



News

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



GSM President, Dave Wilhelm

From the President's Desk...

A little less than two years ago, I wrote my first column as GSM President; now I'm writing my eighth and last. It certainly does not seem like two years. I will say I have very much enjoyed serving as your president, and I hope you feel that you were well served. GSM by-laws limit Board membership to two consecutive two-year terms, so as to encourage new Board members with new ideas. My four years on the Board are at an end. But rest assured, I will continue to be active in GSM. I continue as Video Librarian and with **Becky Galkiewicz** have taken over the task of e-mailing general announcements to the GSM membership. (Excuse us if you occasionally get multiple mailings as we master this task.) Thank you **Bill Robbins** for handling this task for the past many years. As I write this, the November Board meeting is still over a week away, so my successor has not yet been elected. However, elsewhere in this Newsletter you will find the results of officer elections from the November Board meeting.

It has been a busy summer, both for GSM as an organization and for me personally. In July, we had two excellent field trips to Michigan's Upper Peninsula. In this Newsletter, **Vern Schaaf** reports on our three-day trip to the Pictured Rocks area, and **Roxy Knuttila & Frank Janezich** report on our four-day trip to the Keweenaw Peninsula that followed immediately after. In September, **Randy Strobel** organized a Sunday afternoon field trip to Pilot Knob, which overlooks the confluence of the Minnesota and Mississippi Rivers; **Diane Lentsch** has submitted a report on that trip. Thank you, Vern, Frank, Roxy, and Diane for taking the time to inform our members who could not participate in those trips.

Beyond those GSM field trips, in August I participated in two back-to-back Chautauquas with **Randy Strobel & Joanie Furlong**. We studied volcanoes in northern California and southern Oregon. In spite of considerable haze from forest fires in the area, these proved to be very informative and very scenic trips. I'll report on these in our next Newsletter in February.

I am pleased that I have (finally) been able to arrange the third and fourth tours of St. Anthony Falls River Lab. When you read this, one will have already occurred on November 9, with the other to follow December 9. I hope that all of you who were interested had a chance to participate in one of these tours. (See the February 2015 Newsletter for **Mary Kay Arthur's** report on the first of these tours.)

We are always looking for new field trip ideas. Is there some place of geological interest that you would like to visit, or have visited and would like to share with other members? Contact me and I'll put you in touch with someone who has experience organizing our field trips. Local field trips can be as short as a few hours, and often we can recruit a professional geologist as the technical leader.

We are well into the 2015-2016 lecture series, and so far it has been a great one. We are

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from the GSM archives:
 Lunch in Brule River state park, field trip along the south shore of Lake Superior, in Wisconsin, circa 1939.



averaging around 87 persons per lecture, and had an especially good turnout of 104 for our October 26 lecture on Groundwater/Surface-Water Interactions, including over 15 first-time attendees. The full schedule appears on our website (<http://gsmn.org/>). Prior to each lecture **Alan Smith**, who maintains our web site, posts a summary of the upcoming lecture on our home page as soon after the previous lecture as we receive the summary. All lectures and labs are free and open to the general public, so feel free to invite family or friends when topics are presented that you feel might interest them. These lectures are eligible for continuing education credit, if you can take advantage of that. Forms are available at all lectures. If you have an idea for a lecture or lab, or know of a possible presenter, contact **Steve Erickson** with the information. Steve will not start creating the 2016-2017 schedule until January, but maintains a list of suggestions he has received.

Elsewhere in this issue, **Dan Japuntich** thanks everyone who staffed our booth at the State Fair. We have already gotten a number of new lecture attendees and members from our booth. I want to second Dan's thanks to all volunteers, but I especially want to thank Dan himself for stepping up to this important post and for all the time and effort he put into planning the booth setup and arranging the volunteers

Our membership year started in September, when everyone's annual membership payment came due. Thanks to the very many of you who have already renewed. For those who have not, the easiest way to renew is to pay Membership Chair **Joanie Furlong** or Treasurer **Mary Helen Inskeep** at one of the lectures. Or mail in your membership form and dues to the address listed in this Newsletter and on our web site. Be sure we have your e-mail address exactly right. The largest portion of your membership dues contribute toward our speakers' honoraria, so all of us as members do our part in making the 2015-2016 lecture series possible. *(continued on page 3)*

GSM News

Officers:

Dave Wilhelm, President
 Mary Helen Inskeep, Treasurer
 Rebecca Galkiewicz, Secretary

Board Members: Deb Preece; Ruth Jensen; John Jensen; Theresa Tweet; Mark Ryan; Roger Benepe; and Dan Japuntich

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

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

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

Joanie Furlong
 GSM Membership Chair
 P.O. Box 390555
 Edina, MN 55439-0555
 Membership dues are: \$10 Full-time students; \$20 Individuals; \$30 Families

GSM News is published four times a year: **February 15, May 15, August 15, and November 15**. Deadline for article submission is the first of the month, before the date of publication.

