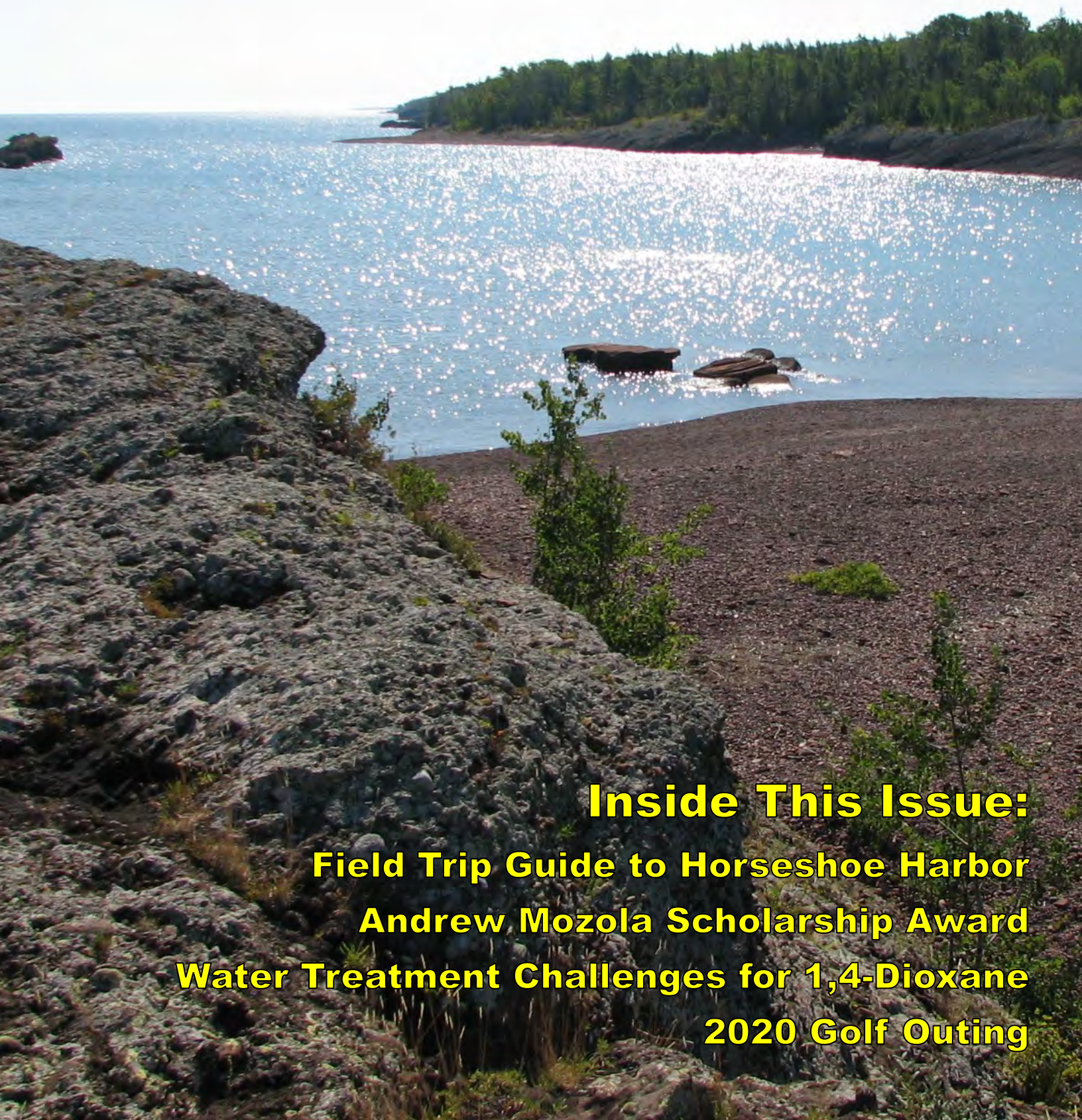


Geologically Speaking

A Michigan Section AIPG Publication



Inside This Issue:

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Andrew Mozola Scholarship Award

Water Treatment Challenges for 1,4-Dioxane

2020 Golf Outing

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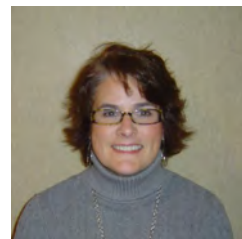
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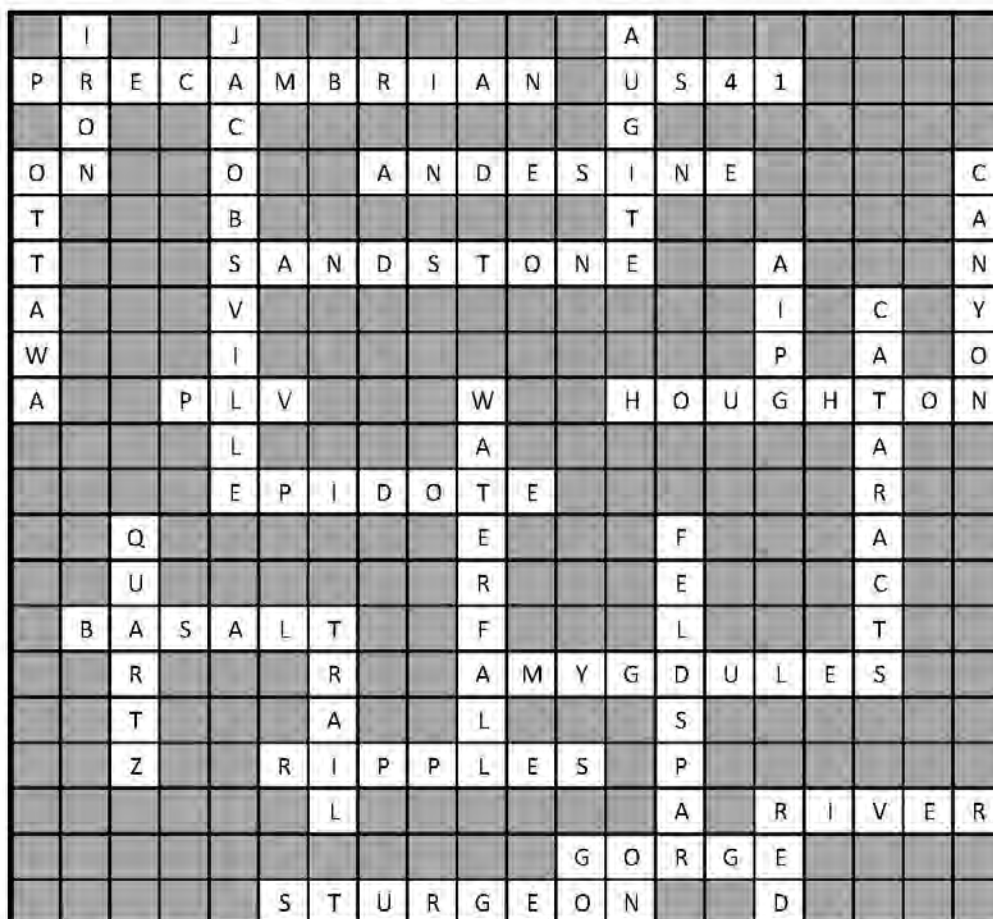
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Geology Crossword #1 Solution



Across

- 1 Ancient History
- 2 Yooper Main Drag
- 3 Plagioclase solid solution mineral
- 4 Cemented beach
- 5 Copper host rock
- 6 First Sate Geologist
- 7 Green mineral
- 8 Black igneous rock
- 9 Filled vesicles
- 10 Potato chip
- 11 Watercourse
- 12 To stuff oneself
- 13 Big fish

Down

- 1 Ferrous metal
- 2 Town in the Keweenaw
- 3 Clinopyroxene mineral
- 4 Canada's Capitol
- 5 Often "grand"
- 6 Ethical organization
- 7 Glaucoma
- 8 H₂O gravity
- 9 SiO₂
- 10 Pegmatite Mineral
- 11 2010 movie
- 12 ___ Forth
- 13 Not off
- 14 To follow

*This geology crossword appeared in the previous edition of *Geologically Speaking*.

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From the President's Desk

Change is hard. How many times have we heard this statement? Countless. Is it an excuse or cliché for taking or not taking action? Perhaps it could be viewed this way?

However, what is true is that change is occurring no matter whether we embrace it or reject it. I can say for certain that 2020 has not gone the way I envisioned it in January. We were excited about holding our first quarter meeting at Eastern Michigan University and hosting a student career event. We were planning the best yet AIPG Environmental Risk Management Workshop. We were deciding on another field trip location to explore and learn about the geology of our region.

Then the pandemic changed everything. We made the difficult decisions to postpone these events with the safety of everyone participating in our events as our biggest concern in advance of executive orders that soon followed. While the orders affirmed our decisions, they did not lessen the disappointment that we felt in not being able to host the events and see everyone. I must admit, when the dates of the workshop came and went with no event, I did feel a bit lost and out of sorts.

We are not completely writing 2020 off as a lost year though. We changed the plans for the golf outing from May to August. We are optimistic that we can still hold this event. Registration information for the golf outing is

available in this edition of Geologically Speaking. We hope to see you there! We are re-planning our meeting at Eastern Michigan University and have invited our partners at the Michigan Association of Environmental Professionals to join us for this meeting. Be sure to watch for separate emails about the upcoming professional development meeting at Eastern Michigan University.

The changes and challenges we have faced in the first half of 2020 have really emphasized to me how much our in-person events are a great benefit of being a member of our organization. (Hmmm, is this my own resistance to change coming through?) I am a fan of technology and video-enabled web platforms, BUT there are limitations to virtual meetings. Who hasn't experienced lost audio, slow internet connections, incompatibilities with web applications and network security, and overall frustration with the technology?

How about the etiquette of virtual events? Do I raise my hand if I would like a turn to speak, are people multi-tasking and checked out of our conversation, and am I truly collaborating with someone on a topic or just checking the box that I have attended another virtual meeting? Perhaps, I should start making marks on the wall of my home office for every virtual meeting I have attended? That would be a lot of marks, and I'm still counting... (I can see a T-Shirt design in this.) There are several funny videos on YouTube poking fun at virtual meetings, and as



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we all know the best comedy comes from things we can relate to. If you need a break from the video chats, take a few minutes to check out YouTube or Saturday Night Live skits. Humor helps us manage change.

While I may poke fun at the virtual meeting format (remember humor helps us manage change), our section has also found opportunity in change by starting the virtual learning platform. Our first event turned out to be a very successful partnering with GHD hosting Matt Rousseau's presentation on Natural Source Zone Depletion of LNAPL, which was recorded and is available on YouTube via the link on the Michigan section website. Thanks to the success of this first event, we have plans for more and have been working out the details on the technology platform we are using.

