May 2020

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…

Before I write this article each quarter, I look back at what I wrote one year earlier, as I typically cover similar topics each year. I did that again before writing this, but more for nostalgia, as so much has unexpectedly changed over the past few months.

As you already know, the last four lectures of the spring schedule, starting March 16, were canceled due to the risks associated with the COVID-19 pandemic. At the time, the Board considered carefully before cancelling; but in the end, our decision was confirmed as Minnesota went on general lockdown shortly after we made our decision. We had four very fine lectures scheduled for Spring 2020, and Program Chair **Steve Erickson** hopes to reschedule those. For the ten lectures in 2019-2020, we had a total attendance of 863 persons, for an average attendance of 86. This is just below our average in the low 90s for the past few years. We had an especially good turnout of 131 for *The Midcontinent Rift System - Almost an Ocean.* Over the 10 lectures, 63 persons (7%) identified themselves as attending for the first time. This shows we are making our presence known to non-members. As usual, the most common reasons given by first-timers are recommendations by friends & relatives, visiting our booth at the State Fair and finding us online.

Steve is working on the 2020-2021 schedule, although we can't yet know how that will play out. As of this writing, Steve has scheduled about half the speakers for next year, included all of whom were cancelled from this year. The tentative plan is that the 2020-2021 lecture program will start with a talk by **Greg Brick** on Underground Minnesota at the **Fall Banquet** at U Garden Restaurant on **Monday, September 21** and continue every other Monday until December 14, before the year-end break and resumption in late January. The full lecture schedule will appear in the August Newsletter and will be available on our web site earlier. If you have an idea for a lecture or lab, or know of a possible presenter, contact Steve with the information. That said, having the banquet depends on it being safe to gather, and on the restaurant still being in business. Live lectures depend on the U of Minnesota being open for business. At this time, these are all unknown. If we cannot have live lectures, we will look into presenting them using Zoom or some other videoconference platform, until the situation improves. You will be informed as soon as we learn more.

Related to U Garden: When we cancelled the Spring Banquet, the Board decided to pay U Garden the normal banquet fee as a gesture of support for a business which has served us very well over the past years as a banquet venue and place to gather.

The COVID-19 crisis has put our planning for the State Fair on hold, as it is uncertain if

GSM President, Dave Wilhelm

Upper photograph, Mark Ryan

Inside this issue:

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from the GSM archives: St. Louis River, Jay Cooke State Park, 1939

the State Fair will even be held this year. And if it is held, will we feel safe staffing a booth to talk to hundreds of fairgoers? As this situation becomes clearer, I will let you know via e-mail.

COVID-19 will also curtail or eliminate GSM field trips this year. **Kate Clover** is investigating a group hike sometime this summer along the Mississippi River near downtown St. Paul followed by a walk through the old Upper Landing neighborhood to explore the Platteville limestone and how it was used as a building stone in houses dating to the 1870s. We think with family radios, we could do it with proper social distancing. Once we select a date, we'll send out an email notice. At the current time, **Joe Newberg** and I have no other ideas for field trips that would work given the restrictions of social distancing, but if you think of something else that you feel might work, let me know and we will investigate.

So, what *does* GSM have to offer in the age of COVID-19? First, we have this Newsletter, which editors **Kate Clover, Mark Ryan, Harvey Thorleifson** and **Rich Lively** have put together as usual. (I never thought the phrase "as usual" would sound so good!) I have previewed bits of this Newsletter prior to its publication, and look forward to reading all of it when you do. Thank you, editors!

Second, I and other members have been looking for interesting seminars and articles that can be accessed online. I will continue to send you e-mails as I become aware of these. If you learn of something that our members might like, let me know and I'll pass it on. **Theresa Tweet, Mark Ryan,** and I also post articles related to geology on the GSM Facebook page as we find them, so check that out occasionally; the link is on Page 2.

Third, a few of us have been meeting socially via Zoom at 7 PM Mondays. If you would like to join a session, drop me a line at dewilhelm53@msn.com, and I'll send you a link and instructions. I have included a photo Kate Clover took of a recent "meeting."

Fourth, if your summer plans include travel in Minnesota, check out our array of over 70 information markers describing interesting geology throughout our state. To find markers where you will travel, follow the link Minnesota's Geology Markers on the home page of the GSM web site. **Rebecca Galkiewicz** and **Alan Smith** have developed a great tool for finding these markers. You can visit them while keeping a social distance from others who might visit at the same time.

Stay healthy and stay informed as we negotiate this new way of living and learning

Dave Wilhelm

GSM

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Lecture Recording: Joe Wright

Web Site: 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:

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

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

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

Newsletter contributions welcome:

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

GSM Board Membership:

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

The Board meets quarterly, on the second Thursdays of February, May, August, and November, or on a different date if conflicts arise. Meetings are from 7-9 PM at the Minnesota Geological Survey at 2609 W. Territorial Rd, St. Paul, MN 55114.

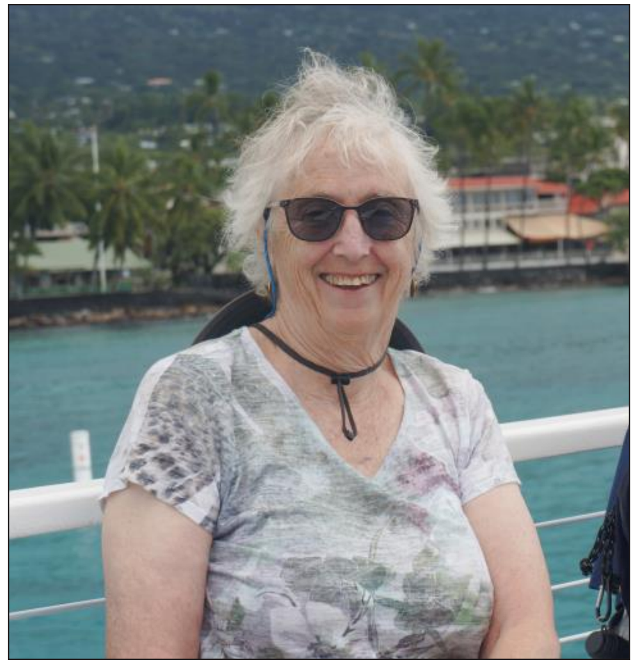
Board meetings are open to all GSM members. If you are a new or long-time member and Board membership is of interest to you, please consider attending a meeting. If you have a topic you would like the Board to consider, please contact Dave Wilhelm, dewilhelm53@msn.com

New GSM Members:

Gary Miland Dukes, Minneapolis

John Fierst, Rochester

GSM Member Spotlight—Mary Kay Arthur



Mary Kay Arthur on a whale-watching cruise; Kona, Hawaii, photo by Dave Wilhelm

In the mid-1990's, I took a canoeing class with Gail Marshall, GSM's long-time membership chair and tireless recruiter. Her persistence won me over, and I've been an enthusiastic GSM participant and lecture attendee whenever I am in Minneapolis. My favorite lectures are those that discuss basic principles, for example, "How was Minnesota compiled." I enjoy talks from Minnesota engineers and researchers who share their research project such as Ray Rogers discussing his dinosaur digs in Montana, and Barr Engineering explaining their efforts to site the bases for wind turbines. Lectures on soil structure helped me understand the vitality of Midwest farm country. I'm always amazed and heartened by the willingness of professional geologists to bring their knowledge to our meetings.

