August 2017

Promoting public interest and educational support in the geological sciences

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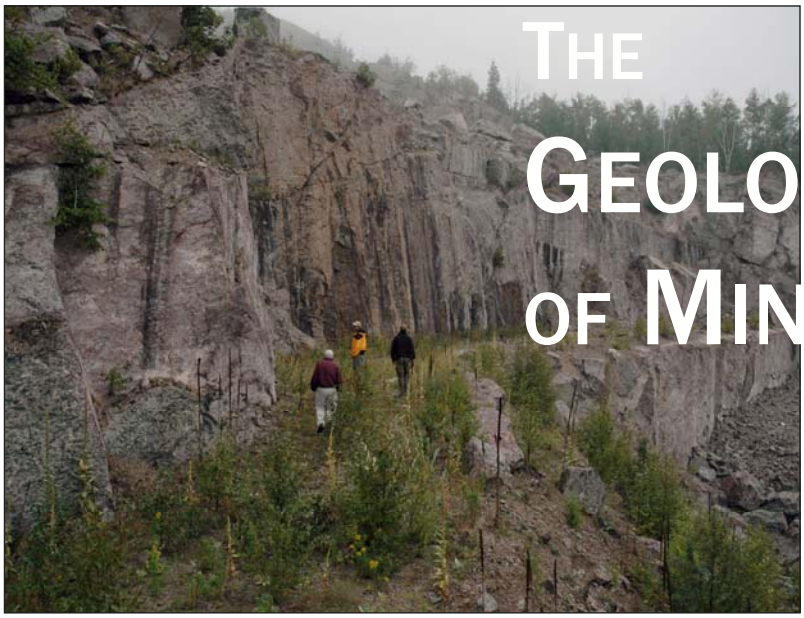


The Geological Society of Minnesota News

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

From the President's Desk…

Summer is almost over, but the GSM activities will keep on coming!

Here is what we have to look forward to over the next few months:

- Solar Eclipse Field Trip – 19 to 27 August
- GSM Booth at the State Fair – 24 August to 4 September
- Minnehaha Falls Walking Field Trip – 17 September
- Fall Banquet and Annual Meeting – 18 September
- Fall Lecture series – 18 September, and every other Monday through December 11
- Mississippi River Biking Field Trip – 1 October
- Minnesota Mineral Club Show Table – 21-22 October

Total solar eclipses don't come around that often, so Dave Wilhelm is taking a large crowd out to a good spot in central Nebraska to see the next one on 21 August. While the group is out there Dave has lined up opportunities to explore many geological attractions in the area. Many of us will be staffing the GSM's state fair booth. If you haven't signed up, there may be a slot left. In the fall, Randy Strobel will be leading the Minnehaha Falls and Mississippi River field trips. See www.gsmn.org for field trip details!

GSM President, Dick Bottenberg

As we do every year, the Fall Banquet starts off the fall lecture series, again at the U Garden Restaurant, 2725 University Ave SE in Minneapolis. Dr. Joe Eastman will present the Historical Perspective on the Evolution of Fish Fauna. Also at the Fall Banquet as part of the Annual Meeting we will nominate and select 2 new GSM Board members. If you are interested in serving on the Board please contact Theresa Tweet, at phoenix8185@gmail.com.

This year's lecture series again looks to be outstanding. Evolution of Antarctic fish, dinosaurs, agates, mining, geophysical exploration, glaciers and space weather are all on tap for this fall! Please see the insert, and our website for the dates and actual titles…. www.gsmn.org.

Finally, the GSM will host a table at the Minnesota Mineral Club's (MMC) annual show from October 21st to the 22nd. This will be a great chance for the GSM and the MMC to work together, and for the GSM to become more known to MMC members. Please contact me at dbottenberg@hotmail.com if you are interested in being involved.

It's going to be a great Geological Fall, gotta dig it!

Dick Bottenberg

Upper photograph: GSM Field Trip, Mark Ryan

Inside this issue:

Visit us on Facebook!

from the GSM archives: Claystone Concretions

GSM News

Officers:
Dick Bottenberg, President
Theresa Tweet, Vice President
Mary Helen Inskeep, Treasurer
Open Position, Secretary

Board Members: Kate Clover, Dan Japuntich, John Jensen; Ruth Jensen; Deborah Naffziger; and Dave Wilhelm

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

Web Site: *www.gsmn.org*

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

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!

Peter Hesse, Hopkins
Chris Skapyak, Savage
Rodey Batiza & Jill Karsten, Eden Prairie
Adam Marks, Moorhead

GSM Board Membership

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

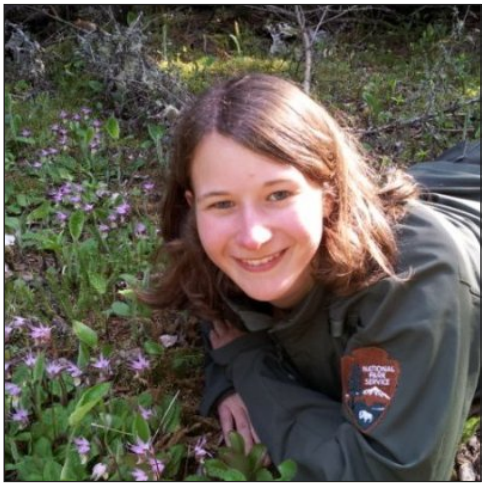
Board meetings are open to all members of GSM. So, whether you are a new member of GSM or have been a member for many years, if Board membership is something that might interest you, or you are just curious to see what our Board does and how it works, we encourage you to attend a meeting. And, if you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

Position Notice: The GSM is seeking a Secretary willing to take notes at four Board meetings per year.