As an organization, AIPG values and promotes professional development for our members, and we see this as another means for providing this opportunity. Moving into the future, I am hopeful that we will be able to use a blend of different tools and platforms to enhance our collaboration, learning, and partnership building. I hope that we never lose the in-person opportunities that have helped us grow, particularly in the Michigan Section, because it is so difficult to replicate the tangible and intangible outcomes from the workshop in getting people together to learn, share knowledge and solve problems, seeing geologic formations in person, touching the rocks, and having this experience with others, and gathering for an evening meeting to learn, make connections, and maintain professional relationships with each other.

While change is inevitable, I know that I will continue to look for the silver linings in the changes we make and "resist" the wholesale change by planning those in-person events (following necessary safety precautions) that are such a great benefit of being an AIPG member. Stay safe and stay well.



Coming August 2020 AIPG Michigan Virtual Learning!

**Watch for registration
announcement for the
August 21, 2020 event.**

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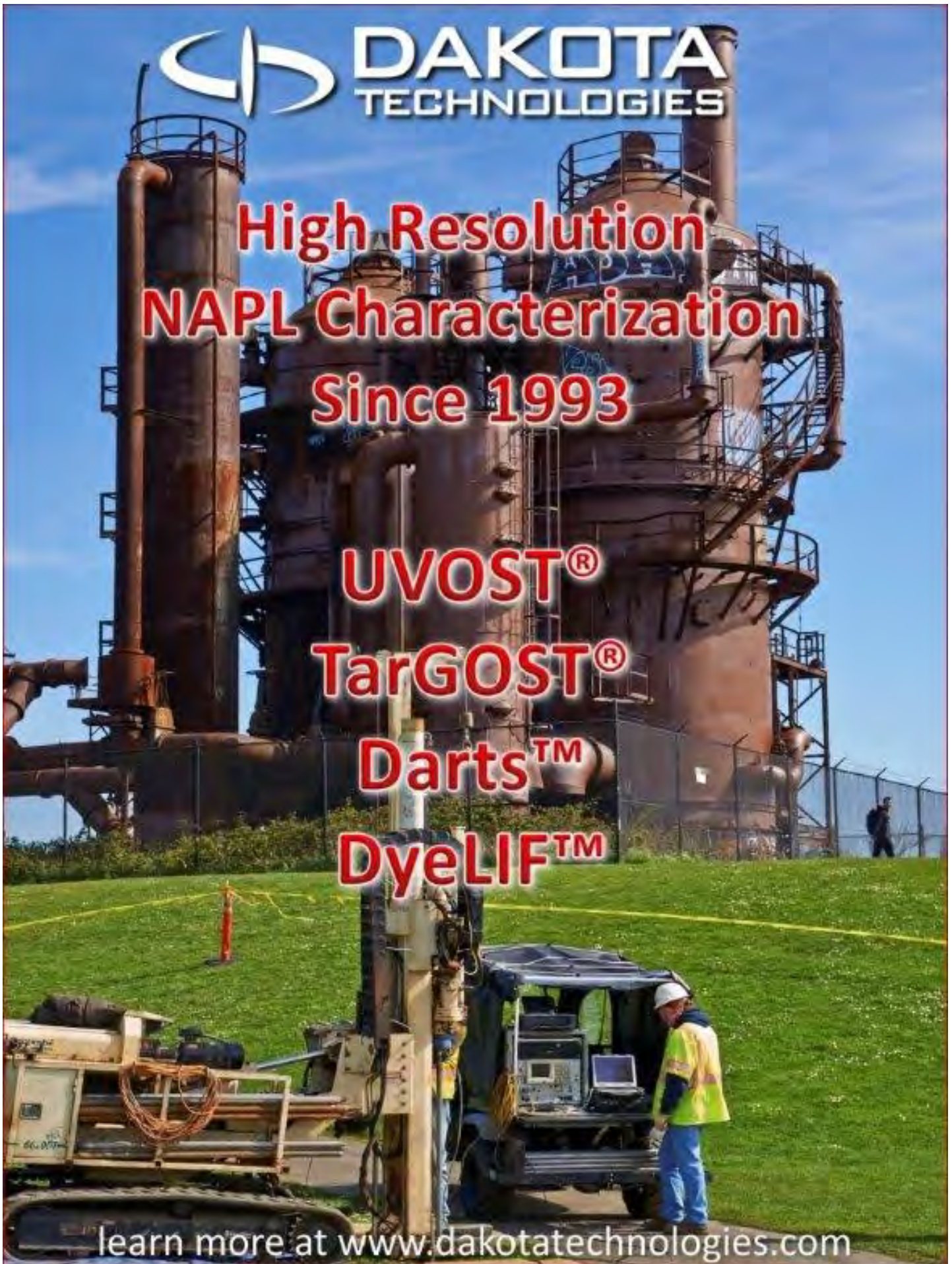
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Did You Know?

This article is intended to remind members of various aspects of AIPG and benefits of membership. If there is something you would like to see featured in this column, please contact the Editor...

What is the Foundation of the American Institute of Professional Geologists? What is its function? The following information is straight from the AIPG website...

The Foundation of the American Institute of Professional Geologists has been established to: make educational grants to support individual scholarships to undergraduate and graduate students in the geosciences; prepare literature with educational content about the role of geosciences as a critical component of the sciences and of the national economy and public health and safety; make grants to classroom geoscience teachers for classroom teaching aids; support development of education programs for the science and engineering community; support geoscience internships in the nation's capital; support geological field trips for K-12; and support educational outreach programs to the public on the state and local level.

The Foundation of the American Institute of Professional Geologists is a 501 (c) (3) public foundation, qualified to receive contributions in support of educational programs. Contributions and gifts-in-kind are tax-deductible.

Support the Foundation of the AIPG

The Foundation supports a variety of programs of the American Institute of Professional Geologists (AIPG) that include student scholarships, student and early career professional workshops, educational programs aimed at

practitioners, the public, and policy makers and, on occasion, some special needs requested by AIPG. The Foundation is engaged in primarily educational and scholarship programs. The Foundation may also support public information forums, public education meetings, teacher seminars, and geological seminars for other professionals such as engineers, architects, planners and others; thus coordinating the expertise of several professions for a better understanding of the geosciences and global issues. The Foundation is proud to be able to serve AIPG and the geosciences by providing financial support for these programs.

We ask that you support the Foundation with monetary contributions that would be used primarily to fund our scholarship and early career professional initiatives, and other Foundation programs as well. The Foundation relies on the support of generous individual and corporate or group donors for financial contributions or gifts in kind. Information about donations is on the Foundation web page of the AIPG web site at: <http://aipg.org/foundation>. You may donate on-line or send your donation check by mail to:

Foundation of AIPG
1333 W. 120th Ave., Suite 211
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Section Website Reminders

The Michigan Section has created a database of geologic photographs on our website. Please submit photographs that you are willing to share to Adam Heft at adam.heft@wsp.com. Don't forget to include your name and a short explanation of what the photograph depicts. The photographs will be uploaded to the website periodically.

If you have suggestions on other items that should be included on the History page, please let a member of the Section Executive Committee know.

Minerals for Sale!

Long-time Michigan mineral collector and dealer, Bill Micols, is selling his lifetime collection of material. Bill is in Milford. For additional details, please see the full-page flyer on the following page.

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Where in Michigan?

The April 2020 edition of *Geologically Speaking* featured a photograph of the Precambrian East Branch Arkose northeast of Felch in Dickenson County. The East Branch Arkose is described as massive light-colored arkose, commonly showing crossbeds, and with thick beds of conglomerate (as pictured). No one correctly identified the photograph.

This edition of *Geologically Speaking* features a new photograph at right - not the photo on the cover page. The first person to correctly identify what the photograph depicts (feature name, location, formation, and age) will win AIPG swag! Submit your entry to the editor; only one per person per issue please.

Don't forget to check out the feature article "Geology in Michigan" in this issue (as well as the April 2020 issue) that presents a geologic feature of interest within Michigan as a mini field guide. One of the best parts about being a geologist is field trips, and we are hoping that in your travels around the state you include these featured spots as a stop. Why not incorporate them into a family vacation or bring friends who may not be geologists and share these locations that make Michigan unique? We hope you enjoy reading about it, and more importantly, go see it in person! We invite you to share unique geologic features that you know about and submit a "mini field guide" to share with our members in future editions.



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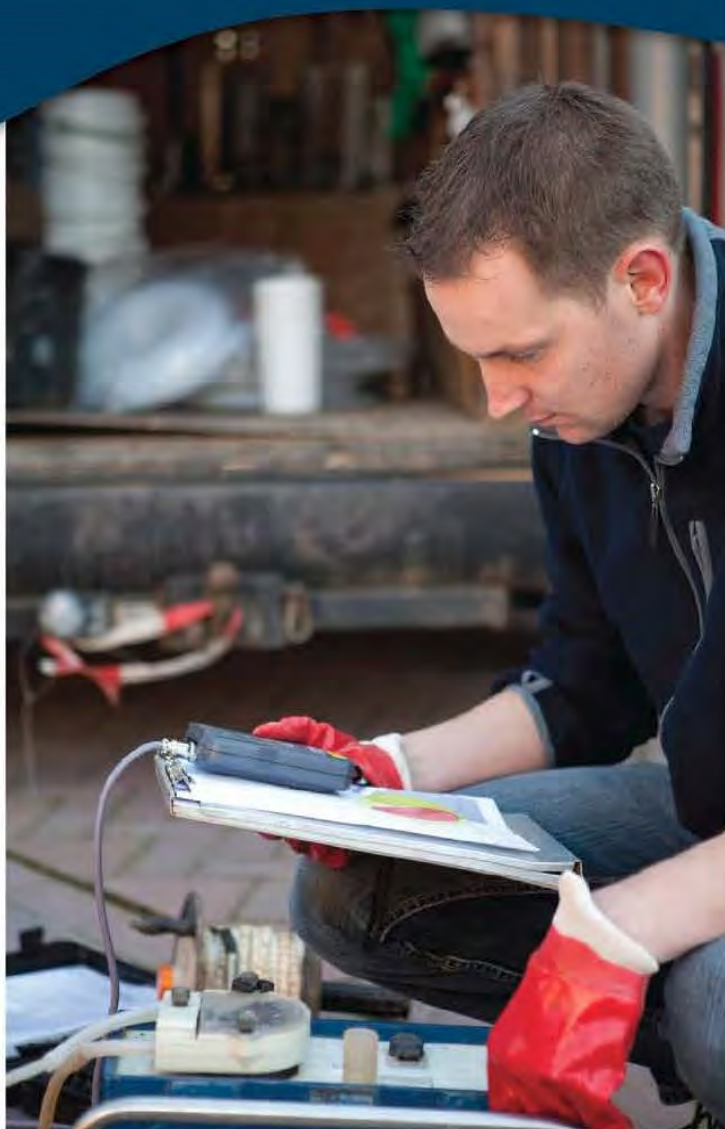
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Regulatory Roundup

Enbridge Energy's Line 5 crosses the Straits of Mackinac and is the focus of much controversy because of the proposed relocation of the pipeline to a tunnel within the bedrock below the lakebed. The Michigan Department of Environment, Great Lakes, and Energy (EGLE) is responsible for the environmental permitting of the for the tunnel project. On July 7, 2020, EGLE announced the launch of the Line 5 in Michigan website to keep the public informed about the proposal. EGLE, together with the Michigan Public Service Commission and the Michigan Department of Transportation (MDOT), will be providing information, contacts, and updates on the website. The website address is www.michigan.gov/line5.