My personal contributions to GSM are slim; however, I organized the summer 2018 GSM field trip to Thunder Bay, Ontario. (The rocks don't stop at the border). And I make great chocolate brownies for cookie break. I love all the friends I have made through GSM, and I love Monday the Monday night lectures.

Winter months find me escaping to warm places. I wander around in my pickup camper enjoying the nooks and crannies of America's out-of-doors. There is great hiking, paddling, birding, plant ID and just plain snooping around in this country's wild places. For in-your-face geology there is nothing like Big Bend in Texas (volcanic mountain, desert, river, and both the Appalachian and Laramide orogeny) or the Kiabab Trail to the bottom of the Grand Canyon.

NOTES FROM THE PAST

From the Summer 1982 Edition of the GSM News

Members who attended our spring banquet were privileged to hear an outline of a timely study Dr. Robert Sloan is preparing on the origin of mammals. With drawings, pictures and charts as well as samples of fossils, he gave us a summary of the enormous amount of evidence of the many species which evolved from reptiles, some of which became mammals. The event was a fitting climax to our lecture series.

We are eagerly awaiting Sloan's account of the search for our ultimate ancestors as the scientific refutation of the claims being propounded by the Creationists.

Special thanks to Mark and Dorothy Jefferys, social activities chairs for their efforts in arranging the banquet. Fifty-nine people attended and several more came later for the talk.

The Geological Society of Minnesota Lab at Macalester College – February 2020

On Saturday morning, February 8th, on the grounds of the Macalester College Campus, Geology Laboratory Supervisor Jeff Thole hosted a Lab entitled, "An Exploration of the Mineralogy and Geochemistry of Gemstones." The Macalester Lab is always a popular lecture, and this year's event was no different and was well attended.

Jeff provides an overview of birthstone gemology

The lecture began with a form of GSM appreciation for Jeff Thole. Since 2010, Macalester College and Jeff have shared the Olin-Rice Science Center Lab and its specimens and instruments with the Geological Society of Minnesota. He also recruited excellent student assistants over the years to help with the labs.

Jeff demonstrates the use of remote analysis tools to determine gem composition

Jeff has been a major part of GSM's Student Outreach program which delivers the science of Geology to 1st through 8th grade metro-area classrooms. He also set up and maintains the cloud site "Team Drive: Geological Society of Minnesota" which enables our Outreach presenters the ability to access, store, share and glean ideas from previous presentations. More recently, he donated fossils collected from an Iowa field trip for GSM to donate at the recent Minnesota Earth Science Teachers Association conference, MESTA. As a sign of our appreciation for this ongoing relationship, the GSM presented Jeff with a GSM hammer created by Estwing Manufacturing, another exceptional organization.

The lab included hands-on activities and demonstrations by geology students

Jeff began the Lab with an overview of birthstone gemology and the minerals that comprise each gem. He showed slides of the processed stones, as well as examples of many of the same stones in the rough. Then using Micros X-Ray Fluorescence (Micro XRF) and SEM/EDS spectrometers, Jeff identified the composition and element distribution of assorted jewelry and stones furnished by GSM participants.

Macalester student Alex demonstrates how a Refractive Index (RI) is collected from a gem

However, then things got different. Jeff invited three students to show some of the different aspects of their work with gemstones.

Alex, a sophomore geology major, showed how a refractometer worked. This device measures the way light reacts (change in velocity) while passing through different minerals. Using a liquid with a refractive index (RI) value of 1.81, a stone is placed flat-side down on top of the liquid, then the refractometer is closed and a monochromatic light source is turned on. Then as you look through the eyepiece, you can directly read the RI of the gem on the scale. Natural and synthetic minerals and glass have a

Mac graduate Emma Thole demonstrates gemstone faceting

Grinding a gemstone on the Facetron faceting machine

specific range of RIs, and this information helps to determine the mineralogy and authenticity of specific stones.

Emma, Jeff's daughter and recent Macalester graduate, was on hand to demonstrate gemstone faceting using a "Facetron" faceting machine. She also demonstrated some new software, Gem Cut Studio that she uses to help with the gem cutting process. Emma added that she likes doing projects that take a lot of time and patience. On the other hand, she noted, "grinding can be very tedious; the smallest mistake can have you redoing your work."

Clara, a junior Geology major, has a collection of gemstones. She explained her work on collecting micro-XRF spectra on the roughly 350 specimens in her collection. The resulting 'empirical database' will be used to compare micro-XRF spectra to the more familiar x-ray spectra collected from the SEM/EDS. The resulting database will hopefully one day be a resource for future Macalester mineralogy students.

This year's lab proved to be interesting and engaging with the students taking on lead roles, both for our benefit and the benefit of future Macalester geology students.

GSM president, Dave Wilhelm (r), presents Jeff Thole with a custom-made geological hammer in appreciation of Jeff's contributions to the GSM

Thank you Jeff for another excellent lab!

Theresa Tweet; photos by Mark Ryan

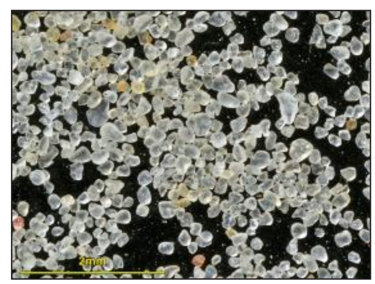
Flowing Sand

On a warm February day, a friend and I hiked along on the rail grade trail from Lilydale to Mendota where the St. Peter Sandstone bluffs hug the trail above and the Mississippi River flows below. I've taken this pretty hike many times. Typically, we see the decomposed sandstone piled along the base of the bluffs, but with spring thaw and water seeping over the hillside, the loose sandstone grains on the hillside had mixed with the water and had formed beautiful flow patterns. And in some areas, the water-saturated sand was actually flowing as we watched. In other areas, the sand had already dried out enough to erase the delicate flow patterns.

St. Peter Sandstone bluff between Lilydale and Mendota, Mn

Intricate patterns created by flowing sand

I wondered, what does this flowing sand feel like? I touched gently. It felt "soft," and my finger left a small impression; and the feeling reminded me of touching a cookie that was baking to determine its doneness. After I touched it, the little divot re-filled with water and plumped back up! Having had lots of experience grabbing fistfuls of sand, I took a handful. It felt like a gritty, slushy ball—and super saturated with water. As I held it, water seeped from between my fingers and the grains. Squeezing it more and feeling the grains, I recognized that the sand grains were very fine. I wondered, if the fine grain size was responsible for the delicate patterns? Likely.