Newsletter contributions welcomed

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

New GSM Members!

Carmen, Dale & Candice Steppa, Virginia
 James Daly, Little Canada
 Craig Flory, Roseville
 Millie Acamovie, Minneapolis
 Gene Van Massenhove & Linda Krugman, Arden Hills
 Caroline Woodruff, Minneapolis
 James Mirick, Chaska
 Michael Convery, St Paul
 Mike Walker, West St Paul
 Ginny Hansen, Arden Hills
 Dan Schmechel, St Paul
 Kristine & Larry Reiners, Apple Valley
 Patrick Pfundstein, St Paul
 Marty Van Duzee, Hudson

Finally, thanks to our Newsletter editors, **Theresa Tweet, Mark Ryan, Harvey Thorleifson, and Rich Lively** for putting this issue together. I look forward to reading it. They are always looking for articles. If you have taken a trip (formally organized or not) or done an activity that you feel would interest others in GSM, consider writing a few words describing your experience and submitting it to Theresa or Mark. We'd love to hear from you. Our Newsletter is by GSM members for GSM members. The deadline for the next issue is February 1, with earlier submissions encouraged. See our web site for submission details.

Hope to see you on campus for lectures and next year on field trips.

GSM President, Dave Wilhelm

FYI – GSM Newsletter Guidelines

<http://gsmmn.mngeology.net/content/gsm-newsletter>

Officers Elected for GSM Board of Directors for 2016

The GSM Board of Directors held their regular meeting on November 12, 2015. Prior to this meeting, John Grams resigned from the Board, due to increased work commitments. Thanks for your service, John. The Board appointed Theresa Tweet to fill out John's term. The Board elected the following officers, whose terms begin January 1, 2016:

President – Dick Bottenberg

Vice President – Theresa Tweet

Treasurer – Mary Helen Inskeep

Secretary – Rebecca Galkiewicz

Although Dick is just re-joining the Board after a few years absence, he served well as our President in 2010-2011, so has good experience. Theresa is also a past President and maintains our Facebook page, among many other duties. Mary Helen and Rebecca are continuing in their roles from 2015, which they are fulfilling admirably. I want to congratulate our slate of 2016 officers and thank them for agreeing to serve our organization going forward. I am very confident that GSM will have great leadership in 2016.

The full minutes from the November Board meeting will appear in a few weeks on our web site in the usual location (<http://gsmmn.mngeology.net/content/gsm-board-minutes>), after they have been formally approved by the Board.

Dave Wilhelm

****2015 GSM Holiday Gathering****

Ed and Sandy Steffner will again be opening their doors to the GSM clan. The Steffners will welcome guests on Saturday, December 12 at 3:30 PM for appetizers, and 5 PM for Pot Luck Dinner; there will be no board meeting again this year.

For food plans and the address please contact Sandy at ssteffner41@gmail.com

www.gsmn.org

THANK YOU, 2015 GSM State Fair Volunteers!

It has been an honor being the State Fair Committee Chair this year! I would like personally to thank all of the volunteers for representing GSM this year at the State Fair. Everyone showed up on time with very few changes of personnel or times. The State Fair Committee booth set-up and take-down went flawlessly. The booth was kept clean and functional by all of you. Joanie says that we have had many new memberships so far!! See you next year!

