Geologically Speaking

A Michigan Section AIPG Publication

Inside This Issue:


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Front Cover: Photo of Saginaw Formation with coal seam. The outcrop is located in Fitzgerald Park near the wastewater treatment facility, Grand Ledge, Michigan. Photo taken by Sara Pearson in October 2020.

Geology Crossword #4 Solution

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Across

1 Michigan State Gem
5 Blue, copper carbonate hydroxide
6 Moh's scale 1 mineral
9 Gray-black iron oxide mineral
12 As 10 down
14 Granitic mineral
17 Mineral for writing
20 Fertilizer component
21 Preservative
22 Moh's scale 10 mineral
23 A prominent knob
25 Calcium borosilicate mineral
26 Often satin spar
30 Yooperlite mineral

Down

1 Strontium sulfate
2 Very low-grade coal
3 Fine grained massive gypsum
4 Semi-precious borosilicate
7 Keweenaw native metal
8 Argentum
10 Auric
11 Green metamorphic mineral
13 Common magma residual fluid
15 Green sorosilicate mineral
16 Fe_2O_3
18 Green calcium aluminum silicate mineral
19 semi-precious gemstone
20 Iron sulfide
24 Often found on beaches
27 Islamic state, abr.
28 Not too or 2
29 Education, abr.

From the President's Desk

Random Pandemic Ramblings:

It has been about a year since the pandemic changed our lives. Hopefully the tide is turning to get us back to a more "normal" situation!

Our golf outing has been moved to a later date, due to not knowing what the rules for gathering will be in May. Hopefully the August date will work well. Thank you to Bob and Kalan for organizing the event!

Zoom meetings are fine, but hardly the same as meeting in person! However, this does give the Section members a chance to get together, chat, and maybe learn something new. It is what we have available at this time. The Break Out Rooms are a good idea, I enjoyed talking with those in my room. Much easier than trying to carry on a conversation with a large group of people. I would really like students to be able to take advantage of this time during our next meeting. It would be a great for them to have an opportunity to network directly with professionals.

One way or another the Summer Workshop is going to be held. Hopefully it can happen in person! Only time will tell.

One great change that has recently occurred in the Section, is an increased role for our Early Careen Professionals (ECP). A position on our Section Executive Committee has been created for an ECP within our newly revised Section Bylaws. Right now we have a great mix of young and energetic, wise and experienced, and for myself, old and (fill in blank) on the Ex Com. I believe it is fantastic we have the ECP voice, it brings in new thoughts and ideas! They along with our student members are the future of our Section.

Section (Melissa, Kalan, Sydney, …) guidance for our Student Chapters is doing a fantastic job! Monthly virtual meetings are being held for our student members. Professionals have given presentations with regards to the particular geologic discipline they practice. If there are any volunteers who would be willing to share their professional experiences with our Student Chapters, it would be greatly appreciated. Let me know if you have interest in sharing your experience with our next generation of AIPG Geologists.

I realize that the majority of our Section membership is employed in an environmental geology related position, whether in the private or public sectors. Even though my background is in environmental consulting, my current position regulating the oil and gas industry leads me to having access to a different group of potential speakers. From a personal standpoint, I have interest in learning about geologic topics that may not be directly pertinent to my job. Hopefully, the speakers I have for our Section meetings will be of interest to you!

We have varying reasons for being AIPG members. Honesty and integrity are cornerstones. Even with all of the events of the past year, we as geologists make a difference in the world. I believe, a better world! We should all be proud and spread the word of the work we do!

The winter gear has been put away for another season, warm weather is on the way, time to get out and collect more rock!

I hope all of you are doing well under the current circumstances! Looking forward to seeing all of you at our next Section meeting!

As always, please contact me with any questions or comments you may have.

Be Safe, Stay Healthy! *Bill*

Students - Reminder

Don't Forget: Your student Chapter Reports are due by May 1 each year. Send a copy to Dorothy Combs at National at aipg@aipg.org and to Adam Heft at adam.heft@wsp.com.

PFAS Analytical Approaches for Dynamic Work Strategies: Definitive vs. Screening, Or Better Yet, Both!

By Mike Rossi, Pace Analytical

Introduction

Over the last two decades, the benefits of using mobile laboratories (inter alia) to support dynamic work strategies at sites contaminated with chemicals such chlorinated solvents and petroleum hydrocarbons has been demonstrated at many sites. Building on this practice, the industry is now starting to use these same work strategies and technologies at sites that are contaminated with per- and polyfluoroalkyl substances (PFAS). Depending on the data quality objectives (DQO) for a given PFAS project, the decision regarding whether a definitive, screening level, or collaborative analytical framework will need to be decided early in the project planning stages. The purpose of this article is to provide guidance for choosing the appropriate level of analytical data quality and to inform the reader regarding what analytical techniques are available.

