into a single comprehensive volume, using fossils and isotopic dates as global "page numbers.""

This paragraph illustrates her skill with analogy and wordplay. There are illustrations, but I would have been happier with pictures of the various rocks. I know what they look like, but illustrations do not do the various minerals justice. But that's my only quibble.

The book goes alphabetically from Acasta Gneiss to Zircon, and covers science, debunked theories, ancient legend, and so much more. I urge you to read the appendices - there is stuff to learn there as well. Her awful puns are helpful and fun. This is a worthy addition to anyone's geologic library.

Deborah Naffziger

A perennial controversy: The St. Peter Sandstone of the American Midwest

Greg Brick has authored a paper in the Journal of Geography and Cartography 2024 (https://doi.org/10.24294/jgc.v7i2.6588). He points out that the St. Peter Sandstone of the American Midwest is presented today in textbooks as a simple and unproblematic example of "layer-cake geology." His thesis is that the very simplicity of St. Peter Sandstone has made it challenging to characterize. He notes that in widely separated states, the sandstone appeared under different names, and that several theories about how it formed began to circulate. He concludes that the story of the St. Peter is not only the story of the assemblage of a stratigraphic unit over a vast area during three centuries, but also the role the study of the provenance of this unit played in the development of sedimentology in the early twentieth century, research that was made all the more challenging by its "simple" mineralogy. He thus found that the St. Peter has been controversial since it was first described.

Figure 1. Starved Rock, a prominent historical landmark of St. Peter Sandstone on the Illinois River in the state of Illinois, known to Europeans since 1682 (From Kett [13]).

Figure 2. The white cliffs of St. Peter Sandstone at the type section of the formation, Fort Snelling, 1844 (Courtesy Minnesota Historical Society).

Figure 3. John Locke's 1839 geological cross-section of the Mississippi cliffs, depicting the village of Prairie du Chien, Wisconsin, on the river bottoms. The St. Peter is here described as "soft sugar-like sandstone" (Courtesy Wisconsin Historical Society).

Figure 4. Saccharoidal Sandstone in the cliffs of the Pomme de Terre River, near Bolivar, Missouri, in 1855, from Swallow [19]. There were several units with the same name, creating confusion.

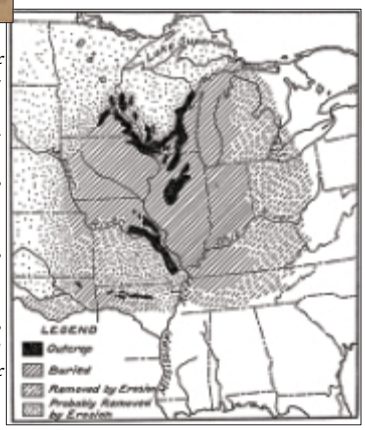


Figure 5. "Distribution of the St. Peter Sandstone" (modified from Thiel [21]). The type section at Fort Snelling, Minnesota, is located among the northernmost outcrop areas shown on the map, as indicated by the star. While this sandstone underlies much of the American Midwest, its vast subsurface extent was not realized until the widespread drilling of artesian wells.

Figure 6. Abraham Werner, father of Neptunism (left) and his water world, showing the Universal Ocean, from Brick [34].

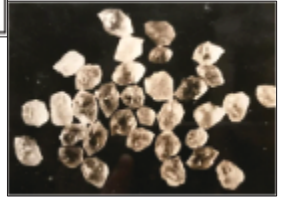


Figure 7. Grains of St. Peter Sandstone, from Brick [3].

GSM Membership Application/Renewal 2024-2025

Membership year begins September 1
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