Photomicrograph of decomposed St. Peter Sandstone, note the rounded grains, photo by Leo Kenney

That brought back memories. As a kid growing up on the shores of Lake Michigan with "sugar sand" beaches, we would build drip castles nearly every day. We dug holes near the shore till we hit the water line, then grabbed handfuls of sand. Then we watched our castles grow as we let the sand and water drip through our hands and fingers. This process formed similar patterns to what we saw naturally occurring on the St. Peter Sandstone bluffs. And both ephemeral.

More intricate sand flow patters

A friend hiking with me questioned why the sand was flowing and making these patterns. Hmm, not everyone has geology background, I explained how the freeze/ thaw cycles causes the sandstone to decompose and to turn back into sand, especially on surfaces exposed to the weather. I also noted that the shape of the lobes indicated the flow direction, something we see in rock, but less often happening in front of our eyes.

Forever being the teacher, I showed the flowing sand and patterns to a couple of 7-year-olds who were walking the trail and encouraged them to touch and describe the sand. They replied with a "ewe" and "cool."

Kate Clover, story and photos

Hawaiʻi in February 2020 to see Volcanoes

Last February, the Institute on Lake Superior Geology (ILSG) offered several GSM members the opportunity to see and study the volcanoes that make up the **Big Island of Hawaiʻi**, the largest island in the Hawaiian Island chain. Two volcanos are active: **Mauna Loa** is the largest shield volcano, **Kīlauea** is the youngest. The other three, **Kohala, Mauna Kea, and Hualālai** are dormant. There is a sixth volcano, **Loʻihi**, rising below the sea to the southeast.

The field trip's leader, Canadian geologist, Allan MacTavish, met five GSM enthusiasts along with three other professional geologists in **Kailua Kona**, an historic seaside town on the Big Island's west coast. We soon left Kona heading south in three vehicles. Our first stop was **Kealakekua Bay State Historical Park** which preserves the culture and history of the Hawaiian people. Here we were first introduced to the massive drystone walls which delineate the *heiaus*, sacred religious structures found all around the Island. Further south, the flows from **Mauna Loa's western flank** introduced us to overlapping layers upon layers of jumbles of masses of towers of ʻa'a flows. I found it difficult to assimilate the forms. The coastal town of **Hoʻōpūloa** was completely buried in a 1926 flow; a new town is still emerging as landowners rebuild. We also saw an endangered Green Sea Turtle on the sand of the Marine Conservation District.

Model showing the 5 volcanoes on the Big Island

Surf draining from rough ʻaʻā lava

Halemaʻumaʻu Crater within Kilauea Caldera

Our next five days were centered at **Hawaiʻi Volcanoes National Park**. Established in 1916 as the 13th national park, it is now an International Biosphere Reserve and World Heritage Site. Its 505 square miles contain **Kīlauea** with its massive caldera and rift zones, and **Mauna Loa**, which is only 25 miles away. Our accommodations were at Kīlauea Military Camp, a military facility located along the caldera's rim and used today for military family recreation and by nonprofit groups. From lovely cottages to dorm bunk beds, we experienced it all.

Kīlauea Caldera, over 4 square miles, is the heart of the National Park. **Halemaʻumaʻu Crater** within the caldera is its most active vent. Eruptions have covered part of the circular **Crater Rim Drive** and destabilized the museum and observatory as well as obliterating parts of the Chain of Craters Road. Other eruptions along the **East Rift Zone** have added 500 acres to Hawaii's south shore.

Footprints in partially-lithified ash

The crater can be seen from several sites: near the visitor center at Steaming Vistas, at the **Keanakākoʻi** overlook, and from the road. No matter from where it is viewed, it is an awesome sight.

Kilauea Iki crater seen from its rim

The park road system has access to trails leading to the various terrains where endless combinations of lava forms can be viewed: spatter cones, spatter rims, fissures, lava tubes, tree molds, plus examples of pāhoehoe and ʻaʻā lavas.

The Kaʻū Desert Trail follows a path once used by Hawaiian villagers and warriors. A 1790 eruption trapped a war party of Hawaiians who left their footprints in the ash; some escaped and some did not.

Mauna Iki Crater Trail branches off and shows different forms of lavas, and I learned a new word: tumulus. Tumuli form when a thin crust of pāhoehoe lava receives a subsequent pulse of molten lava and lifts the original into a swollen dome. They appear in all sizes from bumps to great hills. Here, Joanie Furlong discovered our first glimpse of Pele's hair, thin threads of volcanic glass elongated as they traveled through the air.

A jumble of lavas

Devastation Trail begins on forested land where flowers abound. But soon the trail comes to an extensive moonscape of cinders and towering lava fountains left from the 37-day-long Kīlauea Iki eruption in 1959.

The **Kīlauea Iki Trail** was perhaps the favorite hike. **Kīlauea Iki Crater** is deep and now solidified, but it was once filled with a molten lava lake. (Craters are formed when an underlying lava suddenly drains away and the surface collapses.) The trail begins along the rim where one can look across to the vent under a huge cinder cone. Around the floor of the crater are "bath tub rings" indicating the levels of different flows. Descending to the floor of the crater, the top of the "lake," we found some surfaces smooth but others with piles of crustal plates jumbled like "ice out" sheets. Cairns marked the path across the "lake" surface which was surprisingly warm to the touch.

Lava does not respect traffic laws!

Group in Kilauea Iki crater

The **Chain of Craters Road** descends abruptly to the coast over the **Hōlei Pali. (**A pali is a cliff face of a lava flow.) The scenic 18.8-mile-long drive with an elevation change of 3,700 feet crosses lava flow upon lava flow, both recent and ancient. The youngest flows are the darkest, the oldest flows are vegetated. At the very end of this road lies the **Puʻuloa Hill Historic Petroglyphs**, an archeological site still used by traditional Hawaiian families where at least 23,000 figures, shapes and forms are carved into the pāhoehoe. Also along the road, we found a begging *nēnē*, the Hawaiian goose and state bird. From a population of just 30 endangered birds in 1952, there are now estimated to be 800 in the wild.