The EGLE press release also announced an email address for the public to provide comments to the agency. According to the release, EGLE has established a dedicated permit application email account for the proposed tunnel project, EGLE-Enbridge-Comments@Michigan.gov to provide the public with easy access means for commenting on the proposed project. Those interested in monitoring or commenting on the MPSC proceeding involving the pipeline replacement project can sign up for MPSC email updates through the web site.

In more EGLE news, the Michigan PFAS Action Response Team has awarded \$2.5 million in grants for municipal airport testing. The PFAS sampling grants have been awarded to several Michigan airports where the use of Class B Aqueous Film Forming Foam (AFFF) is known or suspected. MDOT is overseeing the effort and EGLE is

providing technical assistance. Airports including the Detroit Metropolitan Airport, Willow Run Airport, Gerald R. Ford International Airport, Manistee Blacker Airport and more are among the grantees. Approximately \$1.5 million in grant funding is still available under this program. The second Request for Proposals was issued by MPART on July 1, 2020 for the remaining funds for testing of PFAS at current or former Part 139 commercial services airports in Michigan most likely to have, or have used, AFFF. The proposals are due on July 15, 2020. Proposal information is found [here](#).

More regulatory news on PFAS includes the recent passage of HB 4391 which requires promulgation of rules regarding firefighters' use of foam containing PFAS and training by the Senate on June 25, 2020. The bill was approved by the House of Representatives in October 2019.

One last note on PFAS is the pending rule promulgation on the establishment of Michigan's maximum contaminant levels (MCLs) for seven PFAS compounds. More information about rule promulgation of PFAS MCLs may be found [here](#).

News releases, program information, and MI Environment, the Department's blog, are also accessible via the homepage. During these times of great uncertainty, we recommend visiting the homepage frequently to find the latest information and Departmental activities.

Article continues on Page 40...



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Overcoming Water Treatment Challenges for 1,4-Dioxane Using AMBERSORB™ Resin

Case Study using HAPSITE®, Differential Pressure, and Weather Station Monitoring

Authors: Pamela Groff Robertson, Eric Johnson, and Maria Kaplan (WSP USA, Herndon, VA), Steve Kretschman (WSP USA, Pittsburgh, PA) and Steve Woodard (ECT, Portland, ME)

pam.robertson@wsp.com, (703) 318-3958; eric.johnson@wsp.com, (703) 318-3936;

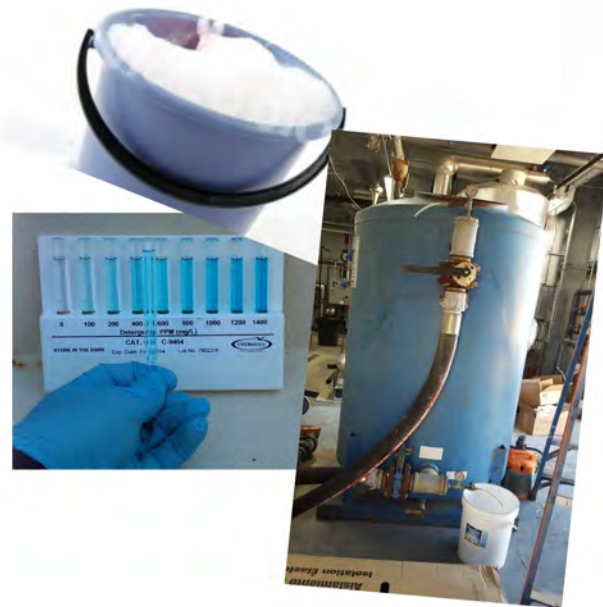
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Background/Objectives. Historical operations at a former manufacturing site in Maryland included the use of 1,1,1-trichloroethane (1,1,1-TCA) for metals degreasing and 1,4-dioxane as a solvent stabilizer. Releases of these chemicals have impacted the groundwater quality in the surficial and underlying semi-confined aquifers at the site. VOCs leaching to the semi-confined aquifer have migrated to off-property residential areas and affected private (residential) water supply wells. Concentrations of 1,1,1-TCA and its degradation products, and 1,4-dioxane are present in the multi-aquifer system at levels posing a human health risk.

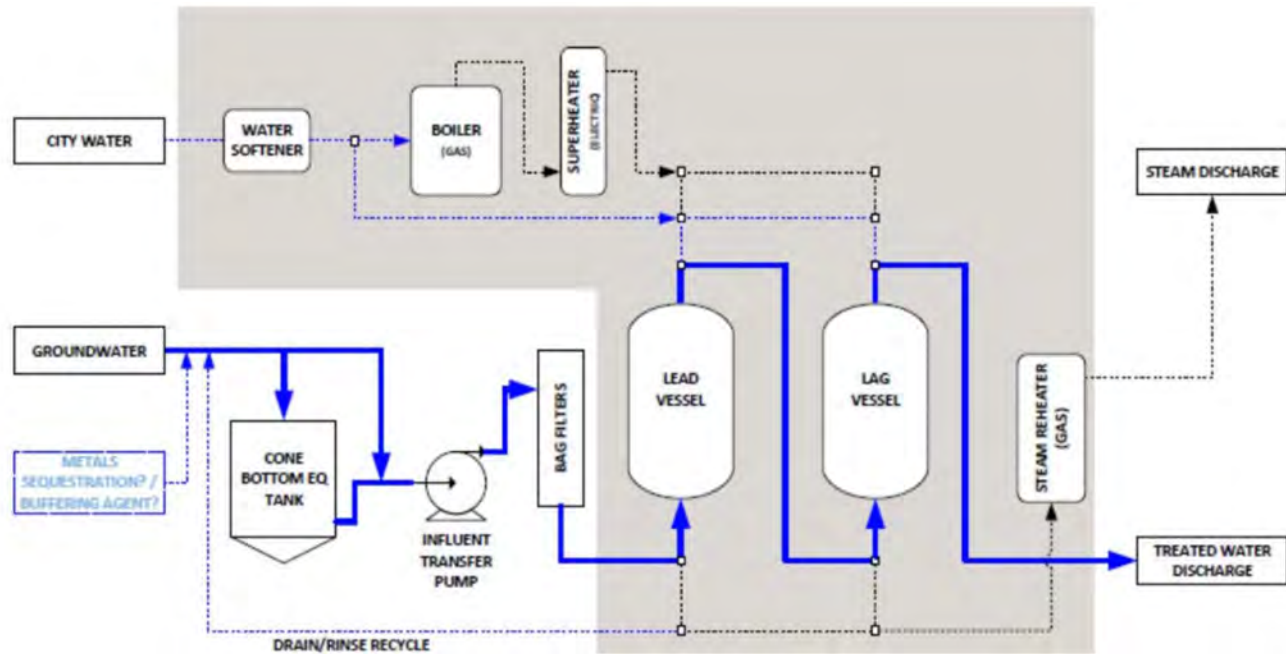
bay restoration initiatives.



Approach/Activities. Hydraulic containment using groundwater recovery wells combined with ex-situ treatment of the extracted water was selected to control VOC and 1,4-dioxane migration and remove contaminant mass from the multi-aquifer system. The approved option for management of the treated water was discharge into a tributary of the Chesapeake Bay. Stringent discharge limits were applied by the regulatory agency in support of the



The chemical properties of 1,4-dioxane, including low volatility and high mobility, presented water treatment challenges. Air stripping and granular activated carbon (GAC), two standard approaches for VOC removal in water treatment systems, were incapable of meeting the 1,4-dioxane treatment goals. HiPOx, an established treatment method using ozone and hydrogen peroxide, was capable of meeting the treatment goals for VOC and 1,4-dioxane. However, this option was expected to incur relatively high maintenance costs, and required the use of chemicals for operation. A recently emerged process designed by ECT using the synthetic resin AMBERSORB™ 560 was evaluated as an alternate approach. The resin, manufactured by The DOW Chemical Company, has a high affinity for organic compounds and has demonstrated success for VOC and 1,4-dioxane adsorption in water



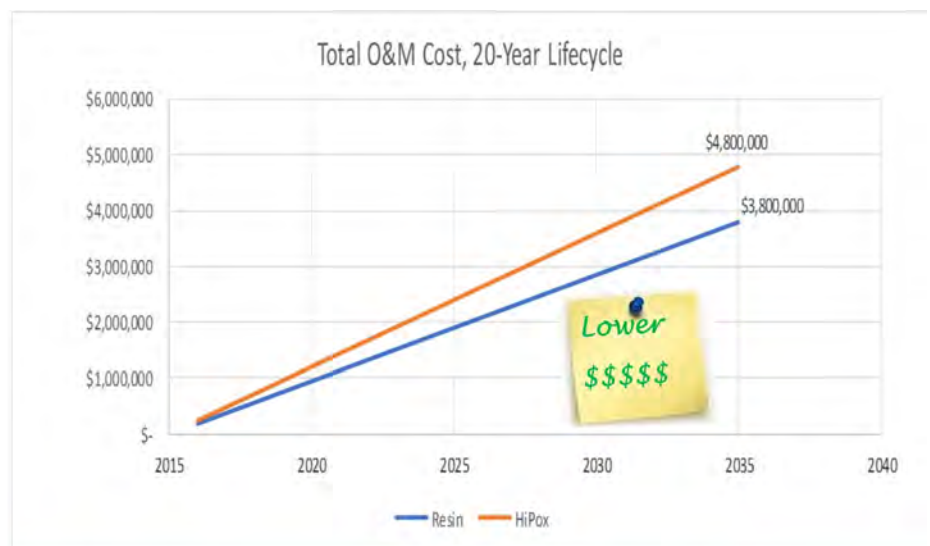
Resin Water Treatment System Process Diagram

treatment applications. Once the resin reaches its adsorption capacity, steam regeneration is applied to strip off the contaminants, which discharge to ambient air. The regeneration process may be repeated thousands of times without noticeable loss of adsorption capacity. Although the capital cost for the resin was significantly higher than HiPOx, the technology has a lower life cycle cost due to decreased operations and maintenance requirements. The synthetic resin was selected for water treatment based on the ability to meet treatment goals, provide overall cost savings, and limit the use of chemicals.

Results/ Lessons Learned. The synthetic resin system operations were initiated in March 2017. Surfactants, potential resin foulants, were identified in pre-startup groundwater samples from the extraction wells. The surfactants were attributed to detergent residue from the decontamination of well development and sampling equipment. GAC was temporarily installed during the initial 18 days of operation to remove the surfactants upstream of the resin, and taken offline once surfactant concentrations were no longer detected.

The resin system has been continuously operating near the design flow rate of 80 gallons per minute. Based on the mass

loading, steam regeneration of the media occurs twice per week without operational down time. VOC and 1,4-dioxane concentrations remain below laboratory detection limits in discharge samples, confirming treatment goals are achieved and supporting the bay restoration efforts.