Also, later on in the year we will need two new Board members as well as a new Treasurer.

Please contact Theresa (phoenix8185@gmail.com) to discuss your potential willingness for any of the positions, any of which will be fun!

Member Spotlight; Maria DeLaundreau



1. How long have you been a GSM member?

I started attending meetings in 2003

when I was in 7th grade. It was a chance for me to learn about rocks, which always fascinated me, with my Dad. We attended meetings together.

2. How did you get interested in geology?

I grew up playing with my grandfather at "The Pit," his defunct open-pit gravel mine. I loved finding agates and bringing them back to him. I did the same thing on the shores of Lake Superior with other "pretty rocks," and he blew me away one time by telling me that by looking at rocks you can learn how it was formed and what it has been through. After that, I became interested in the stories the rocks were telling, so when my mom saw the GSM lecture schedule at the State Fair she knew I would enjoy the challenge of learning more about my rocks and geology.

3. What do you dig about the GSM?

I dig the friendly members who are just as curious about the world as I am, and the awesome field trips.

Notes from the Past

From the Winter 1998 issue of GSM NEWS

Platteville Limestone: Many were Spalled, Few were Chosen

A major building material in the mid-1800s was the local Platteville limestone. In was first quarried commercially in St. Paul in 1856 and in Minneapolis in 1864. The stone – generally blue to gray in color – underlay much of the two downtowns, and builders often simply quarried it on or near the construction site. The casual removal of stone eventually became such a problem that the city of St. Paul passed an ordinance forbidding people from quarrying in the streets. Although prized for its easy availability, Platteville limestone – with the exception of blocks taken from a few select quarries – left much to be desired as a building material. It tended to come in rough laminated beds, was seldom of uniform quality, and had a crumbly texture that made it "extremely difficult to dress and virtually impossible to detail in any but the crudest way."

Still it was about the only stone readily available in the cities until the early 1870s. It was used for early public buildings such as the U.S. Customs House (1873) in St. Paul and the first Minneapolis City Hall (1873), for large commercial and industrial structures, for schools and churches, and for many houses.

Now found mainly in foundations and retaining walls, Platteville limestone – for better or for worse – lent a distinctive look to Twin Cities architecture. Among the best examples of remaining buildings constructed of this stone are Assumption Church and School, and the Alexander Ramsey House in St. Paul, and the F.C. Hayer Company building and the Nicollet Island Inn in Minneapolis.

From the Lost Twin Cities, Minnesota Historical Society Press (1992)

Lecture and Fall Banquet:

Monday, September 18, 2017

Fall Banquet, Annual Meeting,

and Lecture Location:

U Garden Restaurant, 2725 University Ave. SE, Minneapolis

Dinner 5:00-7:00 PM; Annual Meeting 7:00; Lecture follows ~7:15

Historical Perspective on the Evolution of Antarctic Fish Fauna

Joe Eastman, Ph.D., Prof. Emeritus of Anatomy, Ohio University

The interaction between geological and biological processes resulted in much of what we recognize as the modern flora and fauna of the world. This interplay has frequently given rise to unusual faunas in areas that became isolated during geologic history. Antarctica is such a place. Formerly part of Gondwana, Antarctica now occupies a south polar position surrounded by the cold Southern Ocean, and its distinctive fauna inhabits the sea rather than the ice-covered landmass. This talk will consider the modern Antarctic fishes, and their Eocene antecedents, as an example of faunal change through time in a cold, ice-altered environment where there were repeated advances of the ice sheet onto the continental shelf. Antarctic fishes also present examples of both adaptive and non-adaptive radiations. Adaptive radiation is the appearance of group of closely related species, exhibiting notable structural and ecological diversity, in a habitat where they have gained entry. Darwin's finches from the Galápagos are the classic example.

Fall Travels and Finding GSM Markers

Fall is a wonderful time of year to travel around the state of Minnesota – cooler weather, no biting insects, beautiful foliage, fewer tourists, and geological markers just waiting to be discovered! There are only seven more markers left to be inspected to complete the first stage of the GSM Marker Project. You can help!

Here's what needs to be done:

1. Use the information below to find the marker. Take photos of it – show where it is situated and what are the geological features it is drawing attention to.
2. Obtain GPS coordinates using your cell phone or

Marker Name	City/County	Directions
Minnehaha Falls	Minneapolis/Hennepin County	Located in Minnehaha Park.
The Minnesota River Valley	Le Sueur/Le Sueur County	Located on US Highway 169 in the rest area north of Le Sueur
Sioux Quartzite and Pipestone	Beaver Creek/Rock County	Located on Interstate-90 at the tourist information center in Beaver Creek
Geology Complicates Bridge Foundation	Gooseberry Falls State Park/Lake County	Located on state highway 61 in Gooseberry Falls State Park
The Geology behind the waterfalls	Gooseberry Falls State Park/Lake County	Located on state highway 61 in Gooseberry Falls State Park, near the Middle Falls.
The Laurentian Divide	Virginia/St. Louis County	Located on US highway 53 about 5 miles north of Virginia at the Laurentian Divide rest area
Glacial Lake Agassiz	Fisher/Polk County	Located on US Highway 2 at tourist information center near Fisher (near Grand Forks)

GPS unit. Take a photo of the GPS reading if you can.

3. Note condition of marker.
4. Did you have any difficulty finding the markers? How would you improve the directions for finding the markers? Be specific – write new directions if necessary.

