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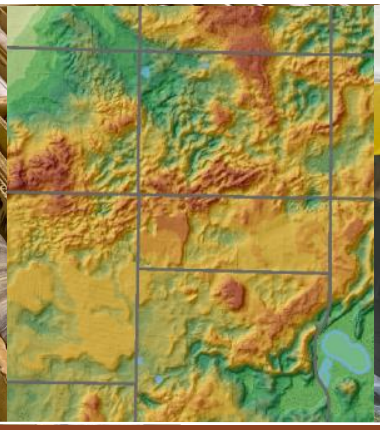
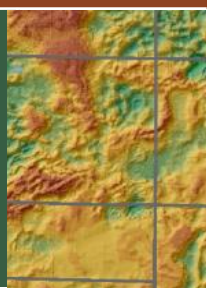


Issue 6
Spring '24

Quarterly Updates from the Michigan Geological Survey

MICHIGAN GEOLOGICAL SURVEY
EST. 1837

Core Quarterly



MGS Welcomes New Director – Sara Pearson

I am honored to assume the Directorship of MGS. I extend my sincere gratitude to Director John Yellich for his remarkable leadership in reviving the MGS after a period of dormancy and for the support of the Geological and Environmental Sciences Department at Western Michigan University. Furthermore, I acknowledge the invaluable contributions of State Geologist Adam Wygant and the Department of Environment, Great Lakes, and Energy (EGLE). Their unwavering support has secured base funding, providing the MGS with a solid foundation for the future. Building upon this strong foundation, the MGS is poised to become the premier scientific authority on Michigan's geology and natural resources. Partnerships will remain a cornerstone of our success. We are dedicated to fostering existing collaborations with stakeholders and forging new, strategic alliances.

The MGS will continue its vital role of preserving and generating invaluable data, publishing comprehensive geological maps and scientific papers, conducting cutting edge research, education and outreach, and developing a robust library of open-access resources from our home, the Michigan Geological Repository for Research and Education at WMU. These resources will continue to be instrumental in driving informed decisions regarding responsible resource utilization, development, and stewardship in Michigan.

Michigan boasts a wealth of natural resources, and the MGS is dedicated to providing the most current and accurate scientific information. This information will empower stakeholders to implement best practices in resource management, environmental stewardship, and economic development.

I am eager to embark on this exciting new chapter with the dedicated team at the MGS. We look forward to keeping you informed of our ongoing progress and contributions to the sustainable development, management, and protection of Michigan's geological future and natural resources for our citizens.

Photograph of Sara Pearson and her husband Adam Heft, fellow geologist, in Iceland at Glacier Lagoon.

~ Sara Pearson

MICHIGAN GEOLOGICAL SURVEY
Western Michigan University
Department of Geological and Environmental Sciences
Established 1837

WESTERN MICHIGAN UNIVERSITY

For more information go to
https://mgs.wmich.edu

https://wmich.edu/michigangeologicalrepository

Key Updates >>>

Introducing New Staff

John Esch – Senior Geologist

John Esch is a geologic mapping expert with 40+ years of experience in the Michigan Basin, glacial geology, GIS, 3D visualization. He developed Michigan's GeoWebFace application and Michigan's environmental justice screening tool (MiEJScreen), and several other mapping applications and statewide geologic data products. He joins us after a successful career at EGLE, having received multiple awards from various organizations. He received his bachelor's degree in geology from Central Michigan University. John's interests include studying the bedrock surface and structural geology of the Michigan Basin, use of unconventional geophysical techniques, groundwater surface water interactions, and the use of GIS and 3D visualization techniques to help understand subsurface geology. He chaired the EGLE GIS Committee for 18 years and Tri-chaired the EGLE Groundwater Technical Team for 3 years. He has been a volunteer with Lifewater International in which he trains people overseas in groundwater exploration, shallow well drilling, and hand pump repair.

Dr. Libby Ives – Geologist, Aggregates

Dr. Libby Ives (she/her) is a geologist with expertise in glacial geology, sedimentary geology, geomorphology, and geologic mapping. She earned a B.S. in earth science from Northern Michigan University (2013), M.S. in geology from Iowa State University (2016), and Ph.D. in geoscience from University of Wisconsin – Milwaukee (2021). She has worked on geologic mapping projects in Wisconsin with the Wisconsin Geologic and Natural History Survey and in Michigan with the USGS's Great Lakes Geologic Mapping Project. In addition to her mapping work, Libby's research has allowed her to explore a wide variety of sediments and sedimentary rocks including the Archean on Mars, Paleozoic of Antarctica and Australia, Cenozoic of Greenland, Holocene of Iceland. Libby believes that public outreach is an integral part of science and has demonstrated her commitment to science communication through activities such as organizing geology field trips as part of the Les Cheneaux Aldo Leopold Festival (Cedarville, MI), speaking at geology clubs in Wisconsin and California, and giving interviews for podcasts and TV segments. At the Michigan Geological Survey, Libby is working as a research scientist on the Aggregate Mapping Project. Libby will be focusing on geologic mapping in the UP and will be based out of the Upper Peninsula Geological Repository in Gwinn.

Trent Adams – Geologist, Aggregates

Trent is a geomorphologist, geotechnical engineer, and GIS expert with over 10 years of professional experience. He holds a B.S. in civil engineering from Washington State University (2008), a B.S. in geology from Central Washington University (2019), and an M.S. in geological science from Central Washington University (2022). His career began in the private sector, working for an engineering firm on the Olympic Peninsula in Washington after completing his first degree. In 2019, Trent shifted his focus to geologic hazard assessments, leveraging his newly acquired geology background. Following his master's degree, Trent joined the Washington Geological Survey's Landslide Hazard Program, where he mapped alluvial fans and debris flows. In early 2024, he worked with the North Carolina Geological Survey's Landslide Hazard Program, mapping landslides, rockfall, and debris flows while providing technical expertise in emergency response situations. Trent joined the MGS mapping group as a full-time employee in June 2024, where he currently focuses on mapping aggregate resources and studying landscapes formed by glaciers.

