



# THE GEOLOGICAL SOCIETY OF MINNESOTA

## News

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

### From the President's Desk...

Been there, done that, doing it again! After two previous terms as GSM President, I was asked to serve again, so you will be reading my thoughts in this Newsletter space for the next few issues. I want to thank Roger Benepe (also a three-term President) for superbly leading us over the past two years. I also want to thank Patrick Pfundstein and John Westgaard for completing two terms (four years) on our Board; Patrick also served as Vice President the two past years (and continues the crucial role of organizing our State Fair presence).

I want to welcome Lowell Hill to our Board, who along with me was elected at our Annual Meeting in September. This is Lowell's first term, and we welcome the fresh perspectives he brings. Dave Kelso, Roger Benepe, and Deborah Naffziger were also re-elected to second terms on the Board. At the November Board meeting, we elected Society officers for 2024. Besides me as President, Deborah Naffziger was elected to serve as Vice President, Dave Kelso to continue as Treasurer, and Stephen Willging to continue as Secretary. Our full Board membership appears on Page 2, along with many other important roles that do not require Board membership. I look forward to working with all of these persons, and all of you, to advance the mission of GSM, which has now been in existence for 86 years, since 1938.

As I write this in late January, our first lecture is a few days away. I look forward to hearing Chris Paola speak on Sediment Records of Extreme Earthquakes, as well as visiting with many of you and enjoying tasty cookies at the break. In-person lectures this semester are in our favorite location, Keller Hall, Room 3-210. Our full schedule for winter/spring appears inside, as well as on our website. I want to thank our Program Director, Steve Erickson, for once again putting together an excellent program of in-person and remote speakers. After Dr. Paola's lecture, our next three will be remote via Zoom, before we return to Keller Hall for live lectures. We will end our 2023/2024 schedule with the Spring Banquet on May 6 at U Garden Restaurant, where Kate Clover will tell us fascinating stories about sands from around the world. Although it seems unlikely to apply this winter, check your e-mail and our website before in-person lectures should the weather seem questionable.

A bit on lecture attendance for fall 2023: For our 6 lectures (5 in-person, 1 remote), we had total attendance of 331, averaging 55. This compares to average attendance of 57 for fall 2022, so essentially unchanged. Twelve identified themselves as first-time attendees, although we did not poll for new attendees at two lectures.

This past October, I participated in a GSM field trip to the Missouri Ozarks, led by Randy Strobel and Joanie Furlong. As we have come to expect from Randy & Joanie, this well-researched field trip took us to a series of interesting, historic, and scenic locations. An article on this field trip appears elsewhere in this issue. As GSM field trip coordinators, Joe Newberg, Nancy Jannik, and I are always looking for field trip suggestions. Local ones might involve a single day or just a few hours, while those farther away might span a



GSM President,  
David Wilhelm

Inside this issue:

Presidents message	1
Board Membership	2
New Members	3
Winter/Spring Seminars	3
ILSG May 2024	3
ESTEP	3
In Memoriam	4
Notes from the Past	5
GSM Member Profile	5
GSM Ozarks Field Trip	6
Geology YouTube Videos	10
Book Review	11
GSM Tshirts and Caps	11
Unusual Lake Superior Agate	12

weekend or up to a full week. Let us know where you would like us to visit. This past December 9, Ed & Sandy Steffner continued the tradition of opening their beautiful home for the GSM Holiday Party. They have been generously doing this for more Yule seasons than I can remember, and it is a highlight of the holiday season. As always, it was potluck, with 35 attendees providing delicious appetizers, hearty main dishes, and sweet desserts – plenty for everyone. Besides hosting, Ed regaled us with his accordion. He also accompanied us on piano as we sang “fractured” seasonal songs, with the lyrics adapted (often torturedly) to geological themes. Thank you, Sandy & Ed. Finally, this Newsletter, ably edited by Kate Clover, Mark Ryan, Harvey Thorleifson, and Rich Lively, is by GSM members for GSM members. Consider submitting an article to the editors about something you read, a place you visited, a geological experience from your childhood, or whatever you think might interest your fellow enthusiasts. Keep on rocking!

David Wilhelm

**GSM**

**2024 Board of Directors:**

David Wilhelm, President  
 Deborah Naffziger, Vice President  
 Dave Kelso, Secretary  
 Steve Willging, Treasurer

**Board Members:** Roger Benepe; Dick Bottenberg; Kate Clover; Pete Hesse; Lowell Hill

**Field Trip Coordinator:** Joe Newberg; David Wilhelm

**Geological Markers:** Rebecca Galkiewicz

**GSM Outreach:** Open

**Lecture Recording:** Dick Bottenberg; Deborah Naffziger

**Membership:** Joanie Furlong  
**Newsletter:** Kate Clover; Mark Ryan; Harvey Thorleifson; Rich Lively

**Programs/Lectures/Labs:** Steve Erickson  
**State Fair:** Patrick Pfundstein

**YouTube Administrators:** Patrick Pfundstein; Randy Strobel

**Video Library:** David Wilhelm

**Webmaster:** Alan Smith

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

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:**

<b>Student</b> (full time)	\$10
<b>Individual</b>	\$20
<b>Family</b>	\$30
<b>Sustaining</b>	\$50
<b>Supporting</b>	\$100
<b>Guarantor</b>	\$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](mailto: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](mailto:dewilhelm53@msn.com)

[Visit us on FaceBook](#)



*GSM Field Trip to Graf, Iowa, Oct., 1939. Studying the Maquoketa Shale and fossils (Orthoceras).*



## Welcome New Members!

Jungwei Fan, Rochester  
 Douglas Carlson, North St. Paul  
 Beth Kivett, Hopkins  
 Patrick Branigan, St. Paul

## Winter / Spring 2024 Seminars

NOTE: Winter/Spring in-person seminars will be held in Keller Hall Room 3-210. Seminars start at 7pm. Please try to arrive early. The University locks all exterior doors at 6:30, but someone will be at the door to let you in.