Send your results to Becky Galkiewicz at rebeccag@usfamily.net.

The table contains the markers that need to be inspected.

Thanks for your help from the GSM Marker Committee

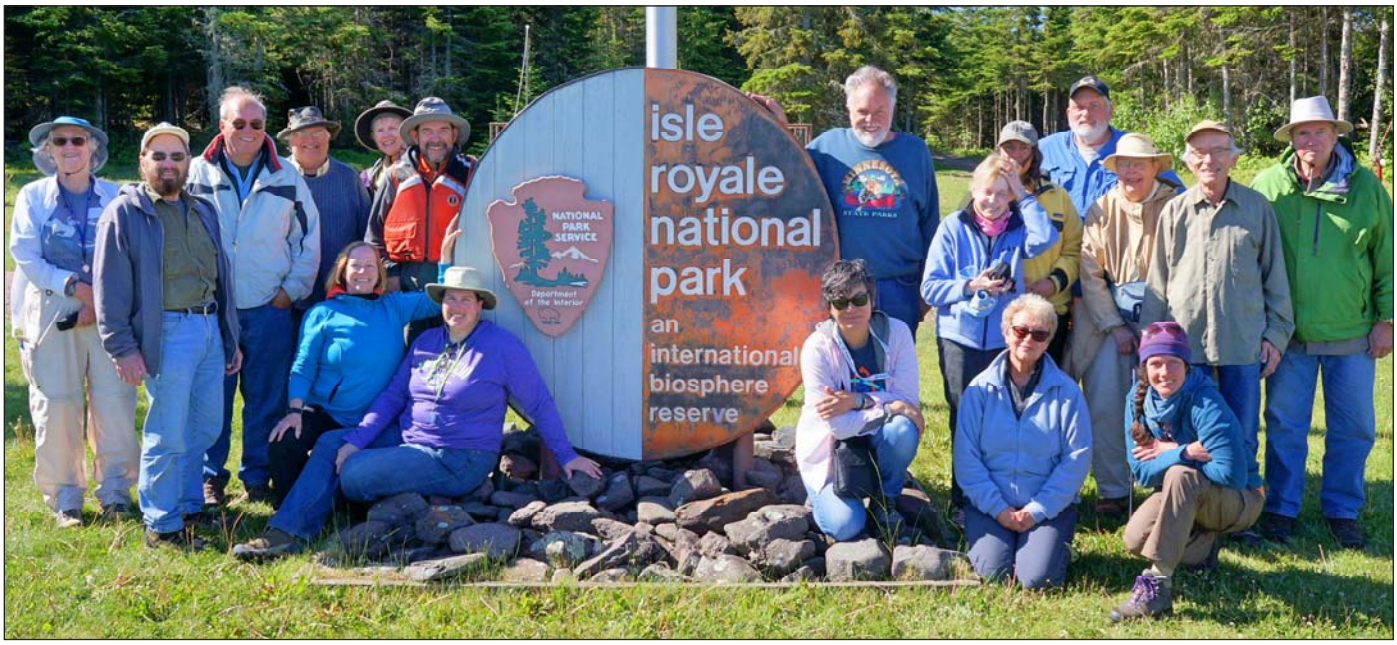
Field Trip to Isle Royale

On June 20, I and 16 other participants, including seven other GSM members, boarded the Ranger III in Houghton, MI for a five-day geology trip to Isle Royale. The trip was arranged by Michigan Tech University and the National Association of Geoscience Teachers, and conducted by Bill Rose, Erika Vye, and Stephen Roblee. Many of you will remember them from the GSM Keweenaw field trip in 2015, which they also led. This trip started in dreary weather as we slowly motored through the Keweenaw Waterway, but by the time we reached the National Park five hours later, the sky had become clear with scattered clouds, as it would remain for the balance of the trip.

Our accommodations on the island were housekeeping cabins, with four beds per unit and incredible views overlooking Tobin Harbor. We were provided boxes and coolers of food, from which we prepared our breakfasts and lunches each day. We were provided home cooked meals (and Keweenaw-brewed draft beer) each night. And Georgia, one of the participants, provided us with a special treat on June 21: a delicious cake celebrating the summer solstice. BTW, the sun did not set until 9:59 that evening.

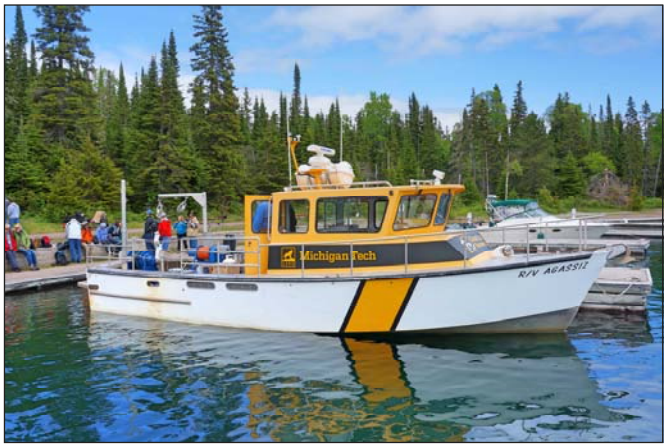
Isle Royale and the over 400 small islands surrounding it compose a national park in the northwestern part of Lake Superior. It is the least visited national park in the contiguous 48 states (17,000 persons/year), primarily because you cannot drive to it and it has no paved roads. But that isolation is a big part of its allure. Isle Royale itself is 45 miles long with numerous long bays and inlets. Although the island is interlaced with 165 miles of foot trails, how does one see all the geology this park has to offer in under five days? Bill, Erika, and Stephen provided the perfect solution: the Michigan Tech research vessel Agassiz (which we also used to explore the Keweenaw in 2015). On each of the 3 full