2015 GSM State Fair Volunteers: Mary Kay Arthur, David Bendickson, Roger Benep, V. Bonnstetter, Dick Bottenberg, Barbara Broberg, Dave Broberg, Tom Burt, Ted Chura, Kate Clover, Fran Corcoran, Mary Davitt, Dorothy Edelson, Sue Engstrom, Steve Erickson, Joanie Furlong, Jean Gorman, Lynne Grigor, Nancy Halvorson, Elaine Handelman, Bill Haralson, Dick Heglund, Janet Hopper, Patsy Huberty, Mary Helen Inskeep, Frank Janezich, Paul Jansen, Dan Japuntich, John Jensen, Ruth Jensen, Judy Jones, Lee Kaphingst, Alfred Kauth, Sherry Keeseey, Roxy Knuttila, Diane Lentsch, John Maronde, John Matlock, Tom Norenberg, Mark Nupen, Mary O'Connor, Rosie O'Donovan, Lisa Peters, Deb Preece, Ly Preece, Ron Rizzo, Bill Robbins, Mark Ryan, Pat Ryan, Vern Schaaf, Cindy Schneider, Tom Schoenecker, Alan Smith, Kay Smith, Ed Steffner, Sandra Steffner, Randy Strobel, Don Swensrud, Bob Thomasson, Justin Tweet, Theresa Tweet, Dave Wilhelm, Roger Willette, Joe Wright.

Dan Japuntich

NOTES FROM THE PAST

Submitted by Katy Paul

From the FALL-WINTER 1964 GSM News - Our annual picnic was held on Sunday, August 2, at the home of Mr. and Mrs. Harry Sommers on the St. Croix in North Hudson. About 60 members came to enjoy the generous hospitality of our gracious hosts. Mrs. Linda Bennit, sister of Mrs. Sommers, gave a talk entitled "Following the Mississippi to the Gulf". It was based on the trip she and Mr. Bennit took in their cabin truck which they call "The Turtle". She described in interesting detail the numerous dams built along the river and the changing width of the channel at various distances; she also told about the difficulty they had in reaching a most distant point through the delta to the Gulf. Having been Geological Society members for many years, they were particularly alert to the geologic features of this challenging trip and were able to transfer some of their interest and enthusiasm to the group. As usual, it was a delightful afternoon for our members, who expressed their appreciation for the cordiality of our hosts and the excellent sweet corn from their home garden.

GSM Annual Meeting

September 14th marked the beginning of our 2015-2016

lecture series, at the U Garden Restaurant on University Avenue – an event that called to mind a tradition of camaraderie spanning 77 years of enjoying the first lecture of the year from the GSM series.

The event began with a leisurely dinner followed by announcements. David Wilhelm, current GSM President and speaker extraordinaire made known the new candidates for Board members, Kate Clover and Dick Bottenberg. These individuals are recognized by the group as familiar participants in most every facet of the GSM Organization and were welcomed as our new additions to the Board. Ruth Jensen and Mary Helen Inskeep also agreed to continue their roles as active Board members and are staying on for the next two years. These four Board members, along with the rest of the crew, bring with them many years of service as well as their long standing commitment in fulfilling the Mission Statement of the GSM. Randy Strobel gave attending patrons information about the up-coming Pilot Knob Preservation Field Trip; Dan Japuntich made a most gracious announcement - thanking the State Fair Volunteers; and lastly, **Justin Tweet**-our speaker for the evening was introduced.

Justin spoke on the “Paleontology of Colorado Plateau National Parks”. The Colorado Plateau of Utah, New Mexico, Arizona and Colorado includes famous parks such as Grand Canyon, Petrified Forest, and Bryce Canyon. The most common Colorado Plateau fossils are from Pennsylvanian to Permian marine rocks – including corals, brachiopods, mollusks, and echinoderms. Archeological sites just outside the Colorado Plateau park zone include Salinas Pueblo Missions National Monument and the Pecos National Historic Park. Here, the history of the mixing of cultures, the Pueblo, Spanish Missionaries and Franciscan Priests, has been preserved in the form of churches, dwellings and petroglyphs.

I found the packrat middens segment scientifically important because if you want to know what a climate was like in a desert region thousands of years ago, examine packrat middens. Packrats would have collected and stored what was available at the time, using it in their nest building process. This included, but was not limited to: seeds, pollen, and other plant growth, as well as animal remains, creating a time capsule for scientists. Thank you Justin!

For more information: <http://geomaps.wr.usgs.gov/parks/province/colo.html>

Bizarre, Human-Size Sea Scorpion Found in Iowa Meteorite Crater

Here is a story drawn to our attention by GSM Member Rick Uthe

<http://www.livescience.com/52052-ancient-sea-scorpion-fossils.html>



The Iowa Geological Survey discovered the fossils during a mapping project of the Upper Iowa River.