**January 29, 2024:** "Sediment Records of Extreme Earthquakes." *Chris Paola*, CSE Distinguished Professor, Department of Earth and Environmental Sciences, University of MN.

**February 12, 2024 (Zoom Lecture):** "Charting Pathways to a More Sustainable Future in the Ogallala Aquifer of Western Kansas." *James Butler*, Senior Scientist, Geohydrology Section, Kansas Geological Survey, The University of Kansas.

**February 17, 2024, Saturday, 10 am - noon:** "Fossils Through Time: Fossil Diversity and the 'Big Five' Mass Extinctions." *Jeff Thole*, Geology Laboratory Supervisor and Instructor at Macalester College.

**February 26, 2024. (Zoom Lecture):** "Geology of Tennessee." *Ron Clendening*, B.Sc., Geologist, Tennessee Dept. of Environment & Conservation

**March 11, 2024. (Zoom Lecture):** "Tales Told by Trilobites." *Thomas Hegna*, Associate Professor, SUNY, Fredonia, Research Associate at the Buffalo Museum of Natural History.

**March 25, 2024:** "From Formations to Foundations: The Geology of Bridge Construction." *Jill Mickelson*, PE and *Josh Kirk*, PE, Engineers at Braun Intertec.

**April 15, 2024:** "Important Events In Precambrian Earth History As Seen Through Minnesota's Bedrock." *Erik Nowariak*, Precambrian Geologist, Minnesota Geological Survey.

**April 22, 2024:** "PFAS: Contaminant Hydrogeology of the East Metro." *Christopher Formby*, Hydrologist, Minnesota Pollution Control Agency.

**May 6, 2024:** Spring Banquet. U Garden, 2725 University Avenue SE, Minneapolis. Dinner at 5 - 7 pm. Lecture at 7 pm. "Digging into the Stories of Sands." *Kate Clover*.



Here's a teaser for the **March 25th**, 2024 seminar. This is the first bridge over the Mississippi River at Red Wing. Known as the "High Bridge," it was constructed in

1895. The bridge was replaced in 1960 by the Eisenhower Bridge, and again in 2019 by the Eisenhower Bridge of Valor. The bluff in the foreground is part of He Mni Can, known to us settlers as Barn Bluff. Photo credit: Minnesota Historical Society.

## ILSG Meeting in May at Houghton, Michigan

The Institute on Lake Superior Geology (ILSG) plans to hold its 70th annual meeting at Michigan Technological University in Houghton, Michigan from Wednesday, May 15 to Saturday, May 18, 2022. One of the co-chairs is Erica Vye, who many will recall leading GSM field trips to the Keweenaw Peninsula (2015) and to Isle Royale (2018). The proposed in-person meeting will consist of two days of technical sessions on May 16 & 17. Field trips will occur on May 15 and May 18. Possible field trips include: 1) Rift-filling Mesoproterozoic Strata and Native Copper Deposits of the Keweenaw Peninsula, Michigan; 2) Mining History and Geology of the Quincy Mine, Keweenaw Peninsula Native Copper District, Michigan; 3) Geoheritage of Buffalo Reef: Industrial Impact on Land, Culture, and Fish Sovereignty; 4) Keweenaw Fault Geometry and Kinematics: Clues to Its Nature and Origin; 5) The Adventure Mine: Geology and History of a Native Copper Mine, Ontonagon County, Michigan; 6) Southern Complex Granitoids, Gneisses and Migmatites: New Data, Discoveries, and Perspectives; 7) Landslides in the Glacial Lake Ontonagon Sediments. Further information appears on the ILSG conference website: <https://www.lakesuperiorgeology.org/Houghton2024>.

ILSG is a non-profit professional society with the objectives of providing a forum for exchange of geological ideas and scientific data and promoting better understanding of the geology of the Lake Superior region. The major activity of the Institute is its Annual Meeting with geological field trips and technical presentations. While ILSG is primarily aimed toward professional geologists and geology students, it is open to interested laypersons; and there is plenty to learn, as I and dozens of GSM members who have attended past conferences can attest. ILSG is often the first opportunity for geology students to present their research to a large audience and to have informal discussions with industry and government geologists outside their universities, so it provides a valuable learning experience. Since one of GSM's goals is to provide educational support in the geological sciences, the Board has in past years elected to contribute to the ILSG Eisenbrey Student Travel Fund to support student participation. This fund helps students defray some of the direct travel costs to the Institute and may allow waiver of registration fees.

Dave Wilhelm

## ESTEP: Getting Earth Science Teachers Excited and Ready

What got you excited about geology? I am sure for many of us it was an enthusiastic, knowledgeable science teacher who introduced you to the wonders and mysteries of our planet. I remember Ms. Miller getting all excited teaching us about the Ring of Fire and Mr. Prunty's incredible rock and mineral collection that adorned his earth science classroom. The way to understand and



protect Minnesota resources and our Earth starts with prepared earth science teachers who are confident and passionate about their subject.