Nēnē

By far the most exciting day included a 75-mile Paradise Helicopter flight over the **Kīlauea Caldera** and the **East Rift Zone**, over much of the area which we had walked. As there were no side doors on the helicopter, camera access was unobstructed, and it was breathtaking looking down into the greatly enlarged **Halemaʻumaʻu Crater.** Dr. Jack Lockwood, retired from the Hawaiian Volcano Observatory had purchased "land" over one of the massive flows so that he could always land a helicopter. And we did! Walking on six-year-old lava, identifying

Recent ropy pāhoehoe

Taking phots from an open helicopter and the helicopter on a recent lava flow

flow features, and listening to the tinkle of the brittle pāhoehoe will surely remain in our memories. Together we walked up the nearby cinder cone associated with fissure 9, one of the most prolific of the 2018 eruptions. The residual heat could be felt through our boots. Later we would visit the undamaged home of Mark Bishop, GSM member and owner of Niagara Cave in Harmony, MN.

Snow and observatories on Mauna Kea

What could be more appropriate after that than seeing **Mauna Kea's** snow? Hawaiians were shoveling pickup beds full. Kids were sledding. Surfers had other uses for their boards. From the summit, the telescopes at **Mauna Kea Observatory** looked like 13 mushrooms in the snow.

Next, we visited two entirely different beaches, the first, **Punalu'u Beach** was composed of black sand (shattered obsidian) and the other, ***Papakōlea,*** of green sand (olivine crystals). **The black sand beach** was inviting with Green Turtles landing in the waves. But reaching ***Papakōlea 's green sands*** was a test. We all walked in on a road that crossed a poorly-consolidated, deeply-incised grassland. The U-shaped beach, surrounded by dark cliffs of ash imbedded with olivine crystals was beautiful, but unfortunately the wind embedded the sand and ash into our sandwiches, hair, teeth, clothes, and shoes. To return to the parking lot, a few of us hitched a ride from a local business that provided a ride worthy of a bucking bronco. That in itself was an adventure.

Turtles on a black sand beach

Unlike the dry Kona side of the island, the eastside is lush. The **Hawaii Tropical Botanical Gardens**, created in the Onomea Valley, near Hilo, in 1977 was spectacularly filled with tropical trees, colorful flowers, waterfalls, and breathtaking vistas. Further north the land is covered with ash, deeply incised by rivers. Originally home to native taro growers, the sugar plantations that replaced them are mostly gone. **At Laupāhoehoe Point,** a tsunami originating in an Aleutian Islands in 1946 event killed many people. Tsunami evacuation route signs abound.

Olivine sand grains from Papakōlea Beach, photo by Leo Kenney

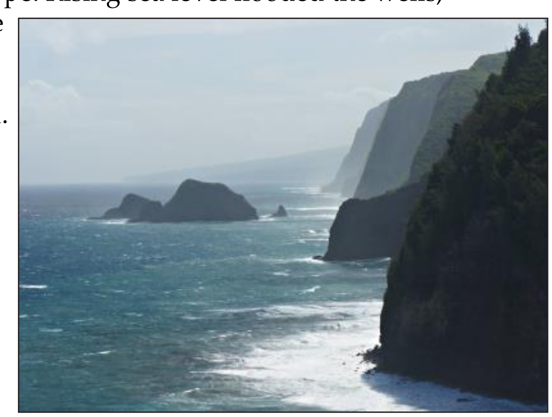
Green sand beach

The northern peninsula was formed by the oldest volcano, **Kohala**. Here the beach has eroded out of a saprolitized (weathered) alkaline mafic flow. The process continues to round the flow into boulders. Maui looms across the strait. Down a dirt road is **Mo'okini Heiau**, one of the most sacred *heiau*. Dedicated to the War God, it was a place of ritual sacrifice. The *kapu*, the set of laws governing all Hawaiian religious life, allowed only the most powerful to enter, but it was opened to all in 1978. The massive but desolate site is still cared for by the same family.

Rounded and polished black sand from Punalu'u Beach, photo by Leo Kenney

Lapakahi State Historical Park on the northwest shore of the island preserves the foundations of a once flourishing fishing village. Houses, canoe sheds, salt production, places of worship, and garden plots surround the bay. But fresh water was scarce on this western slope. Rising sea level flooded the wells, causing the village to be abandoned.

The white sand **Hāpuna Beach** is bordered by an unusual outcrop filed with visible



Deeply incised valleys at Pololū Valley Lookout olivine and pyroxene phenocrysts. Further south, the younger Mauna Loa flows overrides the older **Hualālail** lava flows. The grass lands of **Pu'uwa'awa'a Dry Forest Site** had new plants to see.

Our final destination, the **King Kamehamehai Kona Beach Hotel** was as lovely as it sounds, appreciated for its luxury, its many dioramas of Hawaiian history and displays of artifacts. After that all that remained was relaxing, whale watching, and packing to return home.

The end is as hard to write as it was to do. Allan MacTavish, our guide, created a thorough survey of a large territory; his field guide was excellent and useable, his enthusiasm unbounded. My thanks to him and to Peter Hinz, Canadian geologist and trip co-leader. The professional geologists were all supportive. It was a great group of travelers. Should he offer the trip again, I can recommend it heartily.

Mary Kay Arthur; photos by Dave Wilhelm

New Zealand Travels to Mercury Bay

I count myself as among the fortunate who were able to travel as planned before the COVID-19 lockdown early in 2020. My travels took me to New Zealand, which has long been on my bucket list. My two weeks there were not long enough - I would return tomorrow.

Among the areas I visited was Mercury Bay on the rugged Coromandel Peninsula on the east coast of New Zealand's North Island, about a 2.5-hour drive from Auckland. The peninsula juts north and separates the Hauraki Gulf and Firth of Thames in the west from the Pacific to the east. It is at the end of a belt of volcanic rocks. Mercury or Red Bay is a large V-shaped bay that was named in 1769 by English Navigator Capt. James Cook when he landed to make an astronomical observation of a Transit of Mercury. The area is renowned for both its shorelines and forests. The Cathedral Cove area is also known as Whanganui A Hei Marine Reserve.

View of the Coromandel coast from the upland trail

As I had seen photo micrographs of the beautiful pink sand from Cathedral Cove on Mercury Bay, and being a sand collector, I was hoping to actually find this sand for myself and observe the regional geology and marine environment. We drove to the town of Hahei, and from there, Cathedral Cove is either a 90-minute hike through the verdant fern forest or a 15-minute ride on the water taxi. I compromised and chose the water taxi going in one direction to see the coastal cliffs from the sea and then hiked back to town. This was an excellent decision.

Coastal view of cliffs near Cathedral cove

The short boat ride provided a great view of the steep, white coastal cliffs. And when I asked a boat crew member what the rock was, she said without pausing, "ignimbrite." After reaching the beach, I set off to see the rock up close. I had done research and learned that this rock, ignimbrite or welded tuff, was produced by explosive volcanic eruptions that had occurred about eight million years ago. The close-up view of these pyroclastic sediments revealed tiny angular blocks of pumice and glassy shards in a fine-grained matrix of volcanic ash, quartz and feldspar. Looking at the cliffs, I tried to imagine the magnitude of the eruptions necessary to create these massive pyroclastic deposits.