O&M Cost Comparison of Technologies 20-Year Lifecycle

In Memoriam



The Michigan Section Executive Committee was saddened to recently learn of the death of one of our members. Jeffery Anagnostou passed away on February 11, 2019. Jeff was CPG-07859 since 1990. He worked at Applied Geotechnical Services, Inc. in Livonia.

CALL FOR ABSTRACTS!

Virtual Learning AIPG Michigan Professional Development Offerings

AIPG Michigan Section is seeking abstracts for geologically-related or environmental risk management topics for our virtual learning series. The intent is to make this platform an extension of our Michigan Section Environmental Risk Management Workshop with an opportunity to branch out into additional topics of interest to our members. We are working out scheduling details for one hour presentations to be given monthly or every other month based on interest. Sessions will be recorded and available on demand after the initial offering. Presentation time is planned for the lunch hour Eastern standard time. If interested please contact Sara Pearson at pearsons@michigan.gov or 517-420-3219.

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Invitation to Our Members!

Do you have a case study to share?

The Michigan Section AIPG promotes knowledge sharing and would like to showcase case studies from projects where others may benefit from successes as well as lessons learned. We feel as professionals that learning from each other is a great opportunity that AIPG offers our members. AIPG offers connection with other professionals and their experiences in the work we do every day. This case study represents what we would like to offer more to our members, not only as a way to solve problems, but unify us as professional geologists. Additionally, do you have a suggestion for other types of information to share that would be of interest to our membership?

Please send your case studies and suggestions for future publication in upcoming editions of *Geologically Speaking* to the Editor.

Seeking Employment

As a reminder to our members, any AIPG member (student, ECP, Member, or CPG) can place a "seeking employment" ad in Geologically Speaking. Simply submit a short paragraph to the Editor. Your information will be included in the next issue.

My name is Lincoln Grevengoed, and I'm currently seeking employment as a hydrologist, environmental scientist, or geologist. I have received my B.S. in Geology from Calvin College and will soon graduate with a M.S. in Geology from Western Michigan University. I have attended both geology and hydrology field camps, and also possess a current HAZWOPER 40 hr certification. I've also taken 48 credits of geology, 12 credits of hydrology, and 12 credits of GIS and remote sensing classes. Please contact me at notforgranite@gmail.com or 772-480-6573.

Welcome New Members

The Michigan Section is continuing to grow. Please welcome the following new CPGs, Professional Members, Early Career Professionals, Associate Members, and Students:

Lila Carden, SA-10750; Molly Gardner, MEM-3206; Josh Grant, SA-10757; Garrett Link, SA-10752; Marissa Manshah, SA-10733; and Brian O'Mara, MEM-3201.

To each of our new members, welcome to our Sec-

tion. We encourage you to attend Section meetings and other events. You are also invited to provide information for the Member's Corner articles.

Member's Corner

The Member's Corner includes information about the Section's membership. This is your chance to provide information on where you are and what you are doing. Simply send the information to the Editor for inclusion in this section.

No Member's Corner articles were received for this edition of *Geologically Speaking*.

Interesting Geology Links

The Editor has received links to various interesting geology-related sites. Some of the more interesting links are included here. If you have any links to geology-related sites that you would like to share, please forward them (with a citation, if applicable) to the Editor.

Thanks to Mark Francek of Central Michigan University for sharing via the "Earth Science Site of the Week" emails. This edition features a few "fun" links

12 Collectible Rocks and Fossils of the Great Lakes:
https://greatlakeslocals.com/12-collectible-rocks-andfossils/#utm_source=website&utm_medium=social&utm_campaign=GLG%20rocks

Graphic of Erupted Tephra Volume of Famous Volcanos:
<https://pbs.twimg.com/media/D3kMXLQWsAIYWDt.jpg>

Redrawing the Map of the Midcontinent Rift: https://www.earthscope.org/articles/Redrawing_map_midcontinent_rift.html



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- Ecosystem Restoration/NRDA
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Andrew Mozola Scholarship

In 2017, the Michigan Section AIPG established a student scholarship in honor of and named for Andrew Mozola. Dr. Mozola was a founding member of the Michigan Section, and served as its first President in 1978. For those who didn't know Dr. Mozola, below is a short summary excerpted from a memorial to him written by Robert Furlong of Wayne State University:

Andrew received a B.A. in geology from Wayne State University in 1936, and a M.S. in geology from Syracuse University in 1938 and a Ph.D. from Syracuse in 1954. His first position as a geologist was with the U.S. Lake Survey, Mosaic Map Unit in Detroit. He served as a commissioned officer in the U.S. Air Force from 1941 to 1946, where he served in both the United States and Europe as a photo interpreter, as a specialist in aerial photography and aerial photo map making, and as an instructor in map reading and map interpretation.

Andrew was hired in 1946 as an instructor in geology at Wayne State University; he remained at Wayne State until 1985 when he retired as a full professor. He was best known for his research in hydrogeology and Pleistocene geology, especially in Michigan and the surrounding states. At various times during his 39 years at Wayne State University, he served as consultant to the Ground-water Branch of the U.S. Geological Survey, to Ford Motor Company, the National Sanitation Foundation, the Michigan Department of Natural Resources, the U.S. Army Corps of Engineers, and several other local and national agencies.

He was a Fellow of the Geological Society of America and of the American Association for the Advancement of Science. He was a long-time member of the American Geological Institute, the American Association of University Professors, the National Association of Geology Teachers and the American Institute of Professional Geologists, as well as several other local and national geological societies. He also served as the university representative to the Michigan Natural Resource Council of the Department of Natural Resources, where he served as chairman of the Minerals Committee from 1962 to 1964.

The requirements set by the Michigan Section Executive Committee for the Andrew Mozola Scholarship are that the applicant be a Michigan Section AIPG undergraduate student member (of at least sophomore standing) majoring in geology with an overall GPA of 3.0 and a 3.5 in geology. The student must submit a cover letter stating why they want to be a geologist. In addition, they must provide a copy of their transcripts and obtain a letter of recommendation from a geoscience professor.

The 2020 recipient of the Andrew Mozola Scholarship is CMU student and incoming Chapter President Lauren Galien. Here is what Lauren included in her application:

I am an incoming senior at Central Michigan University majoring in geology and minoring in environmental science. I have been interested in geology since middle school, so I signed my geology major my freshman year of college. I was motivated to become a geologist after learning the positive influence geologists can have on communities and the world, ranging from helping provide clean drinking water, to predicting volcanic activity, to finding resources to support clean energy. I enjoy discovering how the Earth used to look, what organisms used to roam around, and how the Earth was altered over time. It is remarkable to uncover the history represented by

something as small as a single rock to something as vast as an entire environment. To me, it's a puzzle that scientists are constantly finding more pieces to.

I enjoy working in both field and laboratory settings. I love travel and have studied abroad twice during my undergraduate career. I have used these opportunities to further explore my passion for geology by visiting geologic formations, hiking, and taking classes with geoscience faculty outside of my home university. At CMU, I am involved in undergraduate research in geochemistry. I have begun my senior thesis studying trace elements in meteorites. I have been involved in research in some capacity since my sophomore year, and I am excited to have my own project!

Beyond my classes, I stay involved by tutoring students one-on-one in geology, environmental science, and chemistry. I have been employed by CMU as a tutor for three semesters, and plan to continue through my senior year. I was also grateful to receive a position working as a teaching assistant for GEL201, Earth History. I worked closely with the instructor of the course to plan assignments, facilitate labs, and grade assignments. I even gave a guest lecture to the class!

I have loved being involved in our student chapter of the American Institute of Professional Geologists since I joined my freshman year. This year I held a leadership role, as head of club activities, and helped organize a volunteer trip to work with Science Olympiad students. I am excited to take on the role of President of our student chapter of AIPG for my final year at CMU.

After my senior year, I am planning to continue my education in graduate school potentially studying planetary geology or geochemistry. My ultimate goal is to earn a pho-



fessorship where I can inspire young scientists and contribute research to the scientific community.

The Michigan Section Executive Committee has for the past several years set the amount of the Andrew Mozola Scholarship at \$4,000. The Michigan Section Executive Committee congratulates Lauren Galien as the 2020 recipient of the scholarship, and commends her on her accomplishments. We are proud to contribute to her future

success.

Congratulations Lauren!

Golf Outing Reminder

The Michigan Section is still planning to hold our 16th Annual AIPG Golf Outing. Please save the date and plan to participate in this event which takes place on Tuesday **August 25, 2020** at Lyon Oaks Golf Course in Wixom, Michigan.

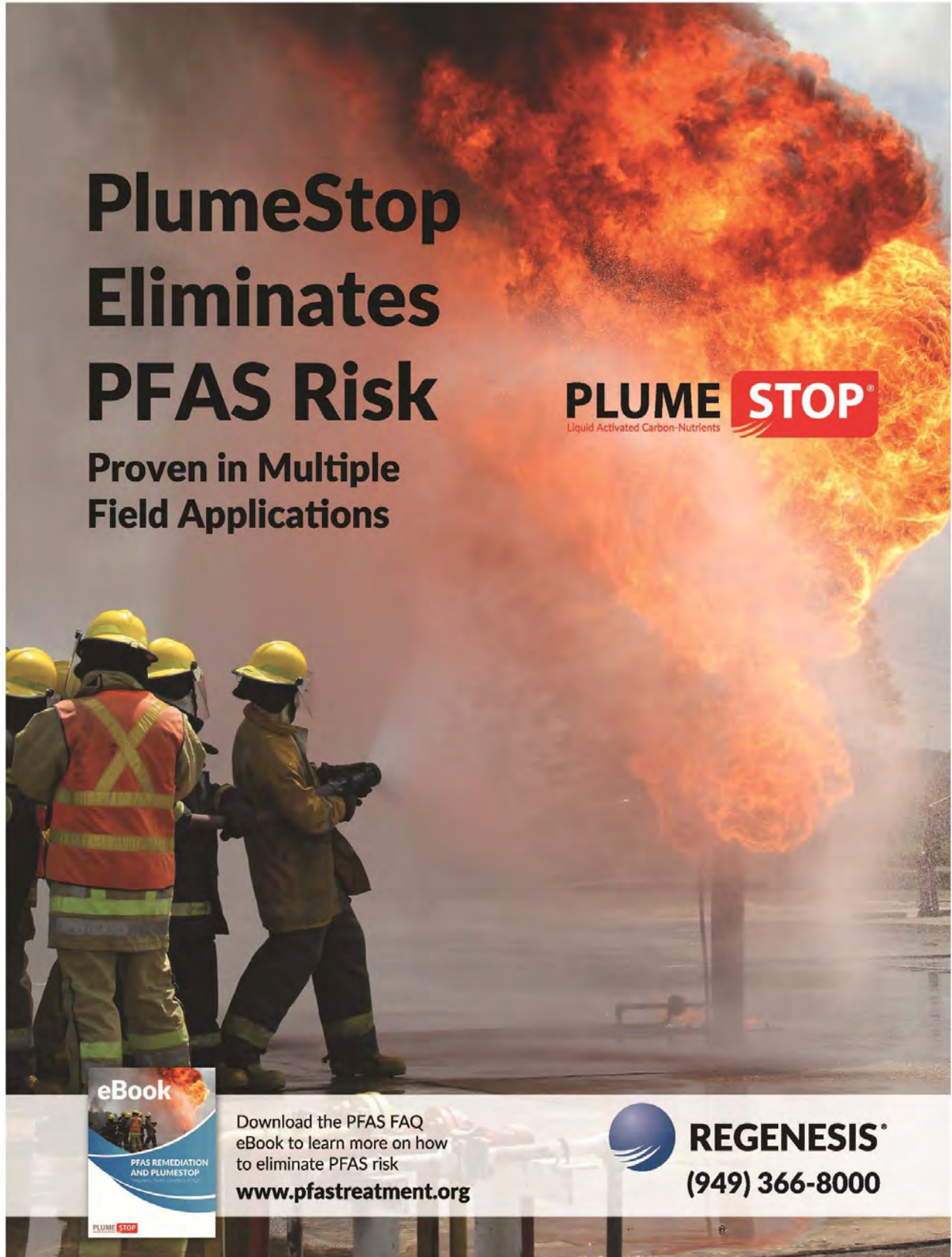
Please consider a sponsorship this year. There are several different levels of sponsorship. These sponsorship opportunities offer great exposure to some of the most influential professionals in our industry. If you don't play golf, we are always looking for volunteers to assist with the outing. The money raised is put toward the Michigan Section's K-12 Educational Grant recipients.