Minnesota is adopting new K-12 science standards. Now, sixth grade teachers will be teaching earth science, many for the first time, and high schools across the state will need to develop and deliver a comprehensive earth science course as a requirement for graduation. Earth science is no longer the forsaken child of the sciences but an equal academic science subject.

Sixth grade and high school teachers, who are new to teaching earth science, need resources and content knowledge in geology, meteorology, hydrology and astronomy. To help solve this urgent need the Minnesota Science Teachers Association (MnSTA), in partnership with five university geology professors and a team of experienced earth science teachers, has received funding from the Legislative-Citizen Commission on Minnesota Resources (LCCMR) to provide in-person and online programs statewide for earth science teachers.

The Earth Science Teacher Education Project (ESTEP) is a professional development program for 6th grade and high school earth and space science teachers. Our goal is to facilitate and model best practices in content and three-dimensional teaching strategies so that Minnesota teachers can become practitioners of the new science standards and create an environment of investigation and discovery in their classrooms. Graduate credit or stipends for all summer five-day "bootcamps" and credits for fall, spring and summer online courses are provided for teacher participants.



*An ESTEP participant collects data on an outcrop in the Oneota member of the Prairie du Chien group outside Mankato. Getting teachers into the field to observe and collect data is a key component of ESTEP.*

Over 270 teachers from throughout Minnesota have participated in ESTEP to date. Summer 2024 will have ESTEP bootcamps for 6th grade teachers held in Bemidji, Rochester and the Metro while bootcamps for high school teacher will be held in St. Cloud and Duluth. An additional three online courses, including such topics as meteorology, astronomy, rocks and minerals, practice-based teaching, and earth science essentials will be offered each in summer, fall and spring. Participation in ESTEP will also help prepare currently licensed high school science teachers

to obtain an additional licensure in 9-12 Earth and Space Science.

ESTEP is giving Minnesota earth and environmental education a shot in the arm by preparing and motivating science teachers to provide quality earth science instruction for their students.

For more information visit [www.mnsta.org](http://www.mnsta.org) and type ESTEP into Search.

Funding for this project was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).



### In Memoriam

#### *Paul Jansen*

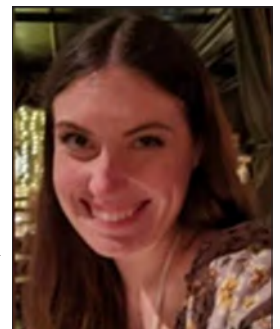
Former GSM Board Member Paul Jansen, 66 of Minneapolis, passed away on Jan. 3, 2024. He had been an enthusiastic subscriber to the Minnesota Orchestra since 1979. He was preceded in death by his parents, Paul Whidden Jansen and Betty Lou Wood Jansen and his brothers, Dave and Tom Jansen. He is survived by his wife, Janet Hopper and his brother, Bill Jansen and sister, Liz Jansen. He was a graduate of Kennedy HS, Bloomington and the U of M, and was an accountant for his entire career.



#### *Katherine Anne Preece*

Katherine Anne Preece, 35, was welcomed by the angels in November 2023. She faced her ordeal with cancer with courage, kindness, grace, and love. She is survived by her parents, Bently (Ly) and Debra (Deb) Preece of Eden Prairie. She is also survived by the love of her life, Adam Kobler of Minneapolis.

Kate was born on May 18, 1988, in Minneapolis, and grew up in St. Paul and Eden Prairie. Kate loved to travel and explore, but Como Park was one of her favorite places. Grand Marais also had a special place in her heart. She and Adam would often take day or weekend trips to explore new places. Kate was very creative. She loved cosplay and historical costumes and often "went down a rabbit hole" exploring costuming and clothing design on the internet. She often designed and sewed her own Victorian and Renaissance period clothing, which she stitched by hand, and often helped friends with their costumes. Kate was also skilled in needlework, and loved to crochet and cross stitch. She had a beautiful voice and enjoyed singing in her high school and college choirs. Kate really loved cats and dogs, especially Bixby, a friend's Cavachon. She took the time to notice nature and the little things in life, especially if they were small and fluffy. Kate's last wishes were that she not be forgotten, and that we should all be kind and love each other.



## Notes from the Past

*From the 1st Quarter 1964 edition of The Minnesota Geologist, Official Bulletin of the Geological Society of Minnesota*

### 1964 FIELD TRIP

Now is the time to start "boning up" on the geology of areas that you will want to visit this summer with the Geological Society of Minnesota under the leadership of Mr. Clark Pettengill in western states including Wyoming, Idaho, Colorado, South Dakota and Nebraska. The bus trip is scheduled for June 13-27.

Areas to be seen include escarpments at Chadron Park, Nebraska, dinosaur fossils at Dinosaur National Monument; Great Salt Lake with its salt flats; an open pit copper mine in Bingham Canyon; lava beds near Idaho Falls and at Craters of the Moon; Grand Teton National Park; Wind River Canyon, the Big Horn Mountains; the Black Hills; Badlands National Monument.

Hot springs, raging rivers, crystal caves, fossils from trilobites to dinosaur bones, ghost towns, buffalo herds, elk - these are a few other attractions that may be seen. The mountain and plateau areas that we are going to cross contain a wealth of mineral deposits - gold, silver, copper, iron, lead, zinc, uranium, salt, coal, asphalt, oil, bauxite, and many gem minerals.