Tobin Harbor, seen from the cabin



Our group at Park Headquarters on Mott Island

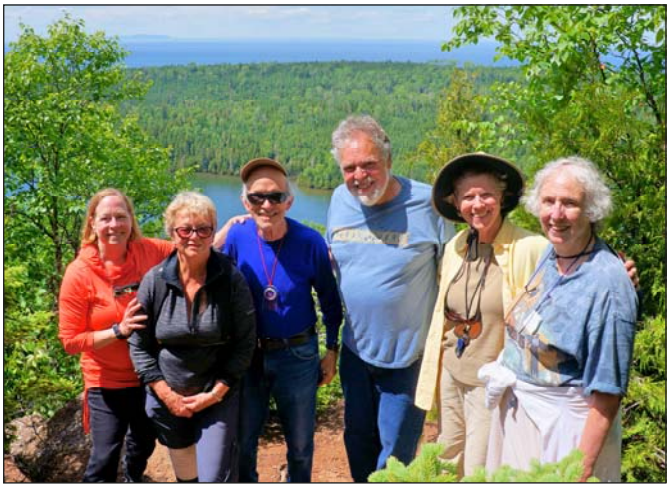
days we were there, Stephen piloted the Agassiz all around the eastern end of the park. This allowed us to see features that can only be seen well from the water. It also allowed us to disembark at various locations, including smaller islands, so we could see and touch the rocks up close. Each day, we (optionally) undertook a long hike to see things a bit more remote, such as Scoville Point, the Minong Mine, and expansive overviews at Lookout Louise and Mount Ojibway lookout tower. Although I had backpacked on Isle Royale five times earlier in the 1970's and 1980's, I feel I saw more of the park on this trip than the previous five put together.



The Agassiz at Rock Harbor

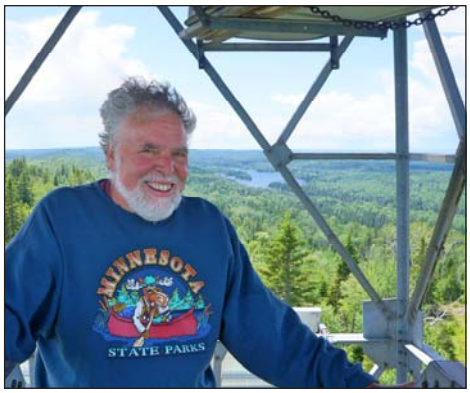
Isle Royale's geological history began about 1.2 billion years ago, when a great rift opened in the Earth's crust. The volcanic rocks produced in the Isle Royale area due to this Earth-shattering event form the bedrock of today's Isle Royale National Park.

These flows were large, based on volume and thickness, but not on distance traveled, since the lavas accumulated within the rift zone. For example,

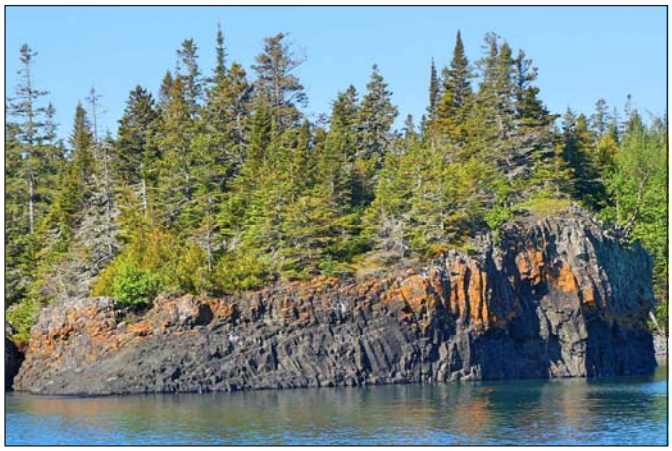


GSMers on Lookout Louise

the largest of these flows, the Greenstone, is one of the Earth's largest lava flows; it had a volume of 400 cubic miles and a depth up to 1500 feet. The cycle of lava eruptions and erosion combined to give Isle Royale its present landscape of ridges and valleys; glaciers overran the ancient lava flows, from



Dave on Mount Ojibway Lookout Tower



Columnar jointing at Scoville Point

Isle Royale ridges and bays seen from Lookout Louise

the northeast to the southwest, and resulted in the entire system of islands being composed of many distinct parallel ridges. Today, this series of island-long, bedrock ridges, as well as the valleys that run between ridges (which usually contain wet swamps or beaver ponds) dominate Isle Royale's landscape. Around 11,000 years ago, 2 miles of ice lay on top of Isle Royale, pressing it down into the earth and further sculpting its topography. 10,000 years ago, the islands began to appear from beneath glacial ice as the glaciers began to retreat; this process gave birth to

Rocky shore formed by glacial action

hundreds of inland lakes, ponds, and bogs. Of course, Bill and Erika explained this geology in far more vivid detail than this article can provide.

But this trip was not limited to geology. Visiting in late June, we saw a great diversity of wildflowers in bloom and walked across a bog with carnivorous pitcher plants. There is less diversity of animal wildlife on Isle Royale than on the mainland, since only species that can swim, fly, or walk across the ice became established there. Prominent of these is the moose, whose population is booming, as the wolf population is down to just two individuals. We visited the Bangsund log cabin, where Rolf and Candy Peterson have collected and studied moose skulls and antlers for over 40 years.