Thomas Valachovics – Geologist, Aggregates

Thomas (Tom) Valachovics joins the MGS team to lead the aggregate mapping project. Tom brings experience working in glaciated terrains throughout the Great Lakes having previously published maps while working for both the Ohio Geological Survey and Indiana Geological Survey. Tom earned a B.S. in Geology from Grand Valley State University working with MGS contract mapper Pat Colgan and earned a M.S. in Geology from the University of Toledo. Tom's research interests include Quaternary geology, quaternary geochronology, and the hydrogeology of glaciated sediments.

Introducing New Staff

Richard Haagsma – Geotechnician

Richard (Ricky) Haagsma is an accomplished project manager with over ten years' experience in managing teams, projects, and accounts. He holds a bachelor's degree in leadership and management from Franklin University, and an associate's degree in art from Mid-Michigan Community College. He dove into 3D printing a few years ago and has developed his hobby into a career. Now, Ricky is leading 3D scanning and modeling to develop an online repository for MGRRE's samples. When not at work, he is golfing, 3D printing, or spending time with his family.

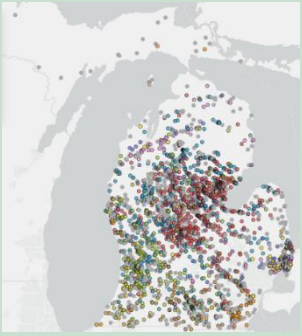
Sam Zink – Research Assistant

Beginning as a drilling team senior research assistant in 2023, Sam provided field support for core documentation, sampling, and boxing. She also worked on the Triage Project digital input team. Recently, Sam has joined MGS fulltime to assist with mapping for the Aggregate Project. In her new position, she will continuw to help with field work, rducation and putreach, and plan and facilite in-person events and YouTube content.

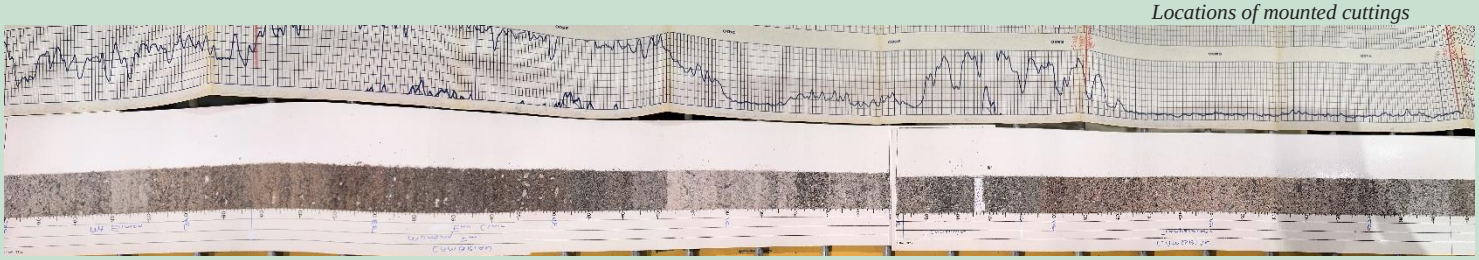
Sam graduated from Albion College in May 2023, with a bachelor's degree in geology with a fine arts minor. She participated in research through Albion's honor's program, creating poster presentations for GSA conferences in 2021 and 2022. As an artist, Sam likes to create diagrams, sculptures, and other modes of visualization to integrate into her research, and communicate geological concepts. Currently, Sam is developing her skills in ArcGIS to continue this passion in the form of creating maps.

Data Highlight – Mounted Cuttings

MGRRE houses a collection of more than 3,300 mounted cuttings. Cuttings were carefully laid out and glued to thick cards at the same depth scale as the associated wireline logs. The cuttings can show changes in lithology, mineralogy, and clues about reservoirs, confining systems, and natural resources. Mounted cuttings can be correlated with wireline logs to improve interpretations, understand changes in log signatures, and build a regional understanding of Michigan's complex geology. Some organizations are even showing success using handheld XRF, microscopes, and more, for advanced analyses. Would mounted cuttings help you with your work? Contact us to learn more!



Locations of mounted cuttings



Photograph of mounted cuttings across the Cambrian interval including Trempealeau through Mt. Simon formations.

Triage Team is Hiring!

The Michigan Geological Survey (MGS) is seeking qualified and skilled individuals for a research assistant position. REMOTE WORK. This is a great opportunity for anyone in earth and environmental sciences, looking to bolster their resume or work a flexible schedule while doing something that directly impacts the health of their community.

You can learn more about the Triage project, and virtually meet some of our current team members on the Michigan Geological Survey YouTube channel.

Research Assistant (I) Job Posting

Michigan Geological Survey (via Western Michigan University)

Go to this Sway

Outreach and Education Activities

Science Olympiad Regional and State Competition Hosted by WMU

Written By: Marie Solum

The Michigan Geological Survey's K-12 Outreach Program, CoreKids, along with WMU's GeoClub, had a productive second quarter of 2024, participating in fourteen youth and general community events. These included school field trips to WMU's Geological and Environmental Sciences Departmentand visits to schools, numerous community and student outreach events, and the Kalamazoo Gem & Mineral Show. In total, our outreach efforts reached over 10,000 students and adults this quarter.

We are proud to have participated in Science Olympiad this year. On March 16, WMU hosted the Regional competition and on May 4, WMU hosted the 42nd annual state competition. For these two events, Dr. Peter Voice wrote the high school geologic mapping exam, Tom Howe wrote the middle and high school fossils exam and Marie Solum wrote the middle and high school dynamic planet exams. During the State competition, Lisah Crall administered the fossils exam for Tom Howe who led the GeoClub/AIPG student chapter trip to Chile. In addition, MGS Media Coordinator Shelby Hurst assisted Dr. Voice in the geologic mapping exam. More than 400 staff and student volunteers worked all day to ensure the event's success.