From the Niobrara plains to the shores of ancient Lake Bonneville with some of the most picturesque of the Rocky Mountain scenery in between, this is a field trip that offers just about everything. The included schedule gives the route numbers of the roads to be taken with the mileage given between large towns and totaled for each day. The trip will cover approximately 3400 miles.

### GSM member profile: Lowell Hill



*Lowell staffing the GSM booth at the 2023 State Fair*

I grew up on a small dairy farm in central Minnesota. My exposure to geology during my earlier years consisted of rock hunting along gravel roads, creek beds and lake shores - mostly looking for agates, petrified wood, and any other rocks that looked interesting. And not really knowing what kinds of rocks I was finding.

Fast forward a bunch of years to September 2021 for my next, more focused exposure to geology. I started taking an online Geology 101 course from Nick Zentner, who teaches geology at Central Washington University in Ellensburg, Washington. My interest in geology at the time was driven by my volunteer work at the Science Museum of Minnesota's (SMM) paleontology lab - working on fossil preparation. I wanted to know more

about the matrix that was obscuring the fossils I was working with. One of my cohorts at SMM steered me towards the Zentner online course that I'm still working on - maybe on the 5-year plan?

In May of 2022, I joined GSM to take advantage of a GSM-sponsored fossil hunting field trip in Floyd County, Iowa that Roger Benepe and Steve Willging were leading. And I've been around GSM ever since (i.e. not a long timer). With GSM, I've volunteered at a couple of MN State Fairs, and have been working with Joe Wright and others on the video recording of the GSM lectures at the U of MN. I will be doing my first stint on the GSM board starting with 2024.

I filled in my "in between" years from the days on the farm to now with a variety of things. I used my degrees in math and computer science to pursue work in IT - about 20 years at BNSF Railroad, and about 20 years at IBM. My work years evolved through online train movement programming, mainframe software infrastructure support, and then work with data center migrations, consolidations, mergers, and site failovers, along with consulting and pre-sales of cloud and managed services for clients in the latter years. The IBM work involved travel to quite a few states and cities within the U.S.

I made a number of trips out west for skiing and summer vacations in earlier years, and still remember Devils Tower in Wyoming as one of the more interesting geological features I've seen.

I caught the volunteering bug back in the early 80s, starting with the Institute for MN Archaeology that existed at the time - doing winter lab work to look for cultural material in samples that people in the field had collected during the summer. Most of the material I worked with related to the Oneota tribe of Minnesota from around 1000 AD.

I took a couple of volunteer vacation trips through Earthwatch Institute - one to Scotland in 1988 to work on a survey of the coastlines of Scotland. During my time there, we worked along the coast of the Scottish Highlands where we would be dropped off in the morning and hike a section of the coastline - mapping/charting coastline characteristics like the type of terrain, how it was being used, was it urban or remote, etc. Some of the work was by zodiac boat if the terrain was too difficult.

My other Earthwatch trip was an archaeology dig in the country of Georgia in 1991. This was at the ancient site of Colchis (from Greek mythology) near the eastern edge of the Black Sea. The site has a lot of building foundation remains with pottery and gold artifacts from around 150 BC and earlier. I found a decorated pot sherd that the Georgian archaeologists were excited about. We also toured Vardzia - a cave monastery site in southern Georgia while there.

One of my pending interests is metal detecting, and I may get into that this coming year, and possibly some astronomy too. I'm enjoying more immersion into geology and other sciences through GSM, volunteering

at SMM, reading, and online courses. I still have my 50+ year-old rock collection, and I'm still not sure what all of the rocks are, but occasionally I consult with the experts to find out more about them.

**GSM's Missouri Ozarks Field Trip,  
October 19 - 23, 2023**

The Missouri Ozarks Field trip of October 2023 was centered in an area about 60 miles southwest of Saint Louis around the volcanic Saint Francois Mountains. The surrounding landscapes are unglaciated limestone, with winding roads and many streams. State Parks and historic sites abound.

Randy Strobel and Joanie Furlong planned and led the trip. Fourteen people including our leaders explored the Ozarks. The trip provided valuable insights into the geological history and significance of this region. The diverse sites explored, from lead mines to volcanic calderas, sedimentary rock exposures, and natural shuttles, offered a rich tapestry of geological features. These visits not only deepened our understanding of the Earth's processes but also underscored the importance of preserving and studying these geological wonders for future generations. The geological history of the Missouri Ozarks is a testament to the dynamic and ever-evolving nature of our planet.

This field trip report is broken up by days and has three authors. Mary Kay Arthur wrote about days 1 and 2; Larry Kalina and Marilyn Nelson described days 3 and 4; and Diane Lentsch wrote about day 5 and an extra hike on day 6.

**Days 1 and 2**

*by Mary Kay Arthur with much credit to David Wilhelm  
Photos by Dave Wilhelm and others as noted*

**The Ed Clark Museum of Missouri Geology**

Trip leaders Randy and Joanie had arranged an early entry to the Ed Clark Museum of Missouri Geology. The museum, part of the Missouri Geological Survey, displays rocks, minerals, and fossils collected by one of the early geologists. The museum staff also provides handouts and maps, assists with technical questions, and even identifies rocks brought in by the public. Display cases along the walls introduced us to the rocks that would engage us for the week. An adjoining room held a model of a Karst Landscape.