Before the national park was established in 1940, it had a long history of human usage. We saw what are arguably the oldest mines in the world, small pits to extract native copper that were probably excavated

Antlers behind Bangsund cabin

shortly after the glaciers retreated. We also saw the remains of more mechanized mining from the late 1800's. There was a thriving fishing industry before (and after) the park was established. Many of these fisheries had life leases that did not expire until the children of the original owners passed away. We saw one that was recently shuttered, while the Park Service decides whether to remove or preserve it. We saw the historic Edisen Fishery, which has been preserved and is occupied during the summer by a volunteer couple who showed us around. And all the islands and rocks around Isle Royale made for hazardous navigation, leading to many shipwrecks and the building of lighthouses; we visited Rock Harbor Lighthouse, which is preserved as a museum, and climbed its tower for great views.

Besides loads of great geology, scenery, history, and weather, this trip was just lots of *fun*. If this article awakened an interest in you to see Isle Royale, you are in luck: GSM is looking to provide a similar opportunity around the same time next year. Erika, Bill, and Stephen have said they will provide an Isle

Minong mine

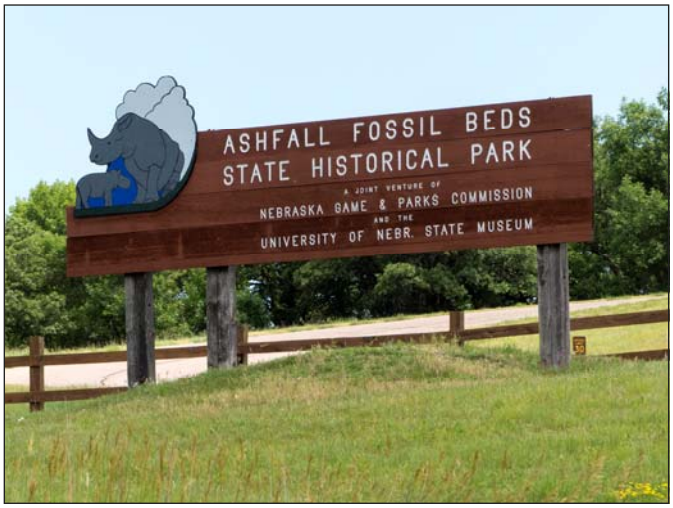
Royale trip in 2018 targeted for GSM members. We will begin planning for such a trip around January, starting with a member survey to gauge if there is sufficient interest. As usual, GSM members will receive notice by e-mail. Specific information on the 2017 trip is here: https://tinyurl.com/IRtrip2017 . More photos of this trip taken by me and other participants are here: https://tinyurl.com/IRphotos2017 .

Dave Wilhelm

Rock Harbor Lighthouse

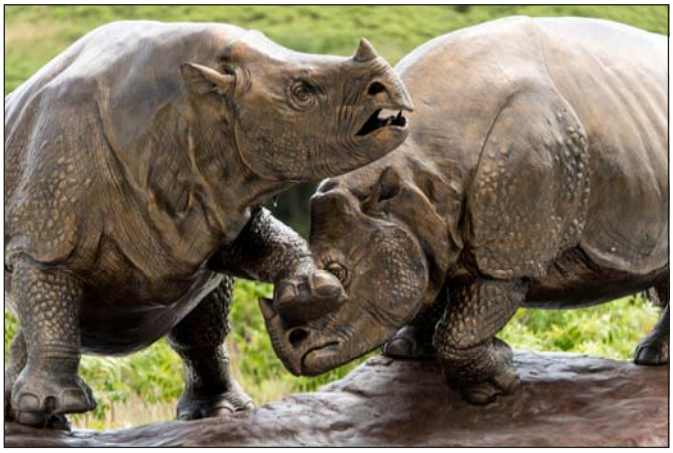
Ashfall Fossil Beds State Historical Park

A farm in northeastern Nebraska is the last place you'd expect to see a herd of rhinoceroses but that's exactly what you'll find at Ashfall Fossil Beds State Historical Park in the Verdigre Creek valley just north of the village of Royal.



Ashfall Beds Park sign

Of course, you won't see any rhinos grazing in the surrounding grasslands today – they've been dead for nearly 12 million years – but you can see them inside Ashfall's remarkable Rhino Barn where their remains, along with those of other prehistoric beasts, can be seen in the exact spot where they last fed and died on the shores of an ancient waterhole. Skeletons of more than 200 animals (made up of 12 species) have been recovered from the amazing fossil site since its discovery more than 40 years ago.



Rhino statues

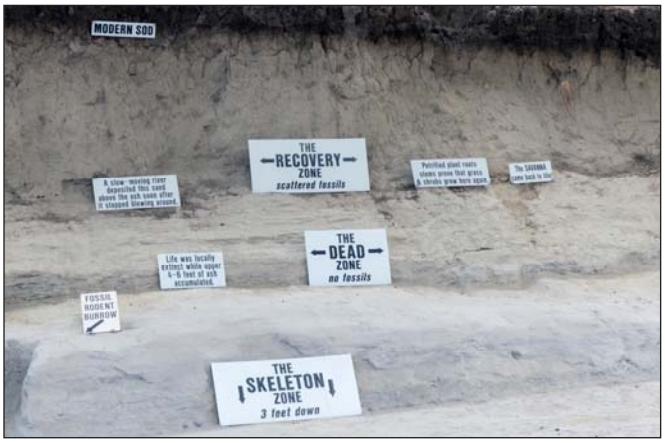
Rhino barn from a distance

In 1971, paleontologist Dr. Mike Voorhies, from the University of Nebraska State Museum in Lincoln, was out prospecting for fossils around Melvin Colson's farm near Orchard when he noticed a skull sticking out of a white layer of volcanic ash sandwiched between two layers of sandstone. Further digging into the hillside uncovered a complete and fully articulated skeleton of a juvenile squat-bodied rhinoceros called *Teleoceras major*, a species common in North America during the middle to late Miocene epoch.