Report of dinosaur discovery in northern Minnesota

This past summer, a team of volunteers from the Science Museum of Minnesota (SMM) discovered a new and, for Minnesota, rare dinosaur fossil, adding another piece to the scant available evidence that dinosaurs once lived in the state. SMM volunteer Len Jannusch found the theropod ungual (claw) on a spoil heap of Cretaceous material at the Hill Annex Mine State Park in Calumet, Minnesota. He made his discovery on the final day of the museum's last scheduled field trip for the season.



SMM Paleontology Volunteer Project Lead (and GSM member) John Westgaard organized several trips to the park over the summer to investigate the Coleraine Formation, a Late Cretaceous conglomerate that overlies the iron ore found in the old Hill Annex mine. The Coleraine Formation was deposited some 90 million years ago, when Minnesota was situated on the eastern edge of a large intercontinental seaway dividing North America. In turn, the Coleraine is overlain by a thick layer of Pleistocene glacial drift.

Typically, when the Hill Annex mine was active, mining operations removed the overburden, storing it on-site in several spoil piles. Since becoming a state park, the mine site has allowed the public to hunt for fossils on some designated piles.

Most fossils collected are of marine origin including oysters, sharks teeth, ammonites, gastropods, and crab burrows. Occasionally, reptilian fossils, such as a crocodile snout, have been found, but the recent dinosaur find is only the second found at Hill Annex, and only one of three confirmed dinosaur fossils found in Minnesota. The field trips were made possible, in part, by one of several Marjorie Bolz Allen grants issued annually to volunteer projects at the Science Museum of Minnesota.

More about the Hill Annex Paleontology Project can be found at: <https://www.smm.org/hill>

Mark Ryan

GSM Field Trip to Pictured Rocks National Lakeshore, Michigan

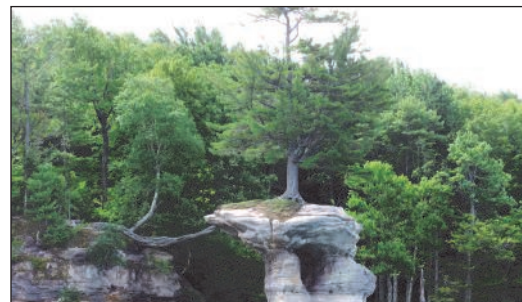
Randy Strobel led a highly enjoyable GSM field trip to Pictured Rocks National Lakeshore from July 19th to 21st, 2015. Randy and Joanie had scouted the area to plan two days at Pictured Rocks and one day for a train and boat ride at Tahquamenon Falls. This trip preceded the Keweenaw Peninsula trip led by Bill Rose and Erika Vye. Participants enjoyed great weather, minimal insects, and lush green landscapes. Randy, along with providing the geological insight, identified birds, trees, flowers (and slime molds!) for us.

Pictured Rocks National Lakeshore (PRNL) extends 40 miles from Munising to Grand Marais. The area became the nation's first National Lakeshore in 1966 to preserve the shoreline, cliffs, beaches and sand dunes. The park consists of two zones: the lakeshore zone managed by the National Park Service, and the Inland Buffer Zone with a mix of federal, state and private ownership.



Miners Castle

Our first morning was a boat excursion along PRNL from which we viewed brilliantly colored sandstone cliffs, including landmarks such as Miners Castle, Chapel Rock, and Grand Portal Point. The color variations are caused by water dissolving minerals as it seeps through the stone. Eventually, it runs down the face of the cliff, leaving the beautiful color variations: red and brown from iron, black from manganese, turquoise and green from copper, and



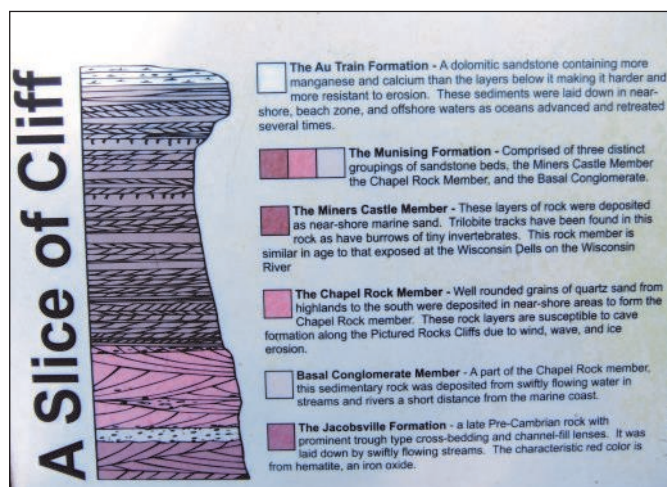
Chapel Rock



Grand Portal Point

white from limonite. These colors contrast with the lake's jade green, making for spectacular scenery.