This event is a great opportunity to spend time with colleagues. It is open to everybody, so please come and take advantage of the opportunity.

The updated registration and sponsorship forms are included in this edition of *Geologically Speaking*. We hope to see you August 25, 2020. Email me at bob.reichenbach@ergp.net if you have any questions.

Bob Reichenbach






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Geology in Michigan – Precambrian Stromatolites at Horseshoe Harbor

This article and photographs provided by Dave Adler

Latitude: 47°28'30"N ; Longitude: 87°48'02.70"W

Section 36, T59N, R27W , Keweenaw County



Figure 1: Area Map showing the location of Horseshoe Harbor in relation to Copper Harbor. Source: www.mappery.com/maps/Keweenaw-Peninsula-Map.jpg.

Directions

Horseshoe Harbor is located near the tip of the Keweenaw Peninsula approximately 4 miles east of the unincorporated village of Copper Harbor, Michigan's northernmost settlement (see Figures 1 and 2). From Houghton, take U.S. 41 north approximately 45 miles to Copper Harbor. Just before coming to Copper Harbor, you'll pass the Keweenaw Mountain Lodge and Golf Course on your right. Approximately 1 mile beyond the golf course there will be a blinking stoplight at the intersection of U.S. 41 and M-26. Turn right and proceed approximately 2.5 miles east on U.S. 41 through Copper Harbor past Fort Wilkins State Park until the pavement ends at the northern terminus of U.S. 41. Continue east on the improved dirt road for approximately 0.9 miles where there will be an unimproved dirt road that goes to the left (north) and downhill. In recent years there has been a sign at this intersection directing you to Horseshoe Harbor to the left (north) or to High Rock Bay by

proceeding straight (east). Proceed approximately 1.2 miles north on the unimproved dirt road until arriving at



Figure 2: Location Map showing a close up of Horseshoe Harbor. Source: Google Earth Pro.

the trailhead on the left and a small parking area on the right. A vehicle with good ground clearance is advised for this road.

There are signs for Horseshoe Harbor at the trailhead. Take the trail to the beach (approximately 1/3 mile). The trail cuts through the forest on conglomerate bedrock and is not handicap accessible. The trail to the beach at Horseshoe Harbor is not difficult, but care should be exercised as the conglomerate rock along the trail can be knobby with exposed tree roots in some places. When you arrive at the beach, proceed left (north) towards a ridge of inclined brownish-red conglomerate bedrock at

Photo 3: Conglomerate ridge at the edge of the water. The best stromatolite exposures are located along the base of the ridge to the left (west) of the gravel beach.



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the edge of the water (see Figure 3). The best stromatolite exposures are located along the base of the landward (south) side of the bedrock ridge to the left (west).

Alternate route: Take U.S. 41 in Houghton to the intersection of M-26 in the hamlet of Phoenix (approximately 25 miles). Turn left onto M-26 and proceed approximately 24 miles to the intersection of M-26 and U.S. 41 at the blinking light in Copper Harbor. You will pass through the old copper mining towns of Eagle River and Eagle Harbor on the way to Copper Harbor. When you arrive at the blinking light in Copper Harbor, proceed straight (east) on U.S. 41 to Horseshoe Harbor as per the above noted directions. This alternate route follows several miles of Lake Superior shoreline and offers outstanding scenery and numerous opportunities to view the Precambrian bedrock (the Outer Conglomerate and the Lake Shore Trap Basalts) exposed along the Lake Superior shoreline.

Horseshoe Harbor is also accessible by boat. There are no docking or marina facilities available. The best time to visit is during the “warm weather” season from mid-May until late October. The dirt roads are not maintained in the winter.

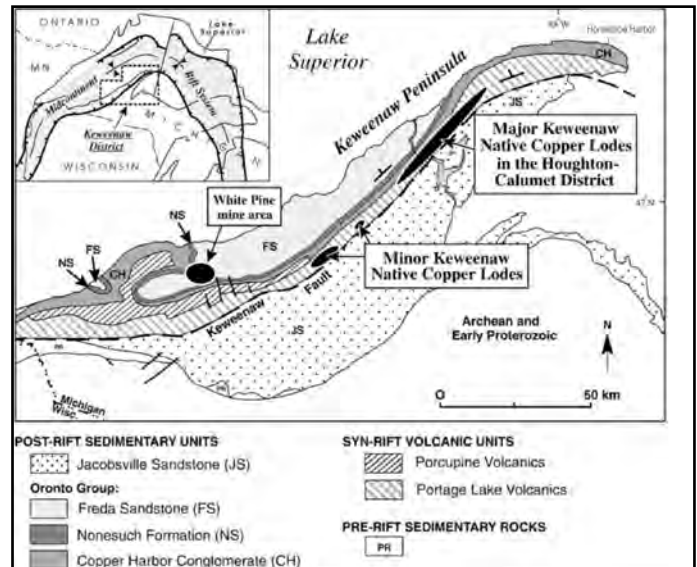


Figure 4: Regional Geologic Setting. Source: Downloaded from https://pages.mtu.edu/~raman/Silver/BlackLavas/Copper_Mining_files/Screen%20Shot%202020-11-15%20at%204.32.50%20PM.jpg ..

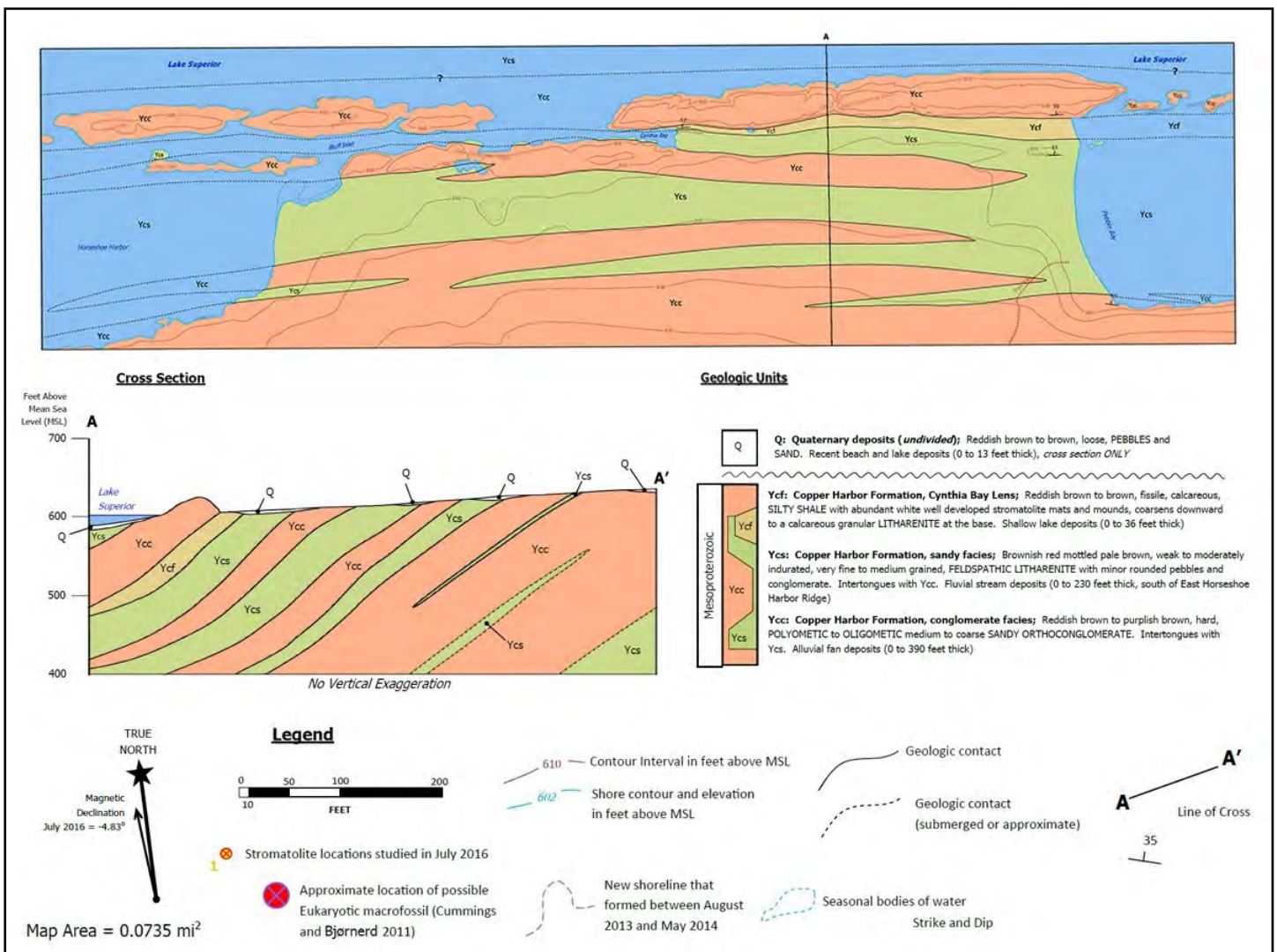


Figure 5: Site Geology. Source: Modified from Baumann et al, 2016 .



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Geology and Nature

Horseshoe Harbor is part of the Nature Conservancy's Mary MacDonald Nature Preserve. The preserve encompasses over 1,200 acres of secluded, forested wilderness with five miles of rocky beaches along Lake Superior. The forest contains white pine, balsam fir, white cedar, white spruce, and white birch trees as well as patches of wild blueberries (three varieties), raspberries, thimbleberries, and chokecherry trees. The forest is home to a variety of mammals including white tailed deer, porcupines, snowshoe hare, and the occasional black bear. A variety of northern climate birds including bald eagles, peregrine falcons, ruffed grouse, indigo buntings, cedar waxwings, pileated woodpeckers, ruby-throated hummingbirds, and a variety of warbler species inhabit the forest and beaches.