The State competition was a great success organized by WMU's Science Olympiad Director Martin Buehler (K-12 Schools Liaison CEAS-WMU STEM-Workforce Collaborative). In total, more than 1,800 of Michigan's best science scholars were on campus competing in 50 diverse and often lab-based or hands-on events. Two high school teams and two middle school teams from this event advanced to the National Finals at Michigan State University on May 24-25.

According to Scot Conant, WMU's Outreach and Recruitment Manager, WMU has been a long-time host of the regional competition, regularly hosting hundreds of competitors from Southwest Michigan. This was the first time WMU hosted the State finals. Reviews were overwhelmingly positive with several coaches having shared that it was their first experience with WMU and they had a great time. Our campus proved to be a welcoming, accessible environment with helpful people and a well-run event. We look forward to participating again when WMU hosts the 2025 Regional Science Olympiad competition on March 15, 2025.

New YouTube Series in the Making

The outreach team has been hard at work developing the next series of YouTube videos! We will be walking through the stratigraphic column and showcasing different time periods in Michigan. Be sure to follow along!

http://www.youtube.com/@michigangeologicalsurvey

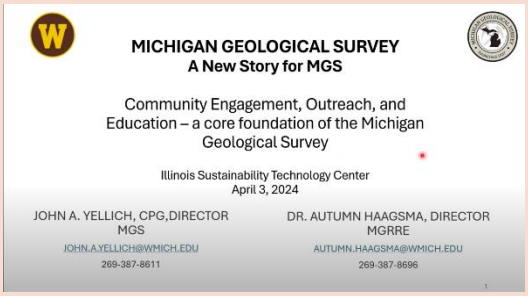
Follow MGS on Instagram!

Did you know MGS has an Instagram? We have been posting mini-videos, rock and mineral highlights, staff highlights, and job posts. Be sure to follow along!

https://www.instagram.com/michigangeologicalsurvey/

Dr. Autumn Haagsma and John Yellich Discuss Importance of Outreach and Engagement

Dr. Autumn Haagsma and John Yellich co-presented to the ***Illinois Sustainability Technology Center*** on the history and importance of outreach and engagement. We discussed strategies and provided examples of different types of engagement. John reviewed the history of the survey and the role outreach played in gaining support and funding. Autumn showed the adoption of these strategies to CCUS projects.



Outreach and Education Activities

U.P. MGS Team Hosts Students from CMU, EMU, and UofM

Written by: Nolan Gamet

What does the team of MGS geologists living north of the mighty Mackinaw bridge do while waiting for the field season to begin? Besides writing grant proposals and attending conferences, there are plenty of other tasks to be completed around the office as the spring season wanes and the mosquitoes begin to thrive. The U.P. MGS team has been keeping busy this spring by leading day field excursions, core repository tours, and inviting guest speakers to give presentations in our neck of the woods. An idea to host one university at the Upper Peninsula Geological Repository (UPGR) ultimately turned into a 3-day long outreach extravaganza. Geology students and professors from the University of Michigan (UofM), Central Michigan University (CMU), and Eastern Michigan University (EMU) abandoned the sedimentary rocks of the Lower Peninsula as they drove north to investigate the slightly more interesting igneous and metamorphic rocks of the western Upper Peninsula (U.P.).

Day one began at the UPGR in which geologists from the MGS and the Department of Environmental, Great Lakes, and Energy (EGLE) gave the CMU class a rundown of the facility and the thousands of linear feet of drill core that it contains (*Figure 1*). Later that day, Bob Mahin guided a group of UofM graduate students around the Marquette area to examine some interesting bedrock outcrops such as the metamorphosed Archean greenstone pillowed basalts (*Figure 2*). Bob also led the group from CMU on a similar tour around Marquette to share his geological expertise of the area over the weekend.

Figure 1. *Central Michigan University geology students (right side of photo) on a UPGR tour guided by Melanie Humphrey, Benjamin Hinks, and Ashley Quigley (from left to right).*

Day two consisted of more core repository tours and an in-person talk on Northern Michigan University's campus. Bright and early in the morning, Bob Mahin accompanied students from CMU and UofM to the Back Forty core repository, located near Menominee, MI, to examine drill core samples from a metallic sulfide deposit. Meanwhile, Ashley Quigley, Nolan Gamet, and geologists with the Department of EGLE welcomed EMU students and faculty into town by giving them a brief tour of the UPGR. During all of the core facility tours, the students were able to inspect drill core as an attempt to grasp a deeper understanding of the western U.P.'s subsurface geology (*Figure 3*).

Figure 2. *MGS Geologist, Bob Mahin, (center) demonstrating how to observe pillowed basalts in Marquette, MI with graduate students from the University of Michigan.*

Figure 3. *Geology students from Eastern Michigan University happily inspecting drill core. Photograph by Ashley Quigley.*

Dr. Adam Simon, professor of geology at the University of Michigan and the Society of Economic Geologists' distinguished lecturer of the year, finished off day two with an awe-inspiring presentation on IOCG-IOA type deposits (*Figure 4*). IOCG-IOA, or iron oxide-copper-gold/ iron oxide-apatite, deposits contain large quantities of important metals such as iron, copper, and gold. These deposit types are crucial for a future dominated by green energy because they contain abundant iron oxides and may contain silver, gold, cobalt, rare earth elements, nickel, uranium, and vanadium as economically important by-products (Rodriguez-Mustafa and others, 2020). Once the presentation concluded, folks hung around the area to network and to ask any rock-related questions that arose during the talk.