Ignimbrite at Cathedral Cove with chunks of pumice and glassy obsidian

Intense wave action along the Coromandel coast results in erosion and the formation of caves, blowholes, arches and sea stacks. See the people for scale

The striking color of the sand from Mercury Bay comes from the polished shell plates of the pink barnacle *Notomegabalanus decorus,* a species found only in waters around New Zealand. This barnacle is large and reaches up to 3 inches at the base. It is the most characteristic and well-known barnacle of the New Zealand shelf. However, unlike other barnacles, this one is seldom seen as it only occurs sub-tidally at around 25 meters depth. Except we find their remains in sand.

Sand from Mercury Bay, photo by Leo Kenney

Barnacles have shells with diverse body plates, and the best examples in this sample are the triangular plate with grooves or hollow channels near 2 o'clock position and the more elongated pink fragment with the ridge near 4 o'clock.

Identifying barnacle plates is not easy. Their conical or volcano-shaped shell is comprised of six rigid carbonate plates; and its operculum (the top plates) is composed of another two pairs of plates which open and close as the animal feeds on plankton and drifting plant material. If you notice that the shapes of the pink fragments do not all look alike, that is because the barnacle base shell has four distinct plates, and the operculum has another two pairs of distinct plates. The triangular plate with hollow channels near 2 o'clock, is a "typical" body plate. The elongated fragment near 4 o'clock, is an opercular plate. To add a further challenge and confusion to identification, the inner and outer faces of these plates are different, and the right and left plates mirror one another (think right and left hands).

Other biogenic grains in this sand include tiny gastropods, as well as remains of sea urchin spines (the striated green rods), coralline algae (the smooth white rods), and bivalves.

This sand includes more than barnacle fragments and the remnants of local marine life. Look closely at the sand's matrix, the tiny grains in the background. The clear quartz and yellowish feldspar grains are the pyroclastic sediments deposited about 8 million years ago that have eroded from the cliff face and are now part of the beach sand.

Kate hiking in New Zealand's fern forest where tree ferns grow 20-30 ft. tall

Yes, I'm grateful I made the trip to Cathedral Cove. Seeing the coastal cliffs from the water, examining the ignimbrite, savoring the beauty of the site, hiking through the verdant fern forest and finding the pink barnacle sand made for a memorable day. So good indeed, we returned for a second visit a couple of days later.

Kate Clover

New and Unusual Fossils in Minnesota's Ordovician Strata

I've been collecting fossils in Platteville and Decorah exposures for 45+ years. In that time, I've found or have seen most all of the usual marine fauna the Ordovician-aged (~440-485 Ma) strata has to offer, including trilobites, brachiopods, cephalopods, *Receptaculites*, rugose and tabulate corals, *Raufella*, crinoids, and even a rare conulariid. Most are abundant and can be found in several locations across southern Minnesota.

In late 2009, while scouring new fossiliferous exposures in Cannon Falls, MN, I found, besides the usual fare – including a splendid 6-inch cephalopod tail - three specimens of a very unusual fossil I'd never seen before. The small fingernail-sized fossils were all on the surface, and fairly close to each other. I think the layer in which the fossils were found may be the Cummingsville Formation which overlies and interbeds with the top of the Decorah shale.

The first three specimens

Each specimen is comprised of a rounded cap about 10 to 12 millimeters in diameter and about half as thick. What makes them stand out is the fact each has a stalk (or the remnant of one) attached at the bottom. The cap of the largest displayed the most detail, with an interlaced texture visible across the surface and a radial aperture perhaps used to take in and expel nutrient-rich waters. The central stem pokes out from the middle of the lower side of the cap, but sometimes a cap displays signs of the remains of similar-sized connection points branching off the side surface. At first sight, they remind one of tiny mushrooms, but the resemblance is in form only.

Specimen close-up showing radial aperture

Since my initial discovery, I've often returned to the site, searching across the exposure for more of these strange little fossils. But it took seven years to find another, and three years after that to find two more. All were found within a square yard of the first three specimens, so I have narrowed my search to that single spot. I have revisited after rains and winters and frosts and it took me another three years, in late 2019 to find two more. Fortunately, the current health pandemic has not kept me from pursuing my favorite solitary activity, and I returned this year in early April and found two more, and again two weeks later four (!) more along with some pieces of possible truncated stalks.

Mystery fossil in situ and four recent specimens

Not knowing if they were coral, sponges or something else entirely, I've emailed photos to some invertebrate paleontologists; and so far, I've learned they were definitely not corals. So maybe sponges? One expert suggested I have a specimen cut and polished and examined under a powerful microscope to look for spicules – a definitive skeletal element of sponges. Jeff Thole (Macalester's Geology Lab manager) and I have discussed doing just that, but now things are in limbo with the Coronavirus lockdown. As yet, I've found nothing in the literature or online except a photograph of what looks to be a similar fossil found in Ontario, although it was stated the specimen itself was missing. Last autumn, at the National Museum of Natural History in Paris, I saw several similar (albeit much larger) fossil sponges from the Cretaceous that were a good 20 centimeters (about eight inches) in size.

Mystery sponge descendants?

Could my tiny fossils be their ancient ancestors? Who knows? But the mystery continues to hold my interest and will keep me searching for answers.

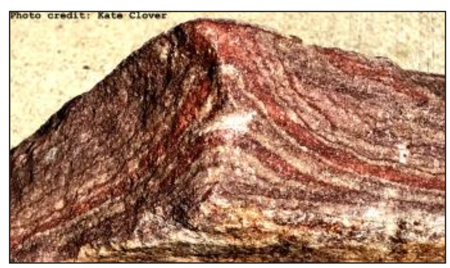
Mark Ryan

Curved Sioux Quartzite

This curved bit of Sioux Quartzite (SQ) is from a quarry located a half mile west of the Jeffers Petroglyphs in Cottonwood County, Minnesota. For years I have puzzled about its curved form. *Naturally-broken* pieces of SQ are slabbed, flat, layered, and range in color from light yellowish-pink to deep burgundy. Some are sparkly, some are dull in appearance, and some show ripple marks from being under water. But all are flat and have broken along straight lines. The *quarried* stone chips (this being one of them) are broken by rock crushers, but they still break along straight edges. Until this piece.

Curved fragment of Sioux Quartzite, photo by Carol Kissner

The striated rock pictured here (10x6x2 inches; 9 pounds) was picked up two miles south of the Petroglyphs. Over the years, numerous rocks of SQ have been placed in my garden, and this piece lives beneath the bay window. It shows banding and cross-bedding. Most SQ rocks are solid colored without marks or lines.