The uppermost sandstone layer is the Au Train Formation, a light brown to white dolomitic sandstone that forms a resistant cap rock resulting in



Pictured Rocks stratigraphy

numerous water falls. Below is the ~200 foot thick Munising Formation, which is further divided into the Castle Rock, Chapel Rock, and Basal Conglomerate members. Next is the banded red and white Jacobsville Sandstone, with at most a few feet of this formation showing above lake level within the PRNL. This was a prized building stone during the 19th century which can be seen in town buildings throughout the area.

We boated past the frequently photographed Grand Island East Channel Lighthouse. Built in 1863, this lighthouse no longer functions and now sits on private property. Its function was replaced by Munising Range Lights.



Grand Island East Channel Lighthouse

At noon we had lunch and hiked at Munising Falls. In the afternoon, we took a glass bottom boat excursion to view sunken ship wreckages. The clear water and glass bottom allowed about 50-foot viewing depths. The narration described three ship wrecks. As we passed over them, we could see wreckage remains such as the anchors, hulls, timbers, and even a toilet fixture.

The second day we drove to sites within the PRNL, beginning with the Sand Point Marsh Nature Trail.



Grand Sable Dunes

We next drove and hiked to Miners Castle and Beach. We could now see the beauty of these sites from land compared to yesterday's views from the lake. As we progressed east toward Grand Marais, we viewed Log Slide Overlook, where logs had been slid down a steep sand dune slope during the lumbering era. We spent time at the Grand Sable Dunes climbing the dunes and browsing the visitor center. The dunes are attributed to earlier higher Lake Superior water levels. The day ended with dinner in the little lakeshore town of Grand Marais.



Toonerville Trolley

On the third day, we drove to Zoo Junction just east of Newberry to board the Toonerville Trolley, a narrow gauge (24 inch) train that we rode five and a half miles through forest and marshland habitats to the Tahquamenon River. A field trip guide was provided and we looked for the 11 tree species identified in the guide. We also saw a black bear



Tahquamenon Falls

within 150 feet of the train walking along the tracks. At the river, we boarded a riverboat for a 21-mile narrated river cruise to the rapids above the Upper Tahquamenon Falls. We saw numerous bald eagles and nests along the route. The Falls could only be viewed from a distance as we were not allowed to descend to the bottom due to a recent rock slide that had damaged the steps. As the photo shows, because of the trees, taking pictures of the Falls was a little difficult. The late afternoon we spent driving to Houghton to start the Keweenaw trip the next day.

We want to thank Randy and Joanie for their early scouting efforts, and for including such interesting sites and beautiful scenery in the trip. As always, Randy did a great job interpreting the geology of the area, as well as highlighting the trees, plants, and birds we saw. The bright sunshine we enjoyed highlighted the colorful lake cliffs, adding to the beauty of the attractions and making for a memorable trip.

Vernon Schaaf

Keweenaw Geoheritage Trip

In July 2015, 28 GSM members travelled to the Keweenaw Peninsula of Upper Michigan to learn about the geological wonders and copper mining history of the region. Erika Vye, a doctoral candidate at Michigan Tech, along with retired geology professor Bill Rose crafted our 4-day tour into four geothemes of the Keweenaw: Lake Superior, Jacobsville Sandstone, the Keweenaw fault and lavas, and the Keweenaw rift. Dr. Kari Anderson, who lives in the area, and Noel Irwin, professor of Environmental Engineering, also assisted in the field trip.