Outreach and Education Activities

U.P. MGS Team Hosts Students from CMU, EMU, and UofM

Written by: Nolan Gamet

Figure 4*. Dr. Adam Simon from the University of Michigan giving talk on IOCG-IOA type deposits on Northern Michigan University's campus. Photograph by Ashley Quigley.*

The third and final day was spent in the Keweenaw Peninsula learning about the 1.1-billion-year-old Midcontinent Rift System (MRS), the rich mining history of the area, and the key mineral that fueled Michigan's copper rush over 100 years ago. The day began with a self-guided tour through MTU's A.E Seaman Mineral Museum where both students and mentors became mesmerized by the world-class mineral collection, especially the abundance of Native copper samples from throughout the Keweenaw (*Figure 5*). The impressive display of minerals made everyone geeked to search for some native copper and silver specimens of their own. To aid with this search for red gold, Nolan led an afternoon field excursion to a handful of publicly accessible copper mine dumps that host a variety of MRS-related flood basalt.

Figure 5*. CMU researchers take on the A.E Seamon Mineral Museum at Michigan Technological University and pose in front of a large native copper specimen from White Pine, MI. Photograph from Dr. Mona Sirbescu.*

The first stop was to the Wolverine Mine No. 2 shaft dump, located about two miles north of Calumet, which offers a plethora of interesting minerals to be found. This mine site allows you to transport yourself back in time to the 1880s by walking around the old building foundations and reminiscing what life during the copper rush may have been like. The next stop on the list was a rock dump along M-41 just south of the Quincy Mine No. 2 Shaft. Although no museum-quality specimens were found this time around, the sound of rock hammers breaking rocks apart was music to a geologists' ears. The view of Houghton and the Portage Canal to the south, combined with crystal blue skies above, made for an optimal picture taking opportunity (*Figure 6*). With pockets full of rocks and faces full of smiles, the time for the CMU class to say goodbye and drive back to campus was imminent.

A huge thanks goes out to everyone who made this week full of activities possible including EGLE, the Back Forty core repository, Northern Michigan University, the professors from each university, and most importantly, the students. Creating sparks in geology amongst students, whether they are a result of hammers striking against silica-rich rocks or from a metaphorical sense of sparking a new passion, is a crucial step towards filling the boots of the great geologists who came before us.

Figure 6*. MGS Geologist, Nolan Gamet, guides team of Central Michigan University researchers throughout Michigan's Keweenaw Peninsula. The infamous Portage Lift Bridge can be seen in the backdrop. Photograph by Nolan Gamet.*

WESTERN MICHIGAN UNIVERSITY
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Serving geologists for 60 years

MGS Attends ILSG 2024

At Michigan Technological University

Written by: Nolan Gamet

Looking for a fulfilling way to learn about new and exciting Lake Superior geology right from the academic source? Well, the Institute on Lake Superior Geology may be the perfect answer for you. The 70th Annual Institute on Lake Superior Geology (ILSG) conference was held at Michigan Technological University's (MTU) campus in Houghton, Michigan and spanned from May 15th to May 18th. This year, geologists from the MGS caravanned westward to the fifth largest city in the U.P. (Upper-Michigan.com, 2024) to partake in this year's conference. They made the most out of the conference by hosting a table at the event (*Figure 1*), attending technical talks and poster sessions, giving a talk on the critical mineral systems cooperative effort between the MGS and USGS in Michigan's U.P., and taking multiple coffee breaks, of course.

***Figure 1**. The MGS U.P. team members (from left to right - Bob Mahin, Nolan Gamet, and Ashley Quigley) pose in front of their table at ILSG 2024. Photograph by John Esch.*

ILSG 2024 also had ample opportunities to learn about Michigan's geologically diverse terrains across the northwestern U.P. by offering excursions on the first and last day of the conference. Out of the many field trip opportunities, two MGS geologists decided to take on the northern portion of the Southern Complex granitoids, gneisses, and migmatites excursion led by Dr. Chad Deering from MTU's Department of Geological, Mining Engineering and Sciences. Most of the field trip was spent exploring a variety of different outcrops exposed in road cuts along M-41 and M-95 between Baraga and Humboldt townships.

The Southern Complex is composed of 'dome-and-keel' type structures that are characterized by elongate domes of Archean basement surrounded by keels of Paleoproterozoic strata of the Marquette Range Supergroup. The rocks observed here are representative of the magmatic, metamorphic, and structural evolution of the Southern Complex with regards to the unique geologic history of the surrounding area. After brief safety talks and geologic interpretations at each of the roadside stops, the group of geologists were able to do what they do best. To help identify minerals in the rock, participants were equipped with rock hammers, safety glasses, hand lenses, and high visibility vests. This essential combination of tools ultimately meant that there was not a single, publicly accessible rock that was left unidentified by this group of geologists (*Figure 2*).

Sadly enough, the shear bliss of being at a geology conference waned as another work week quickly approached. We would like to thank everyone at the ILSG and MTU for putting together such a wonderful conference that encapsulated learning, networking, and memory making all in one unique location.

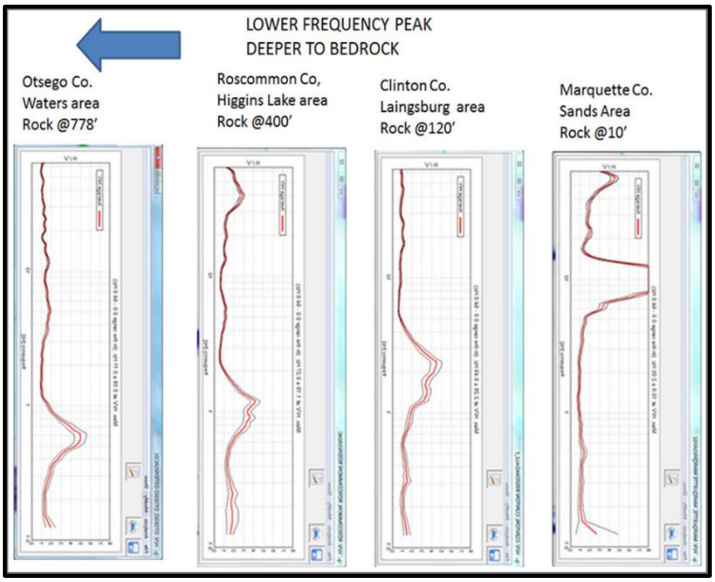
***Figure 2**. Left - Geologists spotted investigating large roadside exposure of the Bell Creek granite with cross-cutting mafic dikes and/ or sills along M-95 near Republic, MI. Right - Geologists in their natural habitat observing an extensive road cut exposure at the Michigamme Roadside Park. Photographs taken by Ashley Quigley.*