Additional discoveries led Voorhies to launch a comprehensive excavation of the site with the assistance of crews from the University of Nebraska and funding from the National Geographic Society. Their efforts uncovered hundreds of fossil skeletons, mostly of rhinos and horses but also camels, sabre-toothed deer, turtles and birds - a virtual lagerstätten of Miocene life - all beautifully preserved in the ash.

The Nebraska Game and Parks Foundation purchased the 360 acre site in 1987 and the park began operation as an attraction four years later when the visitor center first opened. The road to the park was paved in 1995, but as one of the museum workers explained to me, it drew very few visitors, mainly due to its remote location. It wasn't until a large enclosure was built over the active quarry that it began to attract tourists.

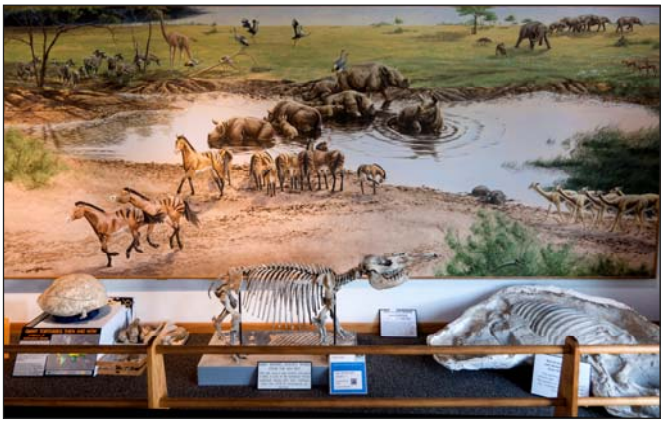
Rhino #3 skeleton



Ash layers

Initially, the enclosure covered just one-percent of the ancient waterhole deposits. But as the quarry has expanded so has the enclosure. The Hubbard Family Foundation funded the most recent expansion and it's now known as the Hubbard Rhino Barn.

What's most remarkable about the ash layer fossils is their pristine state of preservation. Skeletons are perfectly intact and fully articulated with little or none



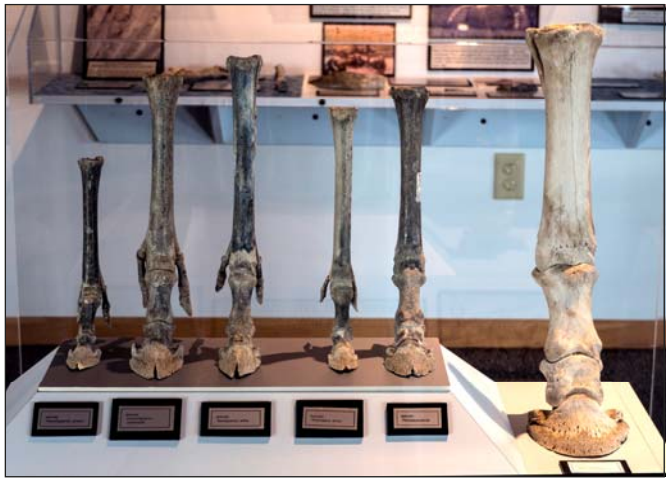
Wall mural

of the usual distortion the weight and depth millions of years of overburden usually inflicts upon fossil bone. Very few of the remains have been scattered by carnivores or erosional forces. The bones are found exactly as the animals died.

The cause of such an unusual fossil assemblage was a supervolcano located 1000 miles away in what is now Idaho that blanketed much of northern Nebraska under a layer of ash some twelve million years ago. The catalyst for the eruption, known as the Bruneau-Jarbidge event, was the very same hotspot that now smolders beneath Yellowstone National Park. The

Idaho eruption was incredibly huge – spewing more than 200 cubic kilometers of ash into the air. Compare this to Mount St. Helens' paltry 1 cubic kilometer of ash or even Krakatoa's 18 cubic kilometers. The Bruneau-Jarbidge eruption was so massive it left a caldera more than 50 miles in diameter!

The fine, airborne particulates that reached as far as northeastern Nebraska were composed of miniscule shards of glass, and covered the area in a foot of ash. It wasn't enough to bury the animals alive – that's not what killed them – it was the winds over time whipping the ash back into the air and deep into the lungs of the waterhole denizens that sealed their fate. Smaller animals, such as birds and reptiles with smaller lung capacity perished first. Their fossilized remains are found at the bottom of the ash layer intermingled with footprints of the larger animals. The mid-sized beasts, such as camels, dogs, and smaller horses died next, followed by the larger horses and the rhinos. Every living thing at the waterhole suffocated



Horse limbs

to death within anywhere from two days to a few weeks time. And as the ash continued to fall, it drifted into piles in the water basin, eventually burying everything under eight feet of the fine particulate.