*Karst landscape model at the Ed Clark Museum*

**Meramec Springs and Iron Works**

In 1823, surveyors discovered a large spring with an average flow of more than 100 cubic feet per second, along the Meramec

River. An iron deposit ½ mile from the spring was noted. In the 1820s, Thomas James developed the Meramec Iron Works. The rushing spring water powered the mine and furnaces while the surrounding woods supplied the trees

for charcoal. The company town served 500. The furnaces, wagons, oxcarts, and trip hammers stand as they were when transportation difficulties closed the Works in 1876. The Iron Works are on the National Registry of Historic Sites. Nearby is a museum with a replica of the Works, complete with moving parts. The park is privately run by the nonprofit James Foundation.

Currently, the stream serves a trout hatchery. Wire baskets in the spillway isolate the various trout age-groups who tumble and scramble for any scraps that tourists throw their way. Just downstream, anglers await.



*Ore Cart with metal rimmed wheels*

**Meramec Caverns**

In 1720, Osage Indians led a French miner to a massive cave. Instead of gold, the yellow color on the walls was saltpeter (potassium nitrate) used in gun powder. In 1864, Confederate soldiers destroyed the gun powder manufacturing facility there. Today, this show cave supports a gift shop, museum, restaurant and fudge shop.

During the 1890s, the massive cave known as "The Ball Room" served as a local party venue complete with dance floor, concert hall, and Mother Earth's air-conditioning. In 1933, air moving through a wall crevice led to the discovery of extensive passages. Low water levels in 1941 revealed other passages plus artifacts traced back to the Jessie James Gang. In all, seven levels and 4.6 miles have been explored. Following our guide on the 1 ¼ miles of public paths, we passed about every



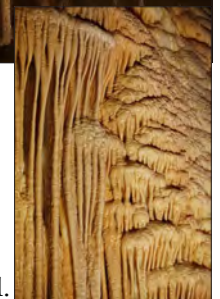
*Diane and Roxy examining rocks with their hand lenses.*



*The furnace at the old iron works remains mostly intact and has been designated as a National Historic Landmark. Remnants of the ironworks are scattered around Meramec Springs Park.*



*Stalactites at Meramec Cave*



*Detail of the "Stage Curtain" flowstone*

kind of cave formation, including “botryoids” which look like grapes, in “The Wine Room.” A 71-foot flowstone wall serves as a screen for a celebratory light show of vibrant LED colors, accompanied by patriotic music.

**Missouri Mines State Historic Site**

In the 1700’s, French mineral explorers began mining in hand-dug sites to exploit the “blanketlike lodes of galena” (lead sulfate) many feet thick, that lay just below the surface. The St. Joseph Lead Mine Company, incorporated in 1864, began in the days of mule power. By the time the company purchased the Federal Mill #3 lead concentrating complex, it dominated its competitors. The Mill closed in 1972 as the ore from The Old Lead Belt



*The processing plant at the former St. Joe Lead Co.*

became depleted. In 1975, the company donated 8,244 acres including the 24-acre building complex to the state of Missouri, giving the state the opportunity to choose whatever equipment might be of interest for a museum.



*The Big Joe Shovel, essentially a mechanical loader on crawler tracks, was designed by the St. Joseph Lead Co. and engineered to the specific underground conditions in the Old Lead Belt. Only 52 were built, the first around 1922.*

The innovative equipment on display in the first room brought efficiency and reduced the need for human and animal

power. Built specifically for The St Joseph Company, the St. Joe shovel, the EIMCO shovel, a man-carrying “speeder” for the bosses, a special 24-gauge locomotive, a rail-transported portable generator in case of power failures, all ran on electricity and compressed air lines that threaded through the mine tunnels.

Another room included exhibits on lead, geology, mineral resources (lots of geodes) and fluorescent minerals. The 3-dimensional topographic model of Missouri also helped to orient us. Lucky us, we also got a special tour of “the back of the room” with all its original equipment.

**Hawn State Park and the Pickle Springs Natural Area**

Hawn State Park sits near the edge of the outcrop area for the Saint Francois Terrane. Here rocks that existed before the formation of the Saint Francois Mountains are visible. After lunch at the picnic area, Randy spent some time explaining the progression we would see on a short walk to a stream where we would be able to find pieces of the Precambrian granodiorite.

But the main event was hiking the Trail Through Time in the Pickle Springs Natural Area. Pickle Creek carved elaborate hoodoos into the very old Lamotte

Sandstone. We passed through a slot canyon and further on “Cauliflower Rocks” formed as erosion removed the sandstone, creating a dramatic Double Arch and the Key Hole. The trail continued through carpeted woodland and into deep cut canyons. Signs informed us that “glacial relicts,” flora and fauna species that are remnants of long-gone glacial eras, could be found. (Shining Club Moss belongs in the Boundary Waters!) Ferns abounded. Owl’s Den Bluff revealed ripple marks and river channels long gone. At Spirit Canyon, the creek dug deep into the sandstone, creating shelters that harbored Indigenous people years ago. A long climb up took us to Dome Rock Overlook on top of the largest hoodoo. Pickle Spring, a permanent-flow spring, unusual in sandstone bedrock, was the creator of this enticing landscape and hike. What a wonderful afternoon.