Research Findings

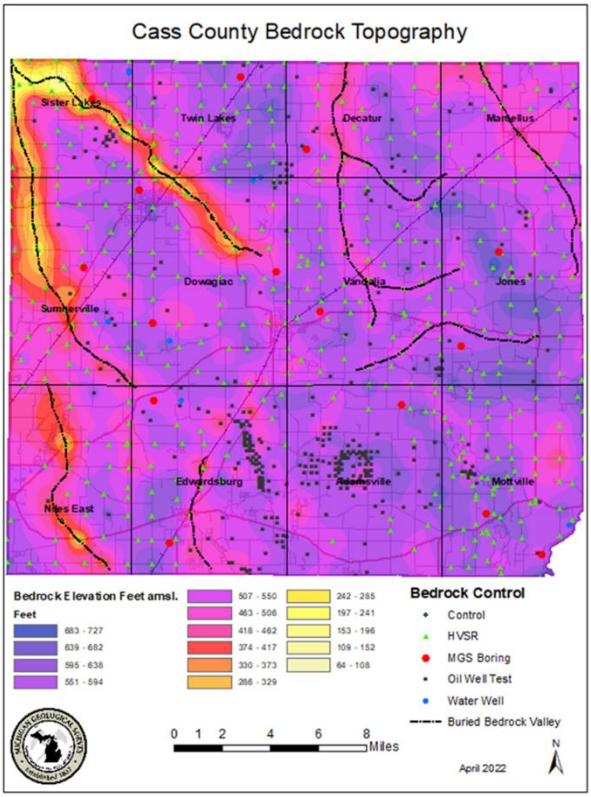
Application of Horizontal-to-Vertical Spectral Ratio (HVSR) to Bedrock Mapping

Written by: John Esch

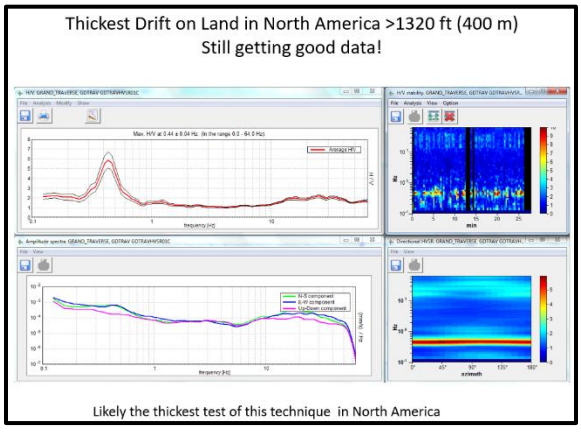
Michigan has the thickest drift on land in North America, but the thickness is quite variable and the underlying bedrock surface is very irregular. Many places have a poor distribution or quality of bedrock depth control points. The bedrock surface is a fundamental surface for many geological, environmental, and engineering investigations. Drilling to bedrock or running geophysical surveys to determine bedrock depth can often be cost prohibitive.
The HVSR method allows one to determine glacial drift thickness (bedrock depth) if there are strong enough velocity and density contrasts between the drift and underlying bedrock. The HVSR method uses naturally occurring seismic noise (wind, waves, flowing water, distant weather) and man-made noise (vehicles, industry) as an energy source. A single station, three-component seismometer (two horizontal and one vertical) is used to record the ambient seismic noise.



The Horizontal-to-vertical spectral ratio (HVSR) passive seismic method has a number of advantages over drilling or other geophysical methods for determining depth to bedrock including low cost, ease of use, one man operation, single station, short sampling times, minimal data processing and its specificity to a single interface (bedrock surface). Additionally, it is portable, noninvasive and can be used in culturally noisy areas. Data can be processed and bedrock depths calculated while still in the field.
A typical workflow for a project is to first develop a local HVSR Calibration curve and equation by taking HVSR calibration readings (over a wide range of bedrock depths) for a given area in the same geologic setting at wells or borings with good quality bedrock depth picks. These are typically water wells and environmental borings that tagged bedrock or oil & gas test wells. HVSR exploration readings are then taken at locations of unknown bedrock depths and the data inserted into the local calibration equation solving for bedrock depth.



The HVSR technique is currently being used in geological mapping, groundwater investigations, karst evaluation, quarry overburden thickness mapping and mineral exploration. It has great potential in geotechnical and engineering investigations and utility excavations. Additionally, it can be used as an independent depth calibration for modeling with other geophysical survey methods.
Mapping the bedrock topography and drift thickness aided by HVSR data are now part of all MGS surficial geological mapping efforts.
Michigan has been one of the early leaders in the use of this technique. Its use and the promotion have encouraged other state geological surveys to now use the HVSR method as a standard tool as part of their geological mapping efforts.



Research Findings

Carbon Storage Confining System Core Workshop

Written by: Dr. Autumn Haagsma

Figure 1. Amber Conner leading group discussions on confining system properties

MGRRE developed and hosted a core workshop designed to bring together a diverse group of professionals and students to review the major confining systems in Michigan, discuss important elements that are needed for an adequate confining system, make observations and interpretations of confining systems, and discuss potential concerns. Our key goals included:

1) Build joint understanding of carbon systems
2) Define confining system properties and characteristics
3) Improve understanding and confidence in assessing confining systems
4) Integrate education, outreach, and DEIA into a technical workshop
5) Establish a data collection strategy for future work

The workshop took place over 2.5 days. Day 1 provided introductory materials on our research, definition of carbon systems, and a group exercise on confining systems (Figure 1). The Cambrian Mt. Simon System and Cambrian-Ordovician Carbon System were reviewed by MGS experts who also described associated cores which were provided for hands-on examination (Figure 2).