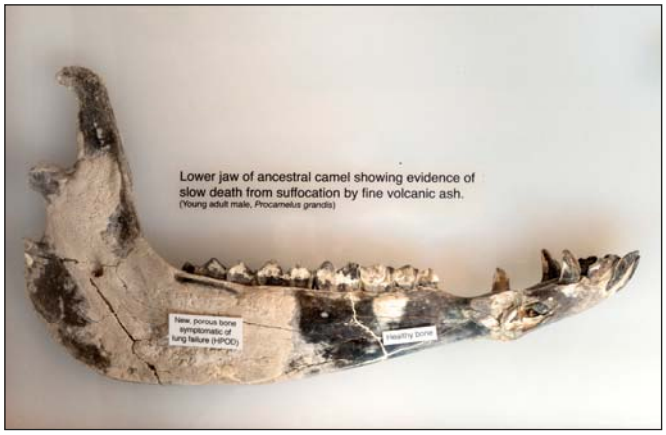
The ash layer is wedged between layers of sandstone which together comprise the Ash Hollow Formation. Evidence of past life is found in the lower sandstone layer consisting of occasional scattered bones and trace fossils such as tracks and burrow fillings. A segment of this pre-volcano layer can be viewed just outside the barn.

The park's visitor and interpretive center contains an abundance of information about the park's past and present, and has several fine displays of fossils found at the site including both three-toed and single-toed horses limbs, and an unusual prehistoric crane with the remains of its last meal, a lizard, within its ribcage.

A working prep lab is set up on one side where you can interact with student volunteers as they clean fossils and answer any questions. A large mural on the opposite wall illustrates the waterhole as it existed prior to the ash cloud's arrival. Rhinos dominate the fauna surrounding the subtropical watering site along with camels, horses, and turtles, all as they existed before the ash killed and encased them. The skeleton of one of the rhino calves is mounted below the mural.

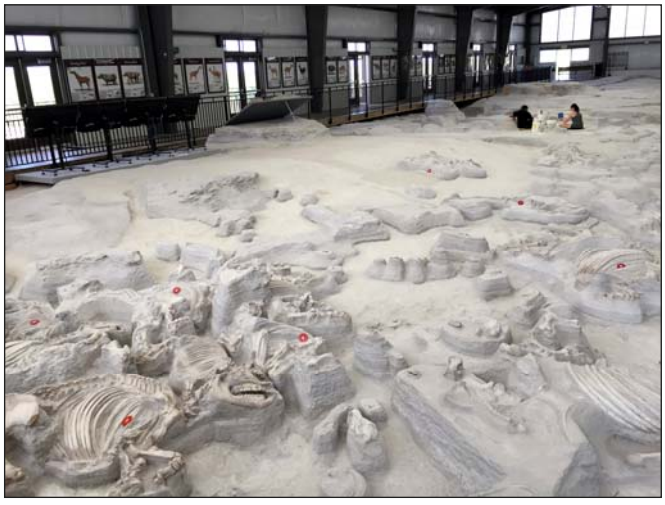
One particularly telling display shows the effect the ash cloud had on all of the victims - distinct indications of suffocation on their bony remains. Veterinarians today report seeing the exact same bone pathologies in present day animals that die from lung failure.

The 18,000 square-foot rhino barn is by far the park's main attraction. Dozens of skeletons are displayed *in*

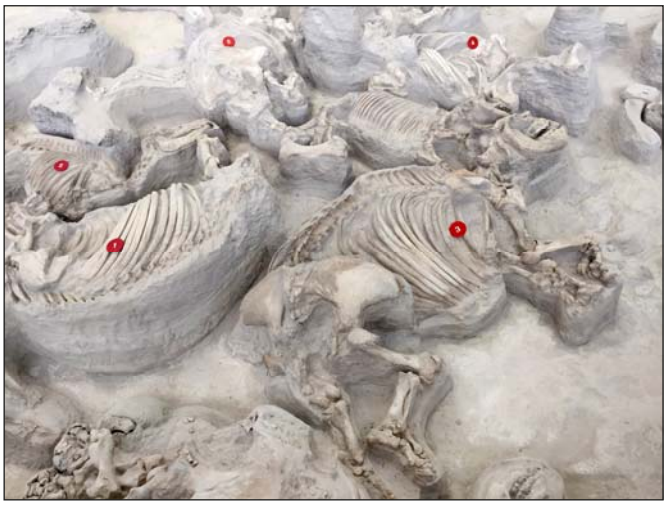


Jawbone pathology

situ just as they had perished in the white ash layer. Walkways line two sides of the active quarry presenting first-hand views of volunteers and students at work exposing new fossil remains, using mainly scalpels and brushes. The top five or six feet of the ash



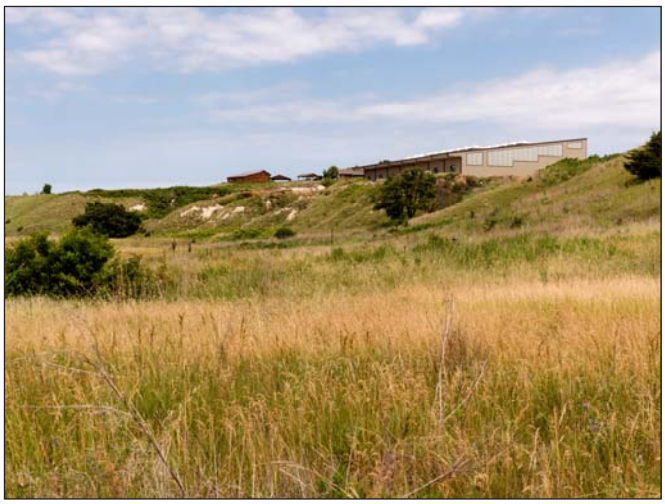
Wide angle shot of the barn interior



Medium shot of barn skeletons

layer has been removed carefully to get to the fossils which sit near the bottom three feet of the ash layer. You can ask the workers questions or find answers in the interpretive placards that line the walkways. These explain the kinds of animals that lived during the Miocene and whether their remains have been uncovered at Ashfall. A poster explaining a sedimentological study of the ash layer (done by Macalester College's Geology Department) is also on display. All the fossils currently exposed inside the barn and any future fossils uncovered there in the future will remain where they're found.