The Late Precambrian age Copper Harbor Formation, also referred to as the Copper Harbor Conglomerate (CHC), is well exposed at Horseshoe Harbor. The expo-



Photo 6: Conglomerate texture – note the pebble to small boulder range of clast sizes.

sures include conglomerate beds with pebble to boulder size clasts, finer grained beds (sandstone, siltstone, and mudstone), ripple marks and stromatolitic layers. The northward dipping inclination of the CHC towards and under Lake Superior can be readily observed. The stromatolite exposures at Horseshoe Harbor are the best on the Keweenaw Peninsula.

Geologic Setting

Horseshoe Harbor is located in the Lake Superior Basin south of the axis of the Lake Superior syncline (see Figure 4 on page 28). The Lake Superior Basin is one of the basins of the Mid-Continent Rift System that extends northeasterly from Kansas to Lake Superior before turning southeastward underneath the lower peninsula of Michigan. The Mid-Continent Rift System formed approximately 1.1 to 1.2 billion years ago (Keweenawan age) by extensional thinning of the rigid Precambrian Superior crustal block (Bornhorst et al, 1983). Extensive volcanic activity occurred during Keweenawan time. Most of the extruded lavas consist of basaltic rocks, although felsitic lavas (e.g., the rhyolites exposed nearby at Bare Bluff and Mt. Houghton) also formed in Keweenawan time.

The Keweenawan rocks exposed on the Keweenaw Peninsula include the Portage Lake Volcanics (PLV), a relatively thick series of basalt flows with interbedded conglomerates that occurs in a relatively narrow curvilinear belt extending from the tip of the Keweenaw Peninsula southwestward to the Porcupine Mountains area near the Wisconsin border. The PLV are composed primarily of tholeiitic basalts. Many of the basalts contain amygdaloidal flow tops. The interbedded conglomerates are rich in rhyolite and have a distinctive brownish-red color similar to the color of the CHC. The PLV are overlain in succession by the CHC, the Nonesuch Shale and the Freda Sandstone.

The PLV are the host rock for the most extensive native copper deposits known. The native copper deposits are believed to be the result of post-rift volcanism hydrothermal mineralization that occurred after deposition of the Freda Sandstone. The native copper deposits of the PLV in Keweenaw and Houghton Counties were worked extensively from the 1840s into the second half of the twentieth century and were the primary source of copper for the U.S. from about 1880 to 1910. Some of the interbedded conglomerates also contain native copper mineralization. The Calumet & Hecla conglomerate in Houghton County was one of the richest copper lodes.

Subsequent filling of the Lake Superior Basin caused downwarping of the thick pile of volcanic and sedimentary rocks. Regional faulting along the margins of the basin resulted in upturning of the rock units along the Keweenaw Fault. The rocks exposed on the Keweenaw



Photo 7: Sandstone outcrop.

Peninsula west of the Keweenaw Fault, including the PLV, CHC, Nonesuch Shale and Freda Sandstone, were tilted to the northwest towards the interior of the basin. This tilting can be seen today in the exposed rocks at Horseshoe Harbor and throughout the Keweenaw Peninsula. The region's distinct valley and ridge-type topography is the result of erosion of some of the softer sedimentary rocks relative to the more resistant volcanic rocks.

The Keweenaw Peninsula is the type area for the CHC. This Late Precambrian Age formation consists of a relatively thick sequence of red, brownish-red, and brown volcanogenic conglomerates with lesser amounts of interbedded sandstones, siltstones and mudstones, and intervening lavas. The CHC has a maximum thickness on the

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order of 6,000 feet (Daniels, 1982). It conformably overlies the PLV and is in turn conformably overlain by the Nonesuch Shale and the Freda Sandstone.

The CHC has been described as a massive piedmont fan deposit with associated flood plain or playa deposits (Huber, 1975), a prograding alluvial fan complex with proximal to distal braided stream and sheetflood facies on coalesced alluvial fans and sand flats (Elmore, 1981), and as a fining-upward, basinward thickening wedge of conglomerate and sandstone with subordinate volcanics that has been interpreted as a piedmont fan deposit (Elmore, 1983).

The CHC is subdivided into the following five members, in succession from oldest to youngest and from



Photo 8: Stromatolites at base of conglomerate ridge.

south to north in their occurrence on the Keweenaw Peninsula:

- The Inner or Great Conglomerate
- The Lower Lake Shore Trap Basalts
- The Middle Conglomerate
- The Upper Lake Shore Trap Basalts
- The Outer Conglomerate (exposed at Horseshoe Harbor)

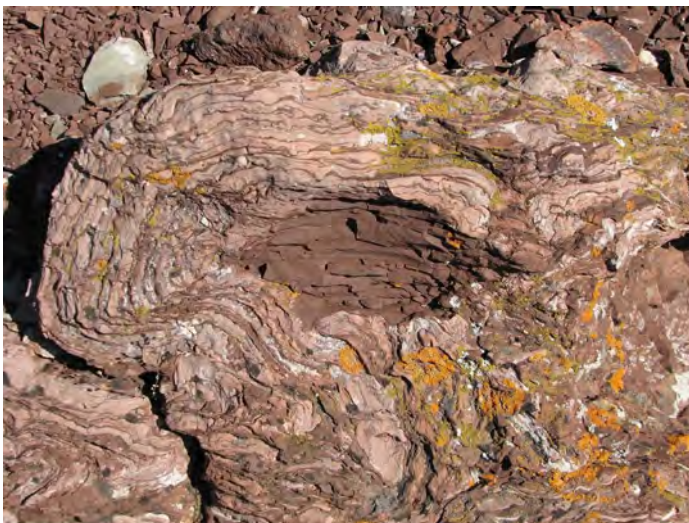


Photo 9: Stromatolites Wrapped Around Mudstone Beds.



Photo 10: View west of sandstone interbedded with stromatolites.

The CHC does not contain significant copper mineralization. The presence of the Lower and Upper Lake Shore Trap Basalts within the CHC represents the last stages of Keweenaw rift volcanism that was followed by a relatively long period of sedimentation as represented by the Jacobsville Sandstone and younger sedimentary formations of the Michigan Basin. The stromatolitic beds occur in the Outer Conglomerate. They are exposed intermittently along the Lake Superior shoreline from Horseshoe Harbor westward to Dan's Point, a distance of approximately eight miles.

Of interest to collectors, the Lake Shore Traps are known to contain agates and more rarely, amethyst. The agates (sometimes referred to as Lake Superior agates) were formed as amygdulites in the basalts. The amethyst



Photo 11: Orbicular Top of Stromatolite Outcrop.

occurs in thin veins and as small pods that may also be of amygdaloidal origin. This author has observed high quality crystallized amethyst specimens in private collections and at the A.E. Seaman Mineral Museum at Michigan Technological University in Houghton. The amethyst specimens are reportedly from the Upper Lake Shore Traps just south of the Horseshoe Harbor area. An agate approximately the size and shape of a football was found in the area south of Horseshoe Harbor by a resident of Eagle River while on her very first agate hunting excursion – the find of a lifetime!



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Photo 12: Stromatolite, Sandstone and Mudstone Outcrops.

Site Geology

The geology of Horseshoe Harbor is shown in map and cross section form on Figure 5 (page 27). The red and brownish-red conglomerate of the Outer Conglomerate is exposed at Horseshoe Harbor. Sandstone and mudstone beds, some of which are associated with the stromatolitic layers, are also exposed. The bedrock exposures are predominantly pebble to cobble conglomerate with well-rounded clasts of rhyolite and basalt, the rhyolite clasts being more abundant than basalt. Boulder size clasts can also be observed. The wide range of clast sizes in the CHC is depicted in Figure 6. The northward dipping inclination of the bedrock (towards and under Lake Superior) can be observed quite clearly, especially in the sandstone outcrops (see Figure 3 and Figure 7).

As you reach the end of the trail leading to Horseshoe Harbor from the parking area, you'll come to a gravel and cobble beach. Before you enter the beach, look straight ahead. You'll be looking east at the rugged, rocky coastline of the Keweenaw Peninsula. As you step onto the beach, turn to your left and you'll be looking northward toward the inclined conglomerate ridge shown in Figure 3. As you walk north towards the ridge, you'll notice the block-like outcrop shown in Figure 7 on your left. This outcrop is mostly brownish-red sandstone, some of which has a shaly appearance. The east-west strike and north-



Photo 13: Stromatolites Wrapped Around Basalt Clasts.

ward dip of the CHC can be observed and measured in this outcrop.

Continue walking towards the inclined ridge. Just before reaching the base of the ridge, you'll see an opening to the west (on your left). Turn left here and proceed west along the base of the ridge. You'll begin to see the stromatolites exposed at the very base of the ridge on your right as you proceed west. Figure 8 shows a good example of the stromatolites in cross section in this area. The stromatolites in this area are wrapped around mudstone layers and are overlain by siltstone and pebble conglomerate beds. Figure 9 shows a close-up view of a similar feature.

As you continue walking west along the base of the ridge, you'll begin to see the stromatolites at the base of the conglomerate ridge on your right and along the rocky



Photo 14: Stromatolite Outcrop - Cross Sectional View.

path in front of you, as shown in Figure 10. The contact between the cobble/boulder conglomerate that forms the ridge and the finer grained sandstone and mudstone that you're walking on is quite distinct at the base of the ridge. The best exposures of the stromatolites at Horseshoe Harbor are in this area. A striking example of the orbicular red and white tops of the stromatolites in this area can be seen in Figure 11. Figure 12 shows some of the stromatolitic layers along the base of the conglomerate ridge and many of the finer grained beds (sandstone and mudstone). The distinct contact between the conglomerate and the sandstone/mudstone at the base of the ridge can also be seen in Figure 12.

The exposure of the stromatolitic layers at Horseshoe Harbor extends laterally for up to 800 meters, although the ongoing high water levels in Lake Superior have reduced the length of the exposure for the time being. The 1.087-billion-year-old stromatolites occur as calcareous, hemispheroidal, and globular shaped structures up to 10-15 centimeters thick and 40 centimeters in diameter draped over and around pebble to boulder sized clasts. Figure 13 shows a good example of stromatolites formed around basalt cobble-size clasts. The stromatolites also occur as undulating mats grown on substrates of mudstone (see Figures 8 and 9).

Origin of the CHC Stromatolites

Stromatolites have been studied for over 100 years and continue to be studied. There is no unified consensus on their mode(s) of formation. There is no consensus on whether they are the result of biological activity or abiological activity. There is no consensus on the definition of stromatolites. Some example definitions are as follows:

- Layered, early lithified authigenic microbial structures – often domical or columnar in form – that developed at the sediment water interface in freshwater, marine and evaporite environments (Riding, 2011).
- Laminated structures attributed or possibly attributable to the work of blue-green or green algae (Rezak, 1957).
- Macroscopically layered authigenic microbial sediments with or without interlayered abiogenic precipitates (Riding, 2011).
- Megascopic organosedimentary structures produced by sediment trapping, binding and/or precipitation as a result of growth and metabolic activity of organisms, primarily blue-green algae (Awramic and Margulis, 1974).
- Layered mounds, columns, and sheet-like sedimentary rocks that were originally formed by growth of layer upon layer of cyanobacteria, a single-celled photosynthesizing microbe (Wikipedia).