Figure 2. Dr. William Harrison discusses cores representing different Carbon Systems.

Day 2 provided overviews on laboratory capabilities at Western Michigan University and Central Michigan University, and the available data preserved by Michigan Geological Repository for Research and Education (MGRRE). Day 3 was designed for core project team members only to develop a data collection strategy, based on our observations and insights gained from the workshop. Dr. Autumn Haagsma led group discussions focused on observations and findings, exploration of features and concerns, and data density, quality, and gaps (Figure 3)

Forty people attended the workshop (Figure 4) including members of geological surveys, faculty, students, researchers, oil and gas, consulting firms, and EGLE.

Figure 3. Dr. Autumn Haagsma leading group discussions

A more detailed summary of the workshop can be found at: https://sites.google.com/wmich.edu/miclimateandenergyresearch/foa2799-advancing-ccus-in-the-michigan-basin\

Figure 4. Group photograph of workshop attendees.

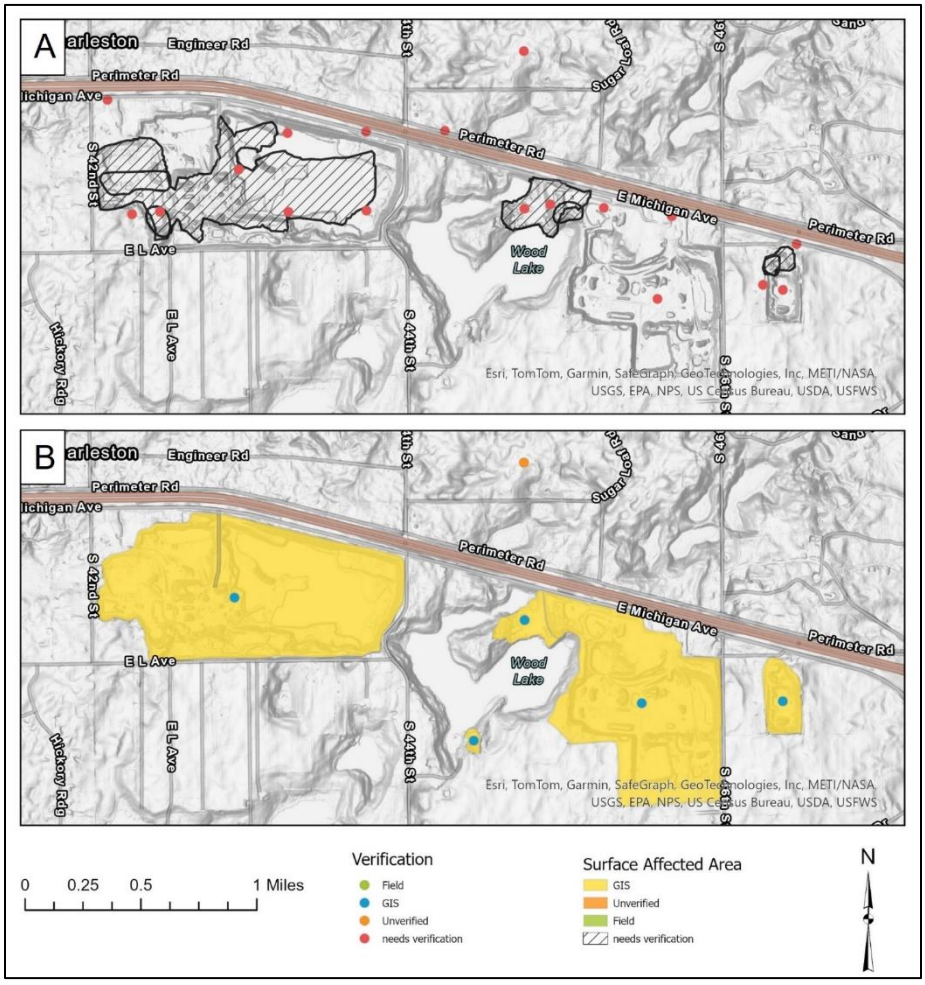
Research Findings

MGS Aggregate Mapping Efforts

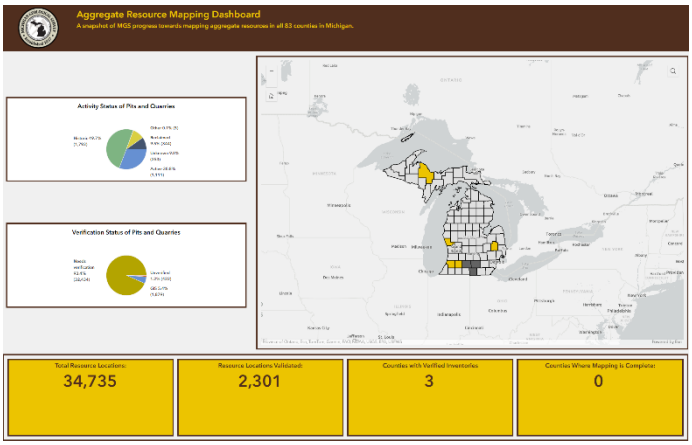
Written by: Tom Valachovics

The MGS aggregate mapping effort is finally underway! Aggregate is medium- to coarse-grained sand and gravel or crushed stone used in construction. Since the last issue, the Michigan Geological Survey (MGS) has expanded to include four more geologists, Trent Adams, Libby Ives, Tom Valachovics, and Sam Zink to work on the aggregate mapping project. Sam also has experience working for MGSon the Wellogic triage project and as a drilling helper. In addition, the group will be assisted by contract mapper Kevin Kincare.