Striated block of Sioux Quartzite, photo by Kate Clover

I grew up near the Petroglyphs and the Red Rock Dells. The Dells, a local name for a quartzite formation, is located two miles west and two miles north of the Petroglyphs, and features a stepped 30-foot waterfall. The surrounding area is featureless, barely rolling farmland with nothing to indicate that a treasure is nearby. The Dells are located on a gravel road with a small bridge over an ordinary creek. But get out of the car at the top of the (very) small hill where a picnic building is standing, and a few yards to the south a

Cross bedding on a block of Sioux Quartzite, photo by Carol Kissner gorge opens up with the waterfall that comes off a one hundred-foot staircase of stepped Sioux Quartzite from which, when flow is available, water cascades down. Fifty feet beyond the southern boundary of the parkland, the flat farmland begins again. This amazing little place appears out of nowhere and recedes as it begins

At the base of the waterfall, the gorge forms two "rooms" with 30-foot walls of Sioux Quartzite. While Native Americans marked the petroglyph site (four miles away) with figures, none have been found at the waterfall site.

"Visible in the rock are distinct layers, indications of advancing and retreating of shore environments. In many places cross bedding is evident, the result of water transport and deposition of the sand grains. The rock is about 1.6 billion years old, is composed of well sorted and well-rounded grains of quartz. The quartz sand is a remnant of granite erosion, being more resistant to weathering than the feldspar and micas. The rounded nature of the grains indicates that it traveled a long distance to get here (being more rounded as it bounced and bumped into other rocks). The composition and size of the bedrock indicates that a very large mountain range must have been present to supply all of the sand. The ripple marks visible here and many other places, and the large amount of sediments indicate a braided stream environment typical of rivers emptying into an ocean or large lake similar to the Mississippi emptying into the Gulf of Mexico. Analysis of the ripple marks reveal a current direction of just east of due south. The red to purple color comes from the presence of iron oxides (rust) coating individual sand grains." – photo and text from MN DNR Minerals Education Workshop 2005; Field Trip guide by Dr. Dean Moosavi and Rick Ruhanen

The waterfall dries up seasonally, but the pool at the base of the Red Rock Dells always has water. Photo credit: MN DNR Minerals Education Workshop 2005; Field Trip guide by Dr. Dean Moosavi and Rick Ruhanen

One mile east of the Dells, the creek is dammed to create a small lake and another small waterfall can be found. It does not have the gorges however.

So why is this piece curved? I have no formal schooling in geology, but have consumed geology lectures, library CDs, YouTube videos, books, and have faithfully attended the geology lectures at GSM. Finally, I found an acceptable explanation to the curved quartzite.

During the COVID-time, Dave Wilhelm sent an email to GSM members with a link https://pages.mtu.edu/~raman/Jacobsville.mp4, provided by Kate Clover, to a lecture about **Jacobsville Sandstone** in Michigan authored by Dr. Bill Rose, retired geology professor from

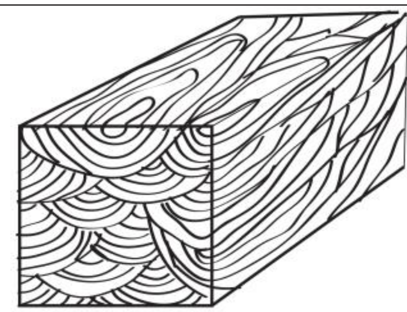


Figure 26. Block diagram showing fluvial trough cross-bedding as it appears on horizontal, transverse and axial sections.

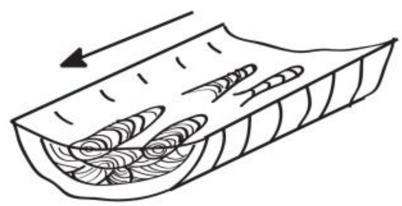


Figure 27. Schematic diagram showing relationship of fluvial trough cross-bedding to steam flow direction and stream channel.

Figures 26 and 27, illustrate cross bedding. From video lecture: GeoElements of Michigan's Keweenaw: The Jacobsville Sandstone

Michigan Technological University. When viewing the video, I noticed a similarity of formation with Sioux Quartzite. Both involve erosion of large mountains; sand transported into braided rivers resulting in channeling and cross-bedding. Fig. 26 and 27 has been recreated from the video.

An interesting side note of living with Sioux Quartzite – the well on our farm was drilled to 116 feet but SQ bedrock was struck at 114 feet. We hit water and also got a weather forecaster of sorts. Two days before a storm the well water would turn opaque orange. A geologist friend said that an "unusually low barometric pressure could lift water toward the surface, bringing with it dissolved minerals/orange color." The taste did not change, but one could not do laundry until the weather system passed. Well #185558 is now capped off.

Red Rock Dells, Cottonwood Co., Minnesota

The farm located next to the Red Rock Dells was once owned by Carol's grandfather. The location was pictured on a postcard.

Carol Kissner

Good Geological Sites in Ohio and Other Fun Stuff

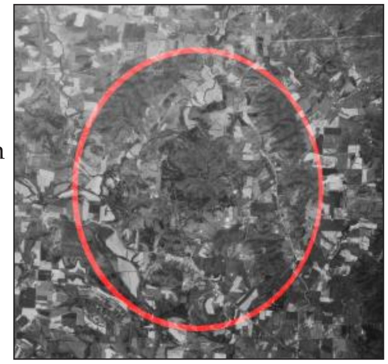
My mother and siblings live in Columbus, Ohio, and I visit there a lot. The brother-in-law and I have made a practice of doing day trips over the years to see all sorts of interesting things, including visiting interesting geological sites.

In fall and winter 2019-2020, after first thinking about a possible GSM tour to the area, I decided to write an article on some interesting sites in Ohio that I have visited. With help from my writing, GSM Members can maybe do their own trips. Two books are recommended over and over: *Ohio Rocks* by Albert B. Dickas, *and Roadside Geology of Ohio* (Mountain Press). They are good, and a real geologist will help if you can find one.

Ohio is geologically diverse. From Southwest to Northeast, the bedrock is Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian (Carboniferous), and Permian in age. Some of these strata are missing in Minnesota, so an Ohio visit presents different stuff to see. There are also a number of interesting archaeological sites, one concurrent with a geological site.

Buckeye Furnace, south Ohio. This is a self-guided site, an old iron refinery. Before, during and after the Civil War, Ohio, West Virginia and Kentucky were big iron mining areas. Buckeye Furnace is one place where the iron was smelted and poured into 'pigs' which were then shipped up the canals to the steel mills in Cleveland and Pittsburgh. The ore came from three layers: the Little Red Block, Guinea Fowl and Yellow Kidney Ores. It was scraped from foot-thick layers on the hillsides and averaged 30-40% ore. Streams flowing off the Appalachian Mountains deposited the iron ore in the wetlands of the Hanging Rock region of Ohio, Kentucky and West Virginia during Pennsylvanian times. The ore was deposited above the Vanport Limestone, which was also mined for flux to process the ore. Iron mining in the Ohio area ended before WWI, after the better quality and much more abundant ore was discovered on the Iron Range in Minnesota. In the park, you can see the buildings where the smelting took place; the museum and gift shop are open on weekends. The covered bridge is refurbished, but is still interesting. Plan for 1-2 hours without the museum. Buckeye Furnace is located 9 miles from Wellston, on State Road (SR) 165-167.