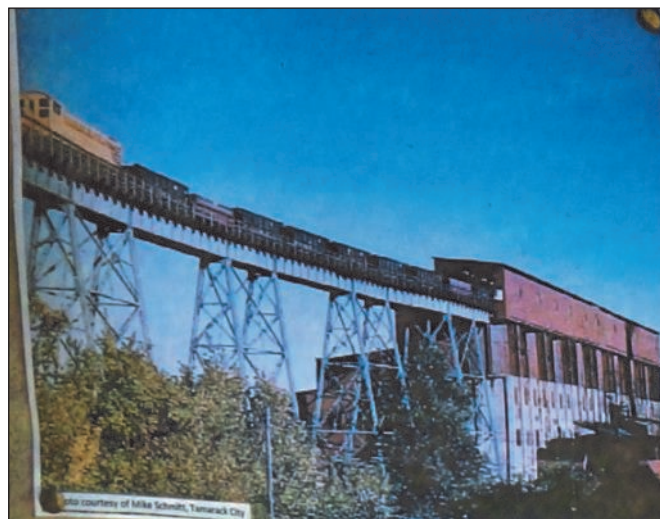
Day 1 - Lake Linden: We met at a park near Lake Linden Marina on Torch Lake, northeast of Houghton. We divided into one group that went out with Captain Stephen Roblee on the Michigan Tech research vessel



Michigan Tech research vessel: Agassiz

Agassiz for the morning, while the other visited sites on land. In the afternoon the two groups traded places, as we did each day to conform with boat capacity.

From the water near the village of Gay, Professor Irwin explained the extent of pollution that remains nearly a century after copper mining began near Lake



Historic photo: stamping mill and train unloading copper ore

Linden. In the early years, large amounts of native copper, which was more than 90% pure, were discovered and mined. But, as those resources were depleted, other methods were used to extract copper from the rock matrix.

Huge stamping mills were built to crush the rock, after which the copper was gravity separated in a sluice. The waste was sent to the lake, creating the huge piles of stamp sand that remain today. To extract more copper, some of the stamp sand was reprocessed. Ball mills were also used for further fragmentation of the sand, followed by chemical flotation with ammonium compounds to further extract copper. A fine sludge from the stamp mills therefore covers the lake bottom, making the environment inhospitable for organisms. By the 1880s, forests were depleted, and coal was brought in to power the stamp mills, so ash also was dumped into the lake, to be followed by PCBs from electrical transformers. As a result, Torch Lake became one of the first EPA superfund sites, with soil being placed



Stamp sands near Gay, MI, photo: Dave Wilhelm

on the sand. We walked along the stamp sands near the village of Gay - words or pictures could not adequately express or show the size of the pile. To examine deposits like these, the R/V Agassiz contains a sampling bucket to collect materials from the lake bottom for lab analysis of size and composition, and they even have a remotely operated vehicle for work away from the main vessel. Surveys show the stamp sands moving out into Lake Superior. The Corps of Engineers is seeking a market for these sands, for example as road building materials or for asphalt roofing. At Big Traverse we viewed a



Stamp sands overflowing the breakwater at Big Traverse.

breakwater built to protect beaches from the encroachment of shifting stamp sands. We also saw sands that had exceeded the breakwater by approximately 4 feet, further threatening the beach.

Day 2 - Jacobsville: We spent the second day of our Keweenaw Geoheritage Trip on the southwest side of the peninsula, to see Jacobsville Sandstone. According to Bill Rose, "The Jacobsville is the youngest of the Keweenawan Supergroup, rock units that filled the midcontinent rift of Rodinia about 1 billion years ago. The rifting of Rodinia (a giant supercontinent which



This rock pile was Brian's sand Beach until the winter storms.

was made up of pieces of all presently known continents) resulted in huge lava flows, bigger than any that have come since. After volcanism slowed, sedimentary rocks flowed into the rift from the steep sides and erosion finally diminished the mountainous landscapes to hills, and with that change, the

sediments evolved from conglomerates to sandstones and shales."

The sandstone contains iron oxides, making it a deep, rich red. Curiously, there are white layers and even white polka-dots in the sandstone. Many impressive buildings were built using Jacobsville Sandstone, both locally and around the nation. The red sandstone was quarried extensively, with the clear, unspotted stone being the most desirable. However, driving around the peninsula, one could observe that the locals had



Jacobsville Sandstone along the south shore.

made good use of the less desirable spotted pieces in their foundations and smaller buildings, making for some quaint red and white polka dot construction. Michigan Tech Engineering student Bryan Kass joined us - his family has had a cabin on the peninsula for decades. A storm last winter made it impossible to get down to the lake at a place where the lake had previously been accessible.

Day 3 - Lac La Belle: The aim of our third day was to visit and understand the Keweenaw Fault, which extends the length of the peninsula, and marks the boundary between the Mid-Centent Rift and adjacent rocks.