The aggregate mapping project is a five-million-dollar, five-year project funded by the DNR to better understand where aggregate resources are in the state and provide a map of surficial sand and gravel deposits. Throughout most of Michigan glacial sand and gravel deposits are the primary aggregate source. As part of this mapping MGS plans to deliver to the Department of Natural Resources (DNR) an inventory of historic aggregate mining in the state and the surface area affected by these aggregate operations. Twelve different aggregate mining inventories from six different state and federal agencies were compiled into a database containing over 34,000 aggregate resource locations. Now the aggregate mapping staff is taking the time to remove duplicates and validate these locations using light detection and ranging (LiDAR) derived digital elevation models (DEMs) and historic aerial photography to create surface area affected extents for each of the operations while also identifying locations where mining has occurred that are not included in the inventories.



Example of pit inventory clean up and verification near Galesburg, Kalamazoo County. Panel A shows points and surface affected areas from all pit databases over a LiDAR hillshade. Panel B shows the same area after MGS staff has combined and summarized like fields from various databases and validated data based on the same LiDAR hillshade.



Snapshot of our new aggregate resource mapping dashboard

See the figure above for an example of this validation from Kalamazoo County. As of the time of writing almost 2,200 resource locations have been validated across eight counties or approximately 5% of the total inventory.

In addition to providing the most complete inventory of aggregate mining, knowing where aggregate mining has occurred in the past will key the staff into locations where previously untapped or under-utilized sources of aggregate resources to aid in the mapping efforts as the staff expands the scope of this project to mapping the surface sand and gravel deposits throughout the entire state. Check out the new aggregate resource mapping dashboard to see the progress! https://experience.arcgis.com/experience/64267e01c3d340c4a2ad8b81c59e1a68/page/Dashboard/

Research Findings

Developing a 3D Repository for Research and Education

Written by: Dr. Autumn Haagsma

In June, MGRRE kickedoff a new project funded by the United States Geological Survey (USGS) under their National Geological and Geophysical Data Preservation Program (NGGDPP). The project team aims to scan hundreds of samples including fossils, outcrop samples, specimens, and hundreds of feet of evaporite core. A dedicated space with high-end equipment was created and is managed by Ricky Haagsma (Figure 1). 3D models created by the team are publicly available for viewing and downloading at https://sketchfab.com/MGRRE

A multi-step process was developed to produce high-quality models which captured a sample's colors, textures, and characteristics (Figure 2). This begins with the 3D scanning using Revopoint MIRACO 3D scanner. Two different types of data are collected including continuous videos and individual photographs. The datasets are then stitched and merged together to create a high-resolution model. The model is edited to remove background, fill in holes, remove extra data points, etc. Next, the image is rendered which transforms the raw mesh into a 3D object. The 3D object is uploaded to SketchFab for another round of editing to adjust for lighting, transparency, and more. The project team reviews the 3D models together to develop descriptions and annotations. Once the team approves the final project, the 3D model is published and is publicly available.

Figure 1. Photograph of Ricky Haagsma at 3D scanning booth

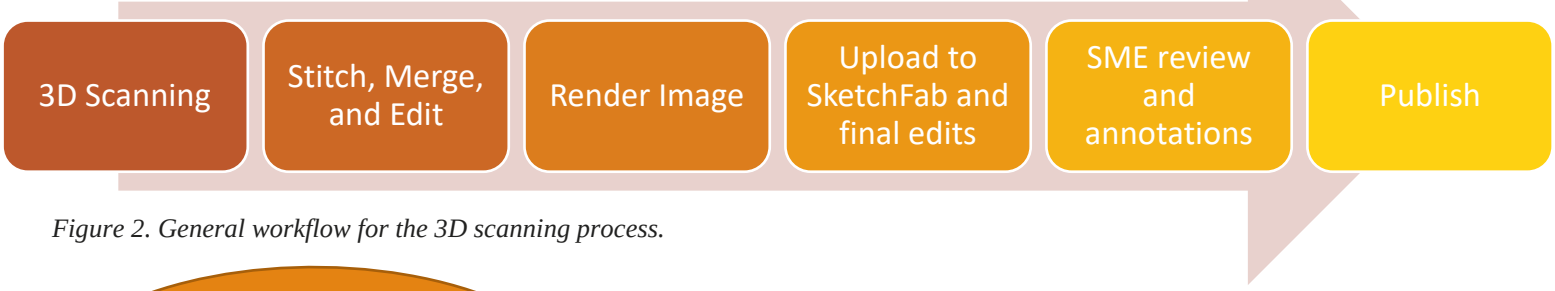


Figure 2. General workflow for the 3D scanning process.

If more kids saw the 3D images of rocks online, I bet more kids would be interested in geology!
- Conner Haagsma

Figure 3. Conner Haagsma taking measurements of samples

How good are these models? Conner Haagsma, 11, takes on this important question as a summer research project. Conner is using a digital caliper tool to measure the length, width, and depth of each specimen (Figure 3). He records the information which is included in the sample descriptions. When comparing the physical measurements to the digital measurements, they are within tenths of a millimeter!

We are beginning by focusing on an historic MGS collection which was collected at outcrops around Michigan and represents many geologic formations. Some samples were even collected during testing for the building of the Mackinac Bridge and represent an important part of Michigan's history (Figure 4). Another collection of focus is the Steve Wilson collection, which is a diverse collection of high-quality mineral and fossil specimens donated to MGRRE several years ago (Figure 5). Currently, more than 40 samples have been scanned and published, with many more in the works. This program will provide access to rocks, fossils, and other specimens which could be used in research, education, and by the general public, increasing awareness of Michigan geology and perhaps inspiring future generations of geoscientists.

Figure 4. Mackinac Bridge core sample

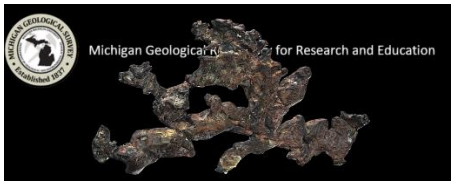


Figure 5. Specimen from the Steve Wilson Collection

Core Stories

Silurian-age Salt and Potash Core Preservation and Research at MGRRE

Written and Interpreted by: Dr. William Harrison

When we received a phone call from Mosaic Corporation in 2008, offering us a core collection from their operations, we had no idea how much core they had, what it contained, or how we would play a role in preserving and researching a multi-billion-dollar resource. We thought we would fill up a pick-up truck with the core and bring it to our repository. Five semi-truck loads of core later, we saw the magnitude of the collection. The cores came from 77 different wells in 9 counties. All 11,400 linear feet of 4-inch evaporite core remained sealed in plastic sleeves, keeping it intact since it was drilled in the 1980's. Those cores now fill 81 3ft-high pallets in our archive (Fig. 1).