The term stromatolite has been generally used by geologists and paleontologists as applying to laminated structures attributed or possibly attributable to the biological actions of blue green or green algae. Stromatolites have been observed in rocks from a wide range of geologic time including Precambrian and much younger rocks. Living algal mats observed today in both marine and non-marine environments often show a striking resemblance to some of the stromatolites seen in Precambrian rocks. Recent occurrences offer insight into the modes of formation and environmental conditions that allowed for the formation of ancient stromatolites. The living algal mats at Shark Bay in Australia are perhaps the most vivid example of recent occurrences (see Figure 15).

In most cases, stromatolites are not the actual remains of algae. They are laminated structures developed by the reactions of organisms to their physical environment. True fossil algae exhibit recognizable organic microstructures including cell walls. Stromatolites in the rock record rarely exhibit recognizable microstructures beyond a fine lamination. They tend to be headlike mass structures resulting from biological activity of primitive algal life forms. The remains of the algae that built the structures are rarely preserved. All that is left of the algae to attest to their original presence are the stromatolites preserved in the rock record (Rezak, 1957).

So what of the stromatolites in the CHC at Horseshoe Harbor? In an effort to avoid overcomplicating, the stromatolites at Horseshoe Harbor are believed to be the lithified remnant structures of prehistoric algal photosynthetic bacteria (*collenia undosa* species as identified by Cornwall, 1955) that grew in colonies or mats during deposition of the CHC. Their association with the finer grained sandstone and mudstone beds suggests a quiescent,



Photo 15: Living Algal Mats in Hamelin Pool at Shark Bay, Australia. Source: Government of Western Australia Department of Mines, Industry Regulation and Safety (www.dmp.wa.gov.au/geological-survey/geological-icons-of-western-1403.aspx).

fresh-water lacustrine environment, possibly lakes that occupied abandoned stream channels on an alluvial fan surface (Elmore, 1983). The algal mats or colonies consisted primarily of filaments of bacteria and fine-grained sediment particles.

As the algal mats grew, they trapped sediment and became interbound with the surrounding sediment. As additional algal mats formed, they accumulated and became buried in sediment and, over time were lithified, producing the layered or banded pattern commonly seen in the CHC stromatolites. The microstructure of the CHC stromatolites consists of alternating layers of detrital and carbonate laminae, and open-space structures. Radial fibrous calcite fans are superimposed on the laminae (Elmore, 1983).

Collenia undosa is believed to have been a species of photosynthetic cyanobacteria that was a common primitive microbial life form in the Precambrian. They were able to flourish in the Precambrian due to a lack of predators. Expiration of oxygen by *collenia undosa* as a result of the photosynthetic process would have contributed to the oxygenation of the Precambrian atmosphere and the rise of the great diversity of more advanced life forms that are preserved in the fossil record and can be observed today.

Closing

Horseshoe Harbor is a secluded wilderness preserve that is open to the public. It offers excellent opportunities for experiencing nature in a pure form and for observing and examining some of the unique geologic features of the Keweenaw Peninsula, including the Precambrian stromatolites in the CHC. Horseshoe Harbor is intended for visitors to experience and enjoy both nature and some of the unique geology of the Keweenaw.

Visitors to Horseshoe Harbor include families with young children. This author has taken his children there on more than one occasion when they were young. As with any secluded wilderness area, visitors to Horseshoe Harbor should be aware that certain services may not be readily

available. As of the time of this article (June 2020), cell phone service did not extend to Horseshoe Harbor. The nearest medical facilities are located approximately 40 miles away in Calumet. Please enjoy your visit and be cognizant of your own personal safety and the safety of those around you.

Lastly, the stromatolite outcrops at Horseshoe Harbor are a rare and unique geologic feature. **Please don't disturb the intact stromatolite outcrops in any way.** Loose specimens can be found in the nearby beach gravels and cobbles. Thank You.

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Chemical Oxidation

- Persulfate Utilizing Multiple Activators
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- Site Specific Health and Safety Plans
- Behavior Based Training
- On-Site Safety Audits
- Daily Site Meetings
- ISNet World Certified



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ASBOG Exam Update

The next date that the Fundamentals of Geology portion of the ASBOG exam will be offered at Central Michigan University is October 2, 2020. Information from Dr. Larry Lemke is that this exam will be held as planned. The deadline to register with CMU is August 6th and the

subsequent application deadline with ASBOG is August 18th. If you are interested in registering for the exam, please contact Dr. Larry Lemke at Lemke1ld@cmich.edu. Details are provided in the following link: se.cmich.edu/asbog.

Member Input Sought

The Section Executive Committee is seeking input from members on a variety of topics. Do you have any suggestions regarding speakers/presentation topics that you would like to hear? What about field trips or other events? Some place you'd like to see us go, or something you think the membership would enjoy doing?

Then make your voice heard; please send your suggestions to one of the members of the Executive Committee; any of the six members would be glad to hear from you. AIPG is your organization. Please help keep it relevant and interesting for all by participating.

Support our Sponsors!

The Section Executive Committee would like to remind its members to support the companies advertising in this publication. Consider working with these compa-

nies, and when you speak with their representatives, let them know that you saw their ad in the Michigan Section's *Geologically Speaking*.



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AST prides itself in being an innovative, technology driven organization that has a proven record of results. In fact, AST has a **90% closure rate** of project sites. Every time AST performs a project, our goal is to achieve the site-specific cleanup standards. AST owns and maintains over 35 pieces of heavy equipment (yellow iron) and specialty in-situ remediation and environmental sampling equipment to fulfill our client's entire project needs.

Our primary goal is to provide cost-effective environmental services for a wide spectrum of projects including soil and groundwater remediation, landfill and cap construction, demolition, and underground storage tank removal. AST's comprehensive experience allows an understanding of the critical need for environmentally sound and economically feasible services that are compliant with local, state, and federal regulations.

AST is also proud to be affiliated with Remediation Products, Inc. (RPI). RPI is dedicated to quality control and achieving site closures by utilizing **Safe, Effective, and Predictable** processes. RPI's business model is different than what you will find with other in-situ remediation product manufacturers. Primary distribution and sales of the Insoil Treat products is handled by a highly-trained international network of RPI Group Members including AST Environmental, Inc., the **National Product Distributor and Approved Installer Trainer**.



Annual Meeting Planning

As you have doubtless have heard by now, the 57th Annual AIPG meeting to be held this year in Sacramento, California has been postponed to October 23-26, 2021. Therefore, the 58th Annual Meeting to be held in Marquette, Michigan has been bumped to August 2022; however, the exact dates have not yet been locked in.

The planning committee is growing but needs your help! The committee is co-chaired by Adam Heft and Sara Pearson. If you are interested in helping with the planning of the 2022 Annual Meeting or would like to be on the planning committee, please email either Adam or

Sara at adam.heft@wsp.com or pearsons@michigan.gov.

As one of the most active AIPG Sections, Michigan wants to have an exciting program and a highly successful Annual Meeting with many attendees. If you have any suggestions or ideas that will make the 2022 Annual Meeting one to remember, please pass them along.

Look for periodic updates on the status of the Annual Meeting planning in future editions of *Geologically Speaking*!

Update Your Information!

Please be sure that you continue to receive the Section's *Geologically Speaking* publication and other announcements. Submit an updated e-mail address to Adam Heft at adam.heft@wsp.com. If you move or change places of employment, don't forget to send your new contact information to both the Section and to National. If you are not receiving announcements directly

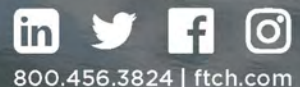
from the Editor, it is because your email address is not up to date with the Michigan Section.

Please help the Editor by making sure that your email address doesn't bounce when the next announcement is sent. And be sure to cc Dorothy Combs, National AIPG Membership Director at aipg@aipg.org when you update your contact information. Thank you!

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-- Continued from Page 15 --

Be sure to stay safe, follow CDC guidelines, and observe social distancing practicing and hopefully, we can limit the spread of the virus.

Proposed Rules

Natural Resources and Environmental Protection Act, PA 451 of 1994, as amended, bill search

Safe Drinking Water Act, PA 399 of 1976, as amended, bill search

Gas Safety Standards, PA 165 of 1969, as amended, bill search



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Coming Events

July 24, 2020: Ohio Section AIPG 2nd Annual Chairty Golf Scramble, Pine Hill Golf Club, Carroll, Ohio. Registration details at: <https://www.aipg-ohio.org/eventdetails.php>.

August 6, 2020: Ohio Section AIPG PFAS Workshop, Columbus, Ohio. Please contact Robert Andrews, Ohio Section AIPG President at: reandrews@earthlink.net for details.

RESCHEDULED:

August 25 2020: 16th Annual Michigan Section AIPG Golf Outing at Lyon Oaks Golf Course. Complete details in this edition of *Geologically Speaking*.

September 9-10, 2020: Michigan Environmental Compliance Conference, Lansing. Info at: https://www.michigan.gov/egle/0,9429,7-135-3308_3333-514064--,00.html. **CANCELLED**

September 21-25, 2020: Michigan Environmental Compliance Week. A week-long virtual event devoted to helping businesses, communities, and environmental professionals protect Michigan's environment by learning how to comply with the environmental regulations that apply to them. The week will include a number of online events and activities. There is no cost for this event.

October 9-11, 2020: Detroit Gem, Mineral & Fossil Show. Macomb Community College Expo Center, South Campus, 14500 East 12 Mile Road, Warren.

October 11-17, 2020: Earth Science Week.

October 27-28, 2020: Great Lakes PFAS Summit, Lansing.

December 1-3, 2020: Great Lakes Water Infrastructure Conference, Novi. Info at: https://www.michigan.gov/egle/0,9429,7-135-3308_3333-500683--,00.html.

December 3, 2020: Michigan Section Annual Meeting, Weber's Inn, Ann Arbor.

RESCHEDULED:

June 14-16, 2021: Michigan Section's 10th Annual Environmental Risk Management Workshop: "The Data Tell the Story" at the Ralph A. MacMullan Conference Center, Roscommon, Michigan.

RESCHEDULED:

October 23-26, 2020: 57th Annual AIPG Meeting to be held in Sacramento, California. The Role of Geoscientists for Resiliency, Sustainability and Opportunities in a Changing Environment. The meeting venue will be the Hilton Sacramento Arden West.

RESCHEDULED:

August 2022: 58th Annual AIPG Meeting to be held in Marquette, Michigan; dates TBD. See article in this edition of *Geologically Speaking* regarding meeting planning.