The fault has had a major influence on the landscape. Many of the most beautiful sites--rivers, lakes,



Erika displays a model to explain thrust faults

waterfalls, and vistas--are at or near the fault. The fault also was a conduit for copper solutions. And, thirdly, the fault raised the copper deposits to levels where miners could find and mine them. The Keweenaw Peninsula contains one of the largest and most unique copper deposits in the world. It is the only district where native copper was the primary mineral mined throughout the lifespan of the mine. At least 6800 years ago, native Americans found and traded the copper all over North America. The huge copper mining industry began in 1845, and was the first mining operation in the US. During the 150 years of mining activity, more than 11 million pounds of copper have been produced in the district.

Day 4 - Eagle Harbor/Copper Harbor: The purpose of the land and boat trips of Day 4 was to see and understand the Keweenaw's black rocks and their volcanic history - Earth's largest ever lava outpouring. There was a short walk at Estivant Pines Nature Sanctuary. These ancient trees average 110 feet tall and 3 to 5 feet in diameter. Then, it was off for a drive up to the top of Brockway Mountain - about as far north in Michigan as it could be without being in the lake - well worth the visit for the incredible views.



Conglomerates of Brockway Mountain

After leaving Brockway Mountain, we drove to the northeastern side of the peninsula, where we took a lovely hike through the woods to visit Bear Bluff, a wonderfully scenic and highly exposed set of cliffs that rise abruptly from Lake Superior, offering a splendid view. Then, at Hunter's Point Park the beach consisted of colorful, highly polished, ping-pong size rocks, all warm and glistening in the sun - it was hard to keep from filling our pockets! It was a rough journey from Eagle Harbor east along the Peninsula to Manitou Island. On the island, we headed down a path through the woods to the Manitou Island Light

House. Before returning to harbor, we saw not only Montreal Falls, but also another spectacular treat: a beautiful calcite vein, which looked like a giant lightning bolt in the beautiful sunshine of the day.



Calcite vein near Manitou Island

The waves had calmed significantly as we made our way back, this time landing at Copper Harbor, where we met up with the rest of the group, and where Erika had prepared a great picnic for us, complete with kegs of Copper Harbor craft beer. Thanks again to the organizers for a wonderful trip!

Frank Janezich and Roxy Knuttila

Field Trip to Oheyawahi / Pilot Knob

On September 20, 2015, Chris Soutter and Gail Lewellan from Pilot Knob Preservation Society, along with Randy Strobel and Joanie Furlong of GSM, led two dozen participants on a short field trip to historic Pilot Knob/Oheyawahi in Mendota Heights MN, on a sunny, warm, end-of-summer Sunday.

Pilot Knob is a high point just south of the east end of Mendota Bridge. It overlooks Fort Snelling and the confluence of the Minnesota and Mississippi Rivers. The confluence is central to the creation stories of native peoples. Oheyawahi was a sacred burial place for the Dakota and other native peoples and later became important for European cemeteries as well. In Dakota, the north slope is



Pilot Knob Preservation Association poster

called Wotakuye Paha—“the hill of all the relatives”. Because of Pilot Knob’s proximity to Fort Snelling and to Henry Sibley’s American Fur Company post at Mendota, this location was proposed as the original site for Minnesota’s territorial capitol. The site is also the place where the Treaty of 1851 between the US government and the Dakota people was signed. In that treaty, the Dakota ceded much of their territory in what is now southeastern Minnesota.

The confluence is geologically significant as it marks the place where the Falls of the Glacial River Warren split. Glacial River Warren flowed when Glacial Lake Agassiz drained at the end of the last glaciation. River Warren was responsible for scouring out the Minnesota River Valley which is now too big to have



Tallgrass prairie

been formed by the size of the current Minnesota River (this is known as an “underfit river”). Where the River Warren Falls split, one waterfall traveled up the Minnesota until it ran out of resistant limestone near present day Black Dog, and the other falls traveled up the Mississippi to present-day St. Anthony Falls. Modern humans stabilized the falls with concrete. If they had not done so, the falls would have continued to migrate up river and disappeared when the limestone ran out just north of Nicollet Island. Randy explained how water falls migrate. Over time, flowing water wears away softer layers below (St. Peter Sandstone in this case) and the resistant layers above (Platteville Limestone) break off at the nick point. At one time there were houses, a gas station and a motel on the site. One participant recalled having spent a night of a honeymoon in that motel. All structures have since been removed, but as recently as 2002, the area was threatened to be developed—again. That’s when the Pilot Knob Preservation Association was formed. Through the Association’s coalition of like-minded groups, the organization was able to save Pilot Knob from development and continue the work of preservation, interpretation and restoration.