*Randy explaining the local geology*



*Partial group: Standing L to R: Frank Janezich, Diane Lentsch, Randy Strobel, Sherry Keesey, Dave Wilhelm. Seated L to R: Michael Pedersen, Carol Pedersen, Chuck Perrin, Kevin Miller, Roxy Janezich (Joanie’s photo)*

Editor’s note: To see more of Dave Wilhelm’s photos from the Missouri Ozarks field trip, look here: <http://tinyurl.com/DaveMissouriPhotos2023>.

**Days 3 and 4**

*by Larry Kalina and Marilyn Nelson*

This next section highlights days 3 and 4 of the GSM field trip to the Missouri Ozarks where we learned geological history and saw great geological features at numerous locations: the Bonne Terre lead mine, Knob Lick Mountain caldera, Millstream Gardens, the Missouri Great Unconformity road cut, Silver Mines Recreation Area, Johnson Shut-Ins State Park, and Reeds Spring Mill.

**Bonne Terre Lead Mine**

We started Day 3 with a visit to the Bonne Terre lead mine. It’s located in the southeastern Missouri Ozarks and has a rich history dating back to the late 18th century. The mine closed in 1962. Lead mining was a



Bonne Terre Mine (Larry Kalina)

prominent economic activity in this region, with the Bonne Terre Mine being one of the most significant. The mine is famous for its extensive underground workings, including miles of tunnels and massive chambers. The lead deposits here are found in the form of galena, a lead sulfide mineral.

The Bonne Terre Mine deposits are Mississippi Valley Type lead-zinc deposits. These

deposits are hosted in limestone and dolomite rocks of Cambrian age and were formed by hydrothermal processes. The visit to this mine offered an opportunity to observe the complex interplay between mineralization and karst geology.

To get an understanding of lead mining and processing in 1948 at the Bonne Terre mine, watch *The Story of Lead*, a fascinating and historic YouTube video from the Department of the Interior. (Scary working conditions by today's standards!) [www.youtube.com/watch?v=6HhdkkdsvTM](http://www.youtube.com/watch?v=6HhdkkdsvTM)

**Knob Lick Mountain Caldera**

The Knob Lick Mountain Caldera is notable in the Missouri Ozarks; it is characterized by its elliptical shape, which is a key indicator of its volcanic origin. The caldera was formed during the Proterozoic era when the Earth's crust experienced intense volcanic activity. The remnants of this ancient caldera are composed of rhyolite and other volcanic rocks. It represents a window into the geological processes and magmatic activity that occurred billions of years ago, shaping the landscape of the Ozarks.

We made a brief stop at this site to view the caldera where Randy gave a brief lecture. Nearby we had access to a fire tower with views of the area.

**Millstream Gardens**



Millstream Garden (photo: Marilyn Nelson)

Our lunch stop was at the Millstream Gardens nestled in the heart of the Missouri Ozarks. It is a picturesque natural area characterized by lush vegetation and crystal-clear streams. The site offered an opportunity to observe a variety of sedimentary rock formations, including limestone and sandstone, dating back to the Paleozoic era.

This site features well-preserved sedimentary rock layers documenting ancient



The group at Millstream. Back row L to R: Joanie Furlong, Carol Pedersen, Kevin Miller, Frank Janezich, Dave Wilhelm, Diane Lentsch, Michael Pedersen, Randy Strobel, Marilyn Nelson. On bench L to R: Chuck Perrin, Sherry Keesey, Roxy Janezich, Mary Kay Arthur (photo: Larry Kalina)

environments such as shallow seas and river systems. These rocks contain fossils that provide valuable insights into the evolution of life dating back to the Paleozoic era.

**Missouri Great Unconformity Road Cut**

The Missouri Great Unconformity Road Cut on Highway 72, just west of Fredericktown, MO exposes a geological feature known as an unconformity. Unconformities represent gaps in the geological record, where older rocks are overlain by significantly younger rocks. In this case, Precambrian igneous and metamorphic rocks are overlain by Cambrian sedimentary layers.

This unconformity represents a gap in the geologic record of nearly 1 billion years. It is a valuable site for understanding the dynamic geological processes that have shaped the Ozarks.



Mary Kay points out the Great Unconformity in Missouri. (photo: Dave Wilhelm)

**Silver Mines Recreation Area**

Our last stop on day 3 was at the Silver Mines Recreation Area where we hiked to the dam.

This park is located in the heart of the St. Francois Mountains, an ancient mountain range in the Ozarks. This region is renowned for its rich mineral deposits, including lead and silver, which played a vital role in the area's



Silver Mine (Marilyn Nelson)



economic development.

In addition to the Ozark's mineral resources, the rocks illustrate geological history and tectonic processes and the area bears witness to the immense forces that shaped the landscape and created valuable ore deposits.

**Johnson Shut-Ins State Park**

Our first stop on Day 4 was at Johnson Shut-Ins State Park, a unique geological site in the Missouri Ozarks known for its exposed Precambrian volcanic and sedimentary rocks as well as its scenic shut-ins. A shut-in is a rock formation that carves through a mountain range, causing a complex of pools, rivulets, rapids and plunge pools. They are often found in streams in the Ozarks. Shut-ins are confined to a narrow valley or canyon, with the river valley widening out both above and below the formation. Here the shut-ins formed by the East Fork of the Black River. The volcanic rocks date back to the Proterozoic era and have been eroded and sculpted by the river's action over millions of years.

The significance of Johnson Shut-Ins lies in its ability to showcase the interaction between geology and hydrology. The exposed rocks and the shut-ins themselves illustrate the powerful role of water in shaping landscapes, while the ancient volcanic rocks provide a glimpse into the Earth's distant past.