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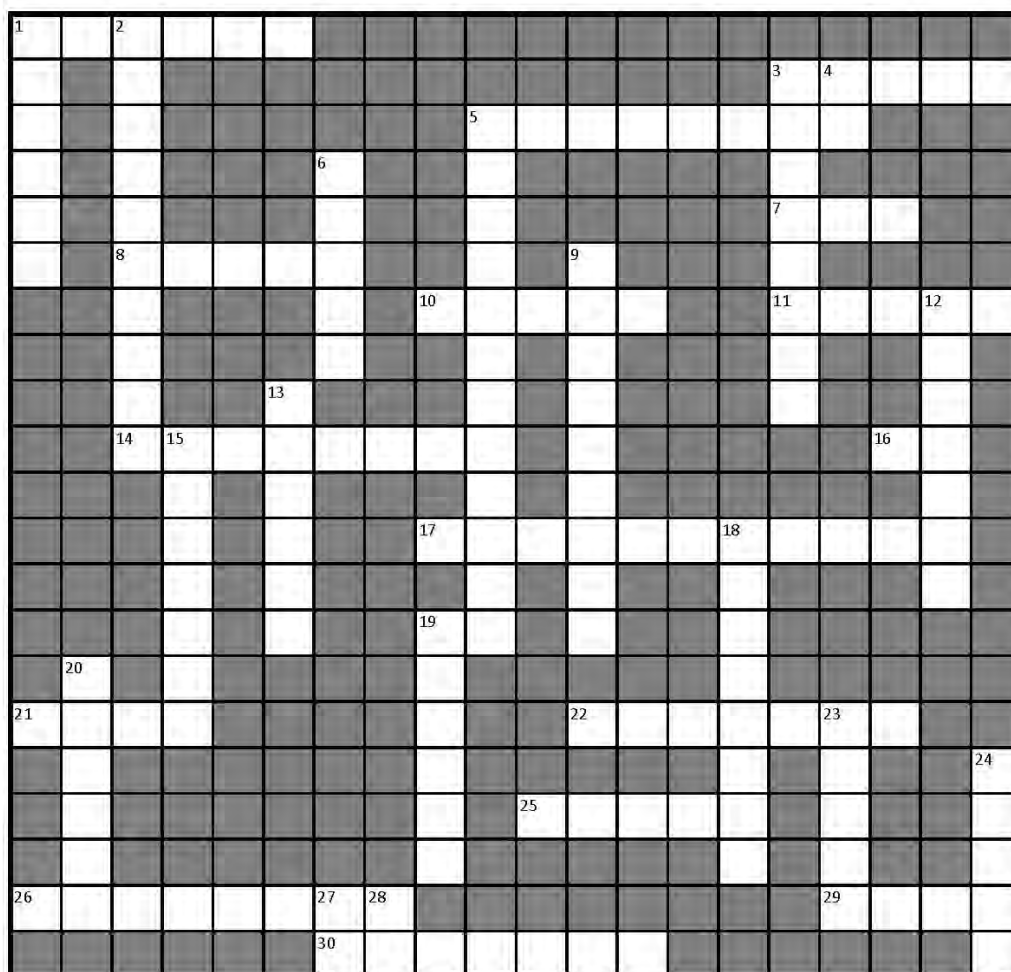
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Geology Crossword #2



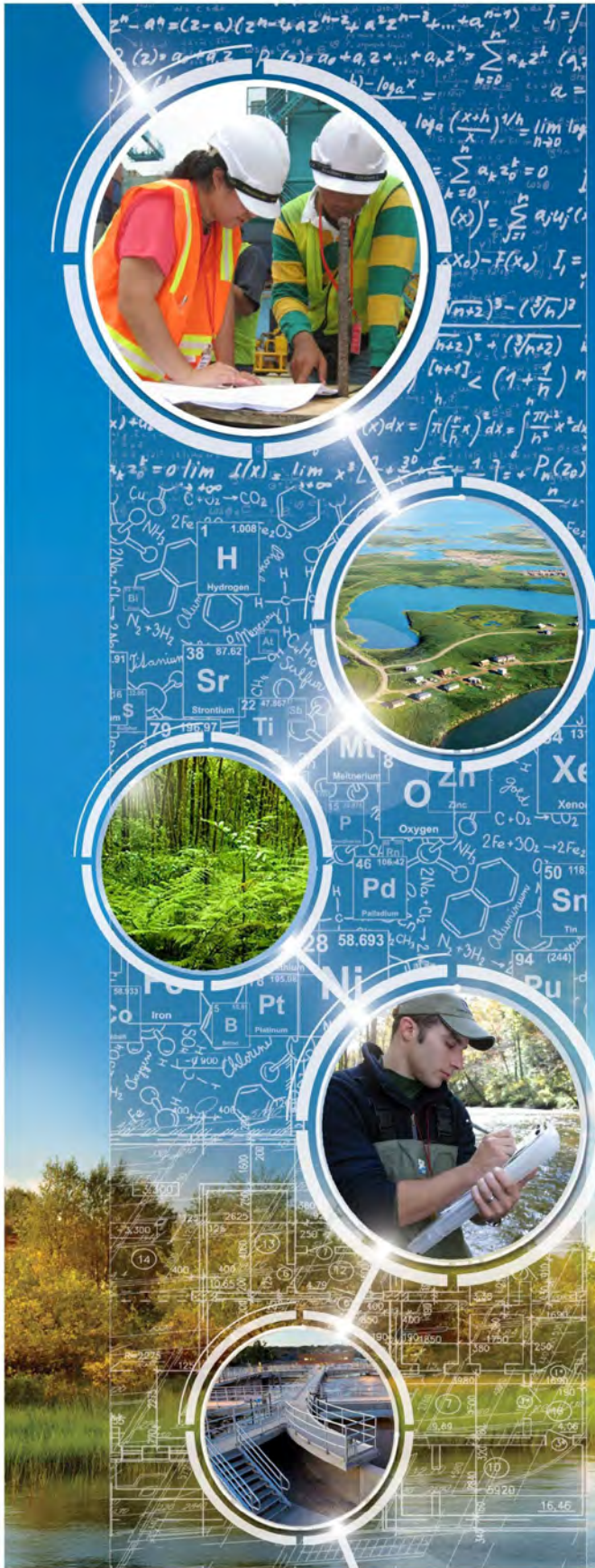
Across

- 1 Massive Silicate
- 3 Copper Company
- 5 Winner
- 7 Happy
- 8 Banded Rock
- 10 A buoyant object
- 11 A mob's light
- 14 First State
- 16 Mined metal
- 17 Historic building stone
- 19 ___ too
- 21 Not yours
- 22 Twin city
- 25 Bird of prey
- 26 Scenic crive
- 29 To collapse
- 30 Very large

Down

- 1 Deep mine
- 2 Filled vugs
- 3 First State Geologist
- 4 Within; half an em
- 5 Often fan-forming rock
- 6 Type locality
- 9 Often cemented quartz particles
- 12 Almost Michigan's capital
- 13 Mafic rock type
- 15 Alteration mineral
- 19 A place for relics
- 20 Argentum
- 23 Hanger
- 24 Continuity break
- 27 Morning
- 28 Yes, slang

*The solution to this geology crossword will be included in the next edition of *Geologically Speaking*.



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16th Annual AIPG Michigan Section Golf Outing

Tuesday **AUGUST 25, 2020**

The 16th Annual AIPG Michigan Section Golf Outing promises to be another successful event. Proceeds generated from the outing benefit the AIPG K-12 Education Grant fund, which provides thousands of dollars to a variety of worthy projects every year. Your generosity has been and will continue to be the key to enabling organizations and schools to provide meaningful educational programs and activities in the Geosciences.

This event also offers our sponsors exposure to many of the most influential professionals in our industry.

The outing is moving back to **Lyon Oaks Golf Course** in Wixom, Michigan.

Place: Lyon Oaks Golf Course
52251 Pontiac Trail
Wixom, MI 48393

Event: 18-Hole Scramble

Date Change: **AUGUST 25, 2020**

Registration: 8:00 to 9:15 am

Shotgun Start: 9:30

Rainout Date: August 27, 2020 (based on availability)

Registration

Register/Pay by **July 30**, \$600/foursome, \$170/Individual
 Register/Pay after **July 30**, \$700/foursome, \$190/Individual

Golfer 1: _____

Golfer 2: _____

Golfer 3: _____

Golfer 4: _____

Accepted forms of payment include:

Eventbrite-search AIPG Michigan

<https://www.eventbrite.com/e/aipg-mi-section-16th-annual-golf-outing-tickets-88107946239?aff=ebdssbdestsearch>

Please provide the point of contact for your foursome:



or

Make Checks to:
Michigan Section-AIPG
c/o ERG
28003 Center Oaks Ct., Suite 106
Wixom, Michigan 48393
Attn: Bob Reichenbach bob.reichenbach@ergp.net

CALL 248-773-7986, or
 FAX 248-924-3108 to reserve your place!
 The AIPG-MI Section is a nonprofit
 501(c)(6) Organization.

Company: _____

Contact: _____

Email: _____

Phone: _____

Includes: Continental Breakfast, green fees, range balls, lunch at turn, networking opportunities, and DINNER. Also includes: 50-50 and Grand Prize raffles along with other prizes including, \$10,000, vacations, or sets of clubs for a "Hole in One", Putt-4 Dough \$2,500, men's and women's Longest Drive and Closest to Pin contests, and goodie bags for all participants.

16th Annual AIPG Michigan Section Golf Outing Tuesday AUGUST 25, 2020

Sponsor Package Information

Executive Copper Sponsor - \$2,500

- 1 foursome and 33% discount for additional golfers
- Highest Visibility Signage at the Event
- Corporate recognition at the awards presentation

Exclusive Dinner Sponsor- \$1,800

Investment includes:

- 1 foursome and 33% discount for additional golfers
- Signage at the Dinner
- Corporate recognition

Beverage Sponsor - \$1,000 (2 available)

Investment includes:

- Signage at the club house and on the Beverage Cart or Oasis.
- Corporate recognition

Breakfast/Luncheon Sponsor - \$800

Investment includes:

- Signage at the grill/tent.
- Corporate recognition

Hole-in-one Sponsor - \$500 (4 available)

Will have visible exposure on a Par 3 Hole.

If a golfer hits a hole-in-one, the prize will be, either \$10,000, a golf vacation or a deluxe set of irons.

Tee Box or Hole/Flag Sponsor - \$280

(36 available)

Investment includes:

- Tee box signage and
- Pin Flag with logo

Skill Sponsor – \$400

Investment includes:

(4 available)

"Longest Drive", "Closest to Pin" awards to Male/female for each.

Practice Tee Sponsor – \$300

Investment includes:

(1 available)

Exclusive Signage at the Practice Tee

Putt-4-Dough Sponsor – \$400 Signage on the putting area, corporate* recognition during the event (includes contest coordination at the turn and following golf provided by you). Provides interaction with all participants.

Team Photo Sponsor:

\$300 SPONSOR FEE – Signage and option to provide a photographer from your organization.

Goodie Bag Sponsor - Give-away items for 120 or more golfers



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