Figure 1. Pallets of cores and potash cores preserved at MGRRE

Photograph of William Harrison showing potash layers

Mosaic, which operated in Hersey, Michigan, obtained these cores while drilling wells to determine the extent of a known Michigan potash deposit. Many companies, like Mosaic, spend millions of dollars to obtain subsurface geological cores. After they have gotten all the data they required from the cores, they can no longer justify providing the space and expense required to keep them. We are grateful that some companies recognize the future value of geologic cores and donate them to MGRRE.

The potash deposit occurs in the Salina A-1 Evaporite formation (Elowski, 1980). It is present in beds up to 30 feet thick as Sylvite (KCl) or as Sylvinite—Sylvite intermixed with Halite (NaCl). The potash zones are deep beneath the surface, between 7000 and 9000 feet deep, in the northern half of Michigan's Lower Peninsula.

Dow Chemical Company initially discovered this deposit in the 1950's. Dow scientists first publicly presented their data in 1970 (Anderson and Egleson, 1970; Matthews, 1970), but Dow didn't develop the deposit through any mining operations.

In the early 1980's discovery of natural gas in the Ordovician St. Peter sandstone in central Michigan kicked off a flurry of drilling deep gas exploration wells. These wells passed through the Silurian Salina salt section and were used by Mosaic as a "piggy back" opportunity to collect cores through the potential potash interval.

Core Stories

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Cores from 46 of those wells, drilled between 1982 and 1985, came from those "piggy back" efforts and include over 8400 feet of core. Mosaic drilled 31 additional production and development wells near their plant where they produced potash and salt from 1997 to 2013. We inventoried the core collection soon after we received it, thanks to funding from the U. S. Geological Survey's National Geological and Geophysical Data Preservation (NGGDPP).

After we placed detailed data about these cores on our web site and on NGGDPP's publicly available national database, two companies interested in potash mining wanted to know more it. When Michigan Potash and Salt Company (MPSC) visited MGRRE to examine the collection, they asked us to take samples from the cores and send them to the Saskatchewan Research Council for analysis. Those analyses showed, for the first time, that the grade of this potash deposit is one of the highest in the world—with values as high as 70% KCl by volume, although average maximum KCl concentrations are closer to 50%.

Through additional funding from the NGGDPP, we used data from several sources, including geophysical logs, (Fig. 2) and estimated that the potash deposit extends into 17 counties in north-central Michigan. Based on the known thickness of potash intervals and grade values shown from core analyses, large-commercial production might be possible in 9 of those counties, representing 2.9 million acres.

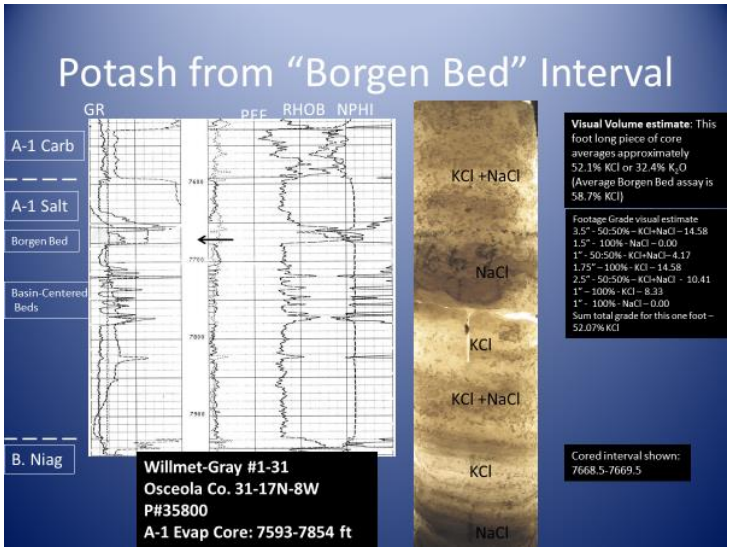

Figure 2. Wireline log with stratigraphic units identified along with selected portion of whole core showing depositional layering and visual estimation of core mineralogy. Peaks in the gamma ray log track show intervals of concentrated potash layers.

So, what's so important about this deposit? Potash is one of 3 essential fertilizer ingredients. It helps plants take up and retain moisture. In the 2024 U. S. Geological Survey, Mineral Commodity Summaries, Jasinski (2024) writes this about potash: "No substitutes exist for potassium as an essential plant nutrient." And he adds, "A large potash resource lies about 2,100 meters under central Michigan and contains more than 75 million tons."

This rare deposit of potash in Michigan may hold the key to unlocking our dependence on foreign countries for this critical fertilizer element. "The vast majority of potash used in the U.S. is imported from other countries, with Canada, Russia, and Belarus being major sources of potash," according to William Knudson, MSU Professor of Agricultural, Food and Resource Economics (Knudson, 2022). Tapping into it could "establish Michigan as a leading U.S. supplier of a key fertilizer used by farmers worldwide," as reported by the U.S. Geological Survey.

Currently there is a bipartisan bill in Congress that would define potash and phosphate as critical minerals, bringing additional attention to this rich Michigan deposit.

At MGRRE, we are dedicated to preserving cores and other data from our geological resources—because we never know how they will be needed. Maybe this resource will meet a national need to provide a domestic source of potash to increase food security for our country.

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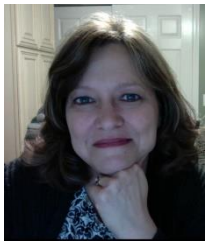

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