Johnson Shut-Ins State Park contains the Taum Sauk 442.5-Megawatt Pumped Storage Project. The Taum Sauk Project, located on the East Fork of the Black River and Taum Sauk Creek, consists of upper and lower reservoirs with pairs of turbine/generator sets at each reservoir. During daylight peak-demand hours, the turbine/generator uses the water in the upper reservoir to generate electricity for the surrounding communities. At night the turbine/generator uses external power to refill the upper reservoir from the lower one.

The Circle of Time is an outdoor labyrinth highlighting phases of earth from the planet's initial creation and through geologic and paleolithic phases. It's also a short hike showing many of the geological features of the area.



GSM members examining the Taum Sauk Circle of Time Labyrinth (photo by Larry Kalina)

On Dec. 14, 2005, a section of dam wall along the old Taum Sauk reservoir collapsed, sending 1.3 billion gallons of water rushing down the side of Proffit Mountain. The wall of water followed the Black River and swept through

Johnsons Shut-ins State Park, depositing tons of rock, boulders and sediment along the way. It also damaged the park's lone residence, which housed the park superintendent, his wife and their three children. They, too, were swept away, but all survived with only minor injuries.

A short hike along the Black River allowed us to get into the scour area, the 1.5-mile section of the river bed that

was swept clean by the reservoir failure.

**Reeds Spring Mill**

Our last stop on day 5 was at Reeds Spring Mill, located near Johnson Shut-Ins, a historical site that once served as a center for milling operations. The mill's foundation is built on exposed Precambrian rhyolite, which adds to its geological significance. Constructed in the 19th century, the mill played a crucial role in the local community's development.

Reeds Spring Mill uses the natural resources of the Ozarks for economic purposes. The mill's location on ancient volcanic rocks serves as a reminder of the interaction between human activities and the geological features of the region.



Reeds Mill (photo Dave Wilhelm)

**Missouri Trip Days 5 and 6**

by Diane Lentsch

**Elephant Rocks State Park**

On day 5, the group gathered at Elephant Rocks State Park to see the 1.5-billion-year-old Missouri Red Granite weathering in place to form huge rounded boulders. Back in the day, someone thought this large grouping of pink granite formations looked like a train of circus elephants, and the name stuck. My understanding is that cracks and joints formed in the granite. Over time, erosion exposed the granite at the surface and water seeped into the cracks and eventually weathered away the sharp edges, causing spheroidal weathering. We saw examples of rotten granite or "grus" at the base of the elephants. Attached to the park is the oldest commercial quarry in Missouri which produced much of the Missouri Red granite for street pavers and building stone in St. Louis and Jefferson City.



Entire gang at Elephant Rocks. L to R: Mary Kay Arthur, Kevin Miller, David Wilhelm, Michael Pedersen, Frank Janezich, Roxin Janezich, Marilyn Nelson, Sherry Keeseey, Chuck Perrin, Diane Lentsch, Carol Pedersen, Randy Strobel, Joanie Furlong, Larry Kalina



Missouri red granite (wiki commons)

Another interesting aspect of Elephant Rocks State Park is the "Braille Trail." This trail provided tactile markers along the way as well as Braille printouts on the interpretive signs. The entire trail was black-topped and fairly level except for the pinnacle near Dumbo and the rest of circus train

core stones. Speaking as a hearing and sighted and able-bodied person, I thought the trail was exceptionally accessible.

**Historical Site of Pilot Knob Civil War Battle Site**

The group next assembled at the Historical Site of Pilot Knob Civil War Battle Site. The Visitor's Center does a nice job of telling the story and provides a movie showing a balanced picture of the events. The site



Pilot Knob Battle Site Monument

had been a Union Fort which was attacked by Confederates. The Union soldiers did not have the resources to continue to defend the fort and under the cover of darkness, were able to sneak past the Confederates and actually blew up the Fort's powder magazine as they left. The Confederates' plans were dashed and they moved Westward.

**Taum Sauk Mountain State Park**

After lunch at Thee Abbey Kitchen Restaurant in Arcadia, we traveled up to Taum Sauk Mountain State Park and hiked to the highest point in MO (1,772 feet). The views along the way were spectacular. That was the end of the official trip, and we said our goodbyes.

**Hughes Mountain (day 6, an extra stop)**

On day 6, four of us took an unofficial bonus hike and climbed up Hughes Mountain to see the views and to examine a rare example of columnar jointed rhyolite. From our vantage point on the mountain, we could see the weather was changing and our days of warm sunshine had ended. Time to start driving back to the north country.



Randy Strobel, Joanie Furlong, Diane Lentsch, and Mary Kay Arthur standing on columnar jointed rhyolite, Hughes Mountain.

**YouTube Videos: Virtual Geology Field Trips and Lectures about Iceland's Volcanic Activity**

Are you looking for virtual geology field trips or a lecture? Shawn Willsey, Idaho geologist and professor at College of Southern Idaho, has a YouTube channel with an array of videos. Willsey gave GSM a Zoom lecture on Idaho geology in spring 2023 and since then, I've been watching videos on his YouTube channel. Currently, his 100-plus videos cover geological sights in eight US states and two countries. His videos are fact-filled and not overly-produced or overly dramatic. His mission is to educate and get people excited about geology, and he's a passionate teacher. At the end of many talks, he answers questions viewers had asked in the "Comments" section in prior videos.