The GSM group walked the visitor trails across exposures of Platteville Limestone and through tallgrass prairie. Chris and Gail identified native plants and explained different approaches to restoring Pilot Knob to oak savanna habitat—including controlled grazing using herds of goats. We visited two medicine wheels on the site—circles divided into quarters, each with a different color of stone: red Oneota dolostone, black trap rock basalt from Dresser, Wisconsin, as well as white and yellow—which are



Blocks of limestone representing the seven Dakota-Nakota-Lakota groups residing in North America

interpreted to represent different human skin colors which must work together for humanity to thrive on this earth. As our group gathered, a flock of migrating pelicans circled in slow motion over where the rivers flow into each other. It was almost as if they were demonstrating the truth in the Dakota name for Pilot Knob—Oheyawahi—which is translated as “a hill much visited”.

For more photos go to <https://picasaweb.google.com/dewilhelm53>, click on the album “GSM Sept 2015 Pilot



Oheyawahi display

Knob”. More information describing Oheyawahi / Pilot Knob: <http://www.pilotknobpreservation.org/Pocket%20Guide%20Interactive.htm>

Diane Lentsch

The US Ice Core Lab Boulder, Colorado

This past summer, I was fortunate to get a chance to join other science teacher colleagues from around the country on a tour of the US Ice Core Lab in Boulder, Colorado.

The primary function of the lab, which is funded by NSF and operated by the US Geological Survey, is to collect, study, and store ice cores from glaciated regions around the world. The lab is the primary (and I believe only) ice core repository in the US. Within its

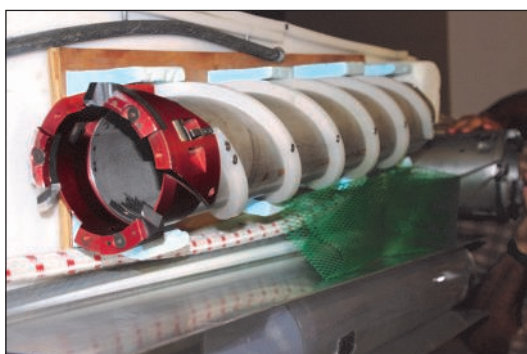


Core casings

thousands of 4" by 1 meter long shiny casings can be found core samples from virtually the entire planet, including Antarctica, Greenland, and Alaska.

Our tour was conducted by Mr. Geoff Hargreaves, the curator of the facility. Geoff has a fascinating and extremely challenging mission: to find, collect, drill, package, transport, catalogue, and permanently store the samples collected by scientific teams from around the world. The logistics of this are impressive. Collection missions can be huge undertakings and may take many months. Since it is often not possible to transport refrigerated trucks to the field site, time is of the essence, making some missions a race against the clock.

Ice cores are cut into 1 meter cylinders at the site and packaged in metallic containers for transport back to the Boulder facility. Geoff estimated the cost of a single 1 meter tube to be approximately \$20,000 or \$2



Cutting head and auger barrel

million per pallet. Grad students at the facility work in the -36 degree Fahrenheit workshop chopping the specimens on high quality but standard

wood saws. The cross sectional area of the core is marked in a pattern similar to a tree log, then ripped along the length of the sample with a band saw before it is sent to the client laboratory for analysis.

The composition of the ice changes as depth increases. While snow on a glacier's surface is approximately

80% air, the density increases with depth. Slightly to moderately compacted snow turns to a substance called firn, and the bottom the glacier can be as little as 20 % air.



Ice core prep room

The primary scientific value of the cores comes from the fact that they preserve paleo-atmospheric data (temperature, CO₂, methane, isotopes of carbon, hydrogen). This data can be used to reconstruct past climates and develop a more accurate understanding of current climates and climate change. Cores in Greenland have been drilled as far as 3000 meters



Slicing an ice core for samples

depth, recording as much as a quarter million years of data. Clients for the services of this national lab include universities and commercial labs around the US.

The National Ice Core lab was a fascinating trip and a fantastic introduction to the science of ice cores and paleoclimatology.

Check out their excellent web site at: <http://www.icecores.org/index.shtml>

David McGill



Justin Tweet speaking at the 2015 GSM Annual Meeting



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