A mile-long trail encircling the park provides the



Ashfall grounds

perfect opportunity for a moderate and peaceful stroll through the surrounding valley and grasslands where you can spot local fauna and flora and examine the local geology or remnants of buildings where Colson's relatives once lived.

Ashfall is considered a branch of the state museum at the University of Nebraska in Lincoln, and charges a separate admission ($7) above and beyond the normal state park vehicle pass but it's very much worth the extra cost. Camping is available in Grove Lake Wildlife Management Area near Royal, and hotel lodging is available in Sioux City (100 miles east) and in the city of O'Neill (35 miles west).

The drive from the Twin Cities to the Ashfall Fossil Beds requires between 6 to 7 hours (also well worth it) and takes you near Pipestone National Monument in Minnesota, and two beautiful state parks situated along the Missouri River in northeastern Nebraska. Ponca State Park is about 90 miles east of Ashfall, and Niobrara State Park is about 90 miles directly north. Both provide camping and cabin lodging, and contain some very interesting rock exposures deposited during the Late Cretaceous period.

Road shot

Links to more information:

http://ashfall.unl.edu/

http://outdoornebraska.gov/ponca/

http://outdoornebraska.gov/niobrara/

https://www.nps.gov/pipe/index.htm

Mark Ryan

2017-2018 GSM LECTURE SERIES

Lectures and Labs are free and open to the public

7:00 PM Mondays at the University of Minnesota

The U locks its doors promptly at 7 PM. Please wait, as a person will come every five minutes to let in latecomers. Exact building, room location and last minute changes will be posted on our web site: **http://www.gsmn.org**

2017:

Sep 18 **Historical Perspective on the Evolution of Antarctic Fish Fauna**
Joe Eastman, Ph.D., Prof. Emeritus of Anatomy, Ohio University
Fall Banquet, Annual Meeting, and Lecture
Location: U Garden Restaurant, 2725 University Ave. SE, Minneapolis
Dinner 5:00-7:00 PM; Annual Meeting 7:00; Lecture follows ~7:15, map on web site

Oct 2 **Questions About Dinosaurs**
Kristi Curry Rogers, Ph.D., Geology Department, Macalester College

Oct 16 **Agate Hunting Made Easy**
James Magnuson, Minnesota Mineral Club, Author of "Agate Hunting Made Easy"

Oct 30 **The Pros and Cons of Mining**
Jeffrey Lipovetz, BS, TKDA Engineering, Saint Paul

Nov 13 **100 Years and Counting, History of Geophysical Exploration - Minnesota**
Val Chandler, Ph.D., Minnesota Geological Survey

Nov 27 **Glacial Geology of Minnesota**
Andrew Wickert, Ph.D., Dept. of Earth Sciences, University of Minnesota

Dec 11 **What Is Space Weather?**
Cynthia Cattell, PhD, School of Physics and Astronomy, University of Minnesota

2018:

Jan 22 **The Minnesota Mineral Collection**
Joshua Feinberg, Ph.D., Dept. of Earth Sciences, University of Minnesota

Feb 5 **Geological Model of the Twin Cities Basin**
Julia Steenberg, MS, Minnesota Geological Survey.

Feb 19 **Glacial Geology of Washington State**
Katherine Marshall, MS, Minnesota Geological Survey

Feb 24 **Laboratory: Hands On Rocks, Saturday 10:00 AM - 12:00 PM**
Conducted by Jeff Thole, M.Sc., Macalester College. The Geology Dept. is in SW area of basement of Olin-Rice Science Center (south end of campus, by tennis courts) at Macalester, building 14 on campus map. See web site for both campus and road map.

Mar 5 **Minnesota Geological Maps and Data Online**
Jacqueline Hamilton, MS, Minnesota Geological Survey

Mar 19 **A Trip to the Bottom of Yellowstone Lake**
William Seyfried, Ph.D., Dept of Earth Sciences, University of Minnesota

Apr 2 **Xcel Energy Plan for the Next 25 Years**
Dana Cottrell, BS, MBA, Xcel Energy

Apr 16 **When Rocks Die: The Science of Soil**
Laura Triplett, Ph.D, Gustavus Adolphus College.

Apr 30 **Trilobites**
Roger Benepe, Geological Society of Minnesota: Spring Banquet & Lecture, 5:00 to 8:30 PM
Location: U Garden Restaurant, 2725 University Ave. SE , Map on web site.

MEMBERSHIP RENEWAL REMINDER

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

Membership renewal September 1, 2017 to September 1, 2018

Name(s): ----_____

Address: -----_____

Phone: --------_____ E-mail(s): _____

Please make check payable to: GSM

Please mail to:

Membership Levels
( ) Student ------$10
( ) Individual----$20
( ) Family -------$30
( ) Sustaining----$50
( ) Supporting---$100

Geological Society of Minnesota
P.O. Box 390555
Edina, MN 55439-0555

_____Membership fee

_____Tax-deductible contribution (GSM is a 501(c) 3 nonprofit educational organization)

_____Total included

P.O. Box 390555
Edina MN 55439-0555

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