Serpent Mound, south central Ohio. Serpent Mound is a world heritage site, with a constructed serpent which is also an observatory for the seasons. The serpent marks solar and lunar positions: sunset at summer solstice, winter solstice sunrise, sunrise and sunset at the equinoxes and lunar risings and settings. These astronomical alignments were discovered only recently since 2000. Climb the tower and view the serpent from above, and then walk around it. The museum and gift shop are good, and the film explaining the culture is well worth watching.



Serpent Mound Crater, red oval shows approximate perimeter (1974 photo), Wikimedia Commons

Serpent Mound is also on the western flank of an astrobleme (an impact structure), the end of a series of meteorites which hit the earth (think Shoemaker-Levy 9) at the end of the Paleozoic. The first hit was in Scandinavia, and they ranged down across to Ohio. This was just as Pangaea was finally coming together. The towns of Sinking Spring and Locust Grove are outside the 4-mile diameter disturbance. SR 73 crosses the disturbance on the southwest edge, and SR 41 from N to S at the eastern side. Parker Ridge Road traverses the center E to W. After your visit, drive southeast into Locust Grove on SR 73 and stop at House of Phaecops, an eclectic rock shop where you can buy Serpent Mound T-shirts and chat with the proprietor about the mound and trilobites and other fun stuff. Plan for 2-3 hours. The site is off SR 73 two miles east of Loudon.

Aerial view of Serpent Mound. This is an old picture; the tree in the bend is gone and the bridge over the spiral is also gone. Photo: Wikimedia Commons

Flint Ridge State Memorial, central Ohio. This is a geological and archaeological site. The beds of flint are part of the uppermost unit of the Vanport Limestone, a Pennsylvanian age deposit. In pre-Columbian times (and after), Native tribes considered Flint Ridge a neutral site. Anyone could come and mine flint for weapons and tools. The flint here is particularly fine, 96-99% pure silica, and it works very well. Specimens of this flint have been found all over North America as it was widely traded. This flint is

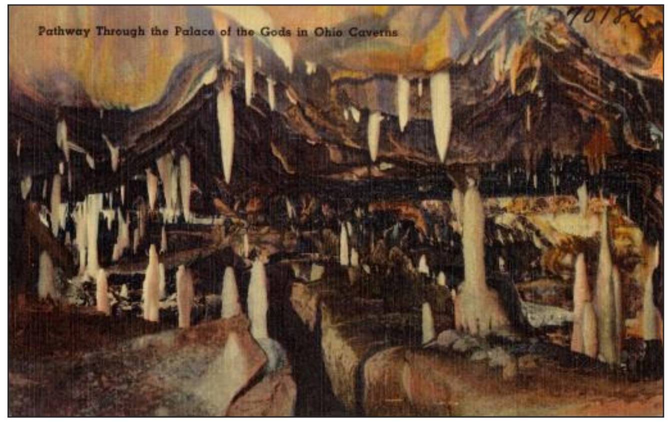
Pennsylvanian age flint, photo by Kate Clover especially colorful—red, yellow and brown in addition to the usual grey and white, and occasionally has bits of druzy stuff as well. Collecting is prohibited in the park, but every winter more flint is heaved up from the soil. If you look at the side of the roads that run around the park, you will find lots of flint in the ditches. There is a small museum and gift shop. Plan for 1-2 hours. This site is located off I-70, north of Brownsville between Columbus and Zanesville.

Hueston Woods State Park, southwest Ohio. This is the site of a farm that was preserved as a park. They dammed a river and created Acton lake, something which Ohio generally lacks. In state parks you usually cannot collect, but there a few sites here where you can collect for personal use. There is a covered bridge in the park, and the riverbed below is full of late Ordovician fossils where you may collect. Park in the picnic spot and take a hammer. I spent about 45 minutes and found a lot, so a dedicated person will be able to find many interesting specimens if they walk up river. Many brachiopods, horn corals and the like. Supposedly there are also trilobites. There is a small museum in the park,

Ordovician horn coral, photo by Kate Clover

which details what might be found, but it is sketchy so you can skip it and just collect for yourself. Apparently there is a map for collecting available at the Park Office, but when we visited, nobody was there. Plan for however long you are willing to collect fossils, an hour at least. This site is off SR 177, five miles north of Oxford, just east of the Indiana state line.

Ohio Caverns, east central Ohio. This is one of Ohio's many caves, but they claim to be the most colorful. I found it to be so. The Devonian Columbus Limestone is the bedrock in the cave, which has been subsequently carved by groundwater over the millennia. The largest crystal deposits are estimated to be 250,000 years old. Many of the cave formations are calcite, but there are also colorful iron oxide and manganese dioxide formations. There is a gift shop and small museum, and plenty of picnic areas, bathrooms and general places to roam