His recent videos include frequent updates on Iceland's volcanic eruptions and unrest near Grindavik, Iceland on the Reykjanes Peninsula in Southern Iceland. First, he covered the unrest leading up to the Dec. 23 eruption, then the actual eruption. After the eruption ended, he continued to present video lectures sharing maps, seismic data, news of the residents who evacuated, plus GPS data which records East/West and North/South earth movement as well as ground inflation. He has compared the December 2023 eruption to previous eruptions that occurred over the past three years plus historic submarine eruptions off the Reykjanes Peninsula. He's continued in 2024 with many lectures about the continuing unrest and the eruption on January 14, 2024.



This screenshot, a photo from the Nature Eye drone (~12:20, local time, January 14, 2024) captures the opening of the 2nd fissure vent a few seconds after the earth broke open. This shows a tight cloud of gas escaping from a newly opened section of the fissure. First the gases escape, then the lava starts to flow. Geologist Shawn Willsey, lower right, watches and provides live commentary from his office in Idaho.

Willsey has also linked up with Nature Eye, a Drone company in Iceland. From his office in Idaho, Willsey has co-piloted a drone with Johann Stefansson in Iceland. On their first flight, they flew the drone close to the active eruption, and Willsey discussed the fissure eruptions, and how the gas content controls lava fountaining. He spoke about the lava colors and temperatures, and the vents and deltas and more. It was truly fascinating to see the pulsating lava in real time and in such detail. On another drone flight after the

December eruption ceased, they flew the drone over the still-cooling lava fields and zoomed into flow fields and steaming vents and craters. What amazing technology! I've hiked Iceland's volcanic fields. Those were rigorous, epic hikes with wind, driving rain, and uneven terrain. Watching the landscape being transformed from the comfort of my living room was pretty satisfying.

To view his videos, search: "Shawn Willsey YouTube." The erupting lava videos are titled: "Iceland's Impressive Eruption: Livestream from Geologist Shawn Willsey." Another drone flight is titled: "Live Drone Flight over Iceland with Nature Eye: Impromptu Livestream."

Once at Willsey's YouTube site, poke around. His "Random Roadcuts" series explores – you got it – roadcuts where he stops, turns on his video camera, then hikes and shares what he's observing about the rocks, their structure, and the local geology.

For me, his video lectures are a reminder for me to slow down when I'm out hiking and exploring and to look more closely at the rocks and the structures. Because the more I see, the more I understand the big picture. And I realize, there is always more to learn.

Kate Clover

### **Book Review: Journey to the Centre of the Earth, A Scientific Exploration into the Heart of our Planet by David Whitehouse, (2015, Weidenfeld & Nicholson, London)**

I like whole Earth geology, and this book delivers in spades. Briefly, it is about the construction of the inner Earth: core, mantle, and all that. Author Whitehouse interweaves the history of the discovery of the various parts of the inner Earth, seismology, and the mineralogy of it all.

Whitehouse weaves a creative tale of eccentric geologists, wild discovery, and earth chemistry. He keeps your attention with entertaining stories and fun chemistry. Well, I think the chemistry is fun, you may not.

He wrote it in response to the 150th anniversary of Jules Verne's *Journey to the Centre of the Earth*, and includes quotes and analogies to that book. That part got old for me very quickly, but they are easily ignored, and the rest is engaging.

He is a Brit, so be prepared to translate British scientific notation into American, e.g. 4,500 million years = 4.5 billion years; plus, there's a strong emphasis on British scientists, though he includes others. He is also a trained astronomer, so he dwells on galactic and star-oriented things. Okay, we all are star stuff, get over it.

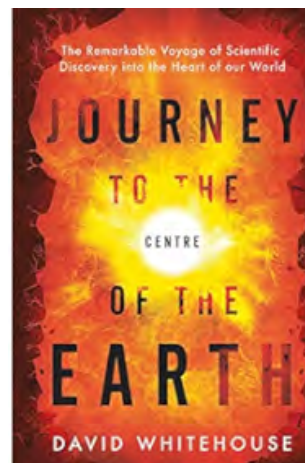
He starts with a quick descent through the Earth, describing each layer as we go through it even though it is impossible, as he acknowledges. Then he goes back and starts with the history of geology and the slow discovery of plate tectonics, seismology and using seismic tomography to map out the inner Earth.

He compares Earth to the other inner planets and details why maybe it might be somewhat rare for a planet to develop life, at least as we know it.

You, as the reader, end up in the inner core of the planet, and what a strange place it is. Compare that to the turkey of a movie *The Core*, and you see why that was voted the most scientifically inaccurate movie ever. (It is also in the video library, should you like a good laugh/cry.) Whitehouse also explains why we have a magnetic field and why it has helped us live and thrive.

There's lots of good stuff in this book. I think it would make a fine contribution to your essential geological library.

Deborah Naffziger



### **GSM Shirts and Caps**

We are considering selling GSM T Shirts and Baseball Caps again as we did in 2019. The shirts would be available in several colors and sizes and have the same 8 ½ inch logo printed on them. Caps would be available in several colors and have the same 2 ¼ inch logo sewn on in gold. Shirts would cost from \$15-19 depending on the quantity ordered and caps from \$17-25, again depending on quantity.

Joe Newberg





*Lake Superior Agate, by Mark Ryan*

---



P.O. Box 141065, Minneapolis, MN  
55414-6065

FIRST CLASS MAIL