Pathway through the Palace of the Gods in Ohio Caverns. Photo: Wikimedia Commons

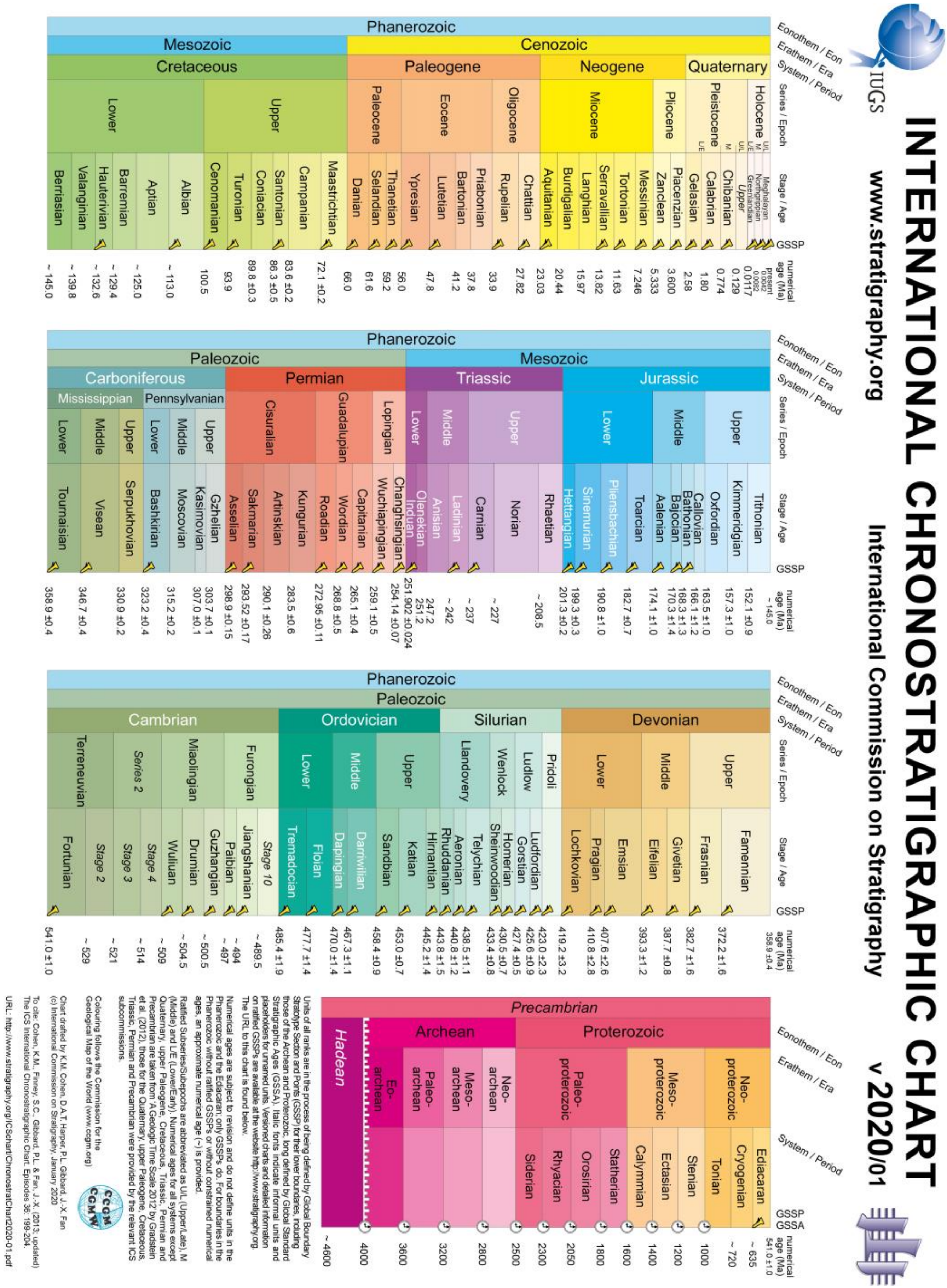
outside the caverns. Take your own flashlight to see minerals in better detail. Plan for at least 3 hours which includes a tour. There are also fun shops in West Liberty, so check them out as well. This is located 4 miles east of West Liberty on SR 245.

Hungry when traveling? The brother-in-law and I always tried to eat at the local mom and pop places in the small towns, and we were always happy. Why eat at chains, when every small town has a local diner, and they are pretty good for the basics. Especially the pies.

Deborah Naffziger

ChronoStratigraphic Chart

The International Commission on Stratigraphy (ICS) has a long tradition of producing international charts that communicate higher-order divisions of geological time and actual knowledge on the absolute numerical ages of their boundaries. The primary objective of ICS is to define precisely a global standard set of time correlative units (Systems, Series, and Stages) for stratigraphic successions worldwide. These units are, in turn, the basis for the Periods, Epochs and Ages of the Geological Time Scale. Setting an international global standard is fundamental for expressing geological knowledge. It is also of considerable pragmatic importance as it provides the framework through which regional-scale higher-resolution divisions can be linked, equated and collated. This is a status update on the International Chronostratigraphic Chart and the ICS website www.stratigraphy.org. (Cohen et al., 2013, Episodes, v. 36, no. 3)


INTERNATIONAL CHRONOSTRATIGRAPHIC CHART
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numerical age (Ma)
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Triassic
Permian
Carboniferous
Mississippian
Pennsylvanian
Devonian
Silurian
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Cambrian
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Chart drafted by K.M. Cohen, D.A.T. Harper, P.L. Gibbard, J.-X. Fan
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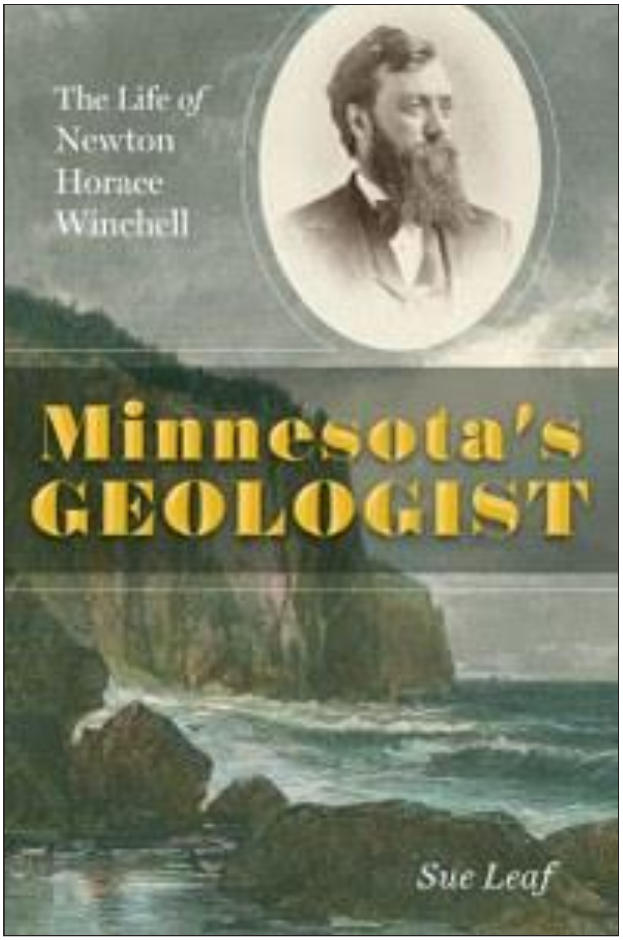
URL: http://www.stratigraphy.org/ICSchart/ChronostratChart2020-01.pdf



University of Minnesota Press

Minnesota's Geologist
The Life of Newton Horace Winchell

2020

Author: Sue Leaf

The story of the scientist who first mapped Minnesota's geology, set against the backdrop of early scientific inquiry in the state

Tracing Newton Horace Winchell's path to becoming a leading light of an emerging scientific field, Minnesota's Geologist recreates the early days of scientific inquiry in Minnesota, when one man's passion for learning could unlock secrets of the state's distant past and present landscape. This first telling of Winchell's life story is set against a backdrop of Minnesota's geological complexity and splendor.

S*ue Leaf has done a great service for the people of Minnesota and beyond by telling the story of Newton Horace Winchell so thoughtfully and beautifully. Readers of Minnesota's Geologist will be rewarded with new insights into why the world around us functions as it does. This is a book that I've been hoping for*. — Harvey Thorleifson, director, Minnesota Geological Survey

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