Background

As mentioned above, it is critical to define project-specific DQO's early in the planning process, ensuring the selection of an appropriate technical approach to meet them while maximizing daily laboratory throughput capacity and minimizing overall project cost. This is exceptionally critical when using a mobile laboratory and dynamic work plan and is aided by including the laboratory in these early stakeholder discussions.

The first big question is whether the project requires definitive and/or screening level analytical data. To answer this, summarized below are the differences between the two levels of analyses.

In the most general terms: definitive data are generated using approved analytical methods with a rigorous QA/QC program such that the resulting data are of known quality. Screening methods do not necessarily use approved methods and usually have less stringent QA/QC programs, hence the data are of a known quality, but the level of quality is likely less than that of the definitive method. The practical difference between the two types of data has to do with the types of decisions that can be made using these different data sets. The EPA document titled Quality Assurance/Quality Control Compendium - Minimum QA/QC Activities (UFP QAPP:Part 2B, 2005) does a great job with describing this difference further:

> "Screening data can support an intermediate or preliminary decision but should eventually be supported by definitive data before a project is complete. Definitive data should be suitable for final decision-making (of the appropriate level of precision and accuracy, as well as legally defensible)". It goes on to state "Screening data should not be confused with data of poor quality or with field screening technologies. Field analyses may produce either screening or definitive data, depending on the nature of the technology. Although definitive data are held to a more rigorous quality standard, screening data should be of sufficient quality to support the intermediate decision in which they are used."

Once the project DQO's are decided and the required level of analytical data quality is understood, the next steps are to match the sampling program to the analytical capacity of the lab and evaluate the analytical program's impact on the overall cost of the project. Ultimately, if these variables are evaluated effectively such that all work components of the project are well aligned, the result is often a shortened project timeline and reduced costs.

Approach for Selecting PFAS Analytical Programs

The following section describes the two levels of analyses that are currently available for mobile laboratory work, followed by separate discussions covering the three most common scenarios that are encountered while doing environmental work involving dynamic work strategies and mobile laboratory services.

1. Definitive Analyses via a Liquid Chromatography/ Tandem Mass Spectrometer (LC/MS/MS) method that is certified via an established accreditation program. The two most commonly used programs are DoD's Environmental Laboratory Accreditation Program (ELAP) and the National Environmental Laboratory Accreditation Program (NELAP). The laboratory throughput for definitive analyses is approximately 10 -15 samples per day and detection limits are in the single digit ng/L range and hundreds of ng/Kg range for water and soil samples, respectively; and

2. Screening Analyses via an accelerated LC/MS/MS quantitative screening method that deploys a relaxed set of QA/QC procedures. This method provides higher analytical throughput of approximately 25-30 samples per day. Detection limits are in the single to low tens of ng/L (ppt) range and hundreds of ng/kg (ppt) range for water and soil samples, respectively.

Definitive PFAS Analytical Data Prerequisite

Given the relatively lower throughput and higher cost per sample associated with doing definitive work in the field, projects with the following characteristics would benefit most from this analytical program:

- Sample production fewer than 15 samples per day.
- DQOs that require definitive analytical data because the project team needs to make final decisions (as opposed to intermediate) that carry a high risk (and cost) if the decision is incorrect.
- Fast turnaround times (TATs) are required to accelerate project tasks and minimize project costs related to expensive sampling or remediation operations. The balance is the relatively high unit sample cost versus the cost of equipment standby. It is assumed that next-day results, as opposed to a three-day TAT at a fixed lab, will allow project work to progress more efficiently and with minimized down time.

Screening Analytical Data Prerequisite

Given the relatively high throughput and lower cost of the screening method, the following are characteristics of projects that would benefit most from this analytical program:

- Sample production more than 25 samples per day.
- DQOs that will allow for a screening level of analysis to support the decisions being made by the project team. These decisions are intermediate (not final) in nature, and the risk associated with making an incorrect decision is low enough that the more economical screening-level analysis is warranted.
- A follow up phase of work will be completed that will involve the collection of additional samples for definitive analyses. This may involve monitoring well installations and/or other post-dynamic work strategy sampling efforts.

Collaborative Analytical Data Prerequisite: Combining Screening with Definitive

Often, a collaborative data approach is of best value where there is a need for a combination of screening and definitive analytical data sets. These projects often involve compressed field schedules and the work is all completed within one mobilization to the site. This concept of using collaborative data sets has been used successfully at many sites over the years and is an important component of the USEPA Triad Approach (Triad, 2003). Here, the higher throughput screening technique is used to support field-based (intermediate) decisions regarding site activities while a subset of split samples (typically 10-20%) are sent to a fixed lab for definitive analyses. The definitive data are used for two purposes: to verify the accuracy of the screening data and if the samples selected for definitive analyses is done in a strategic manner, the data can be used to support final decisions regarding risk assessment and delineation.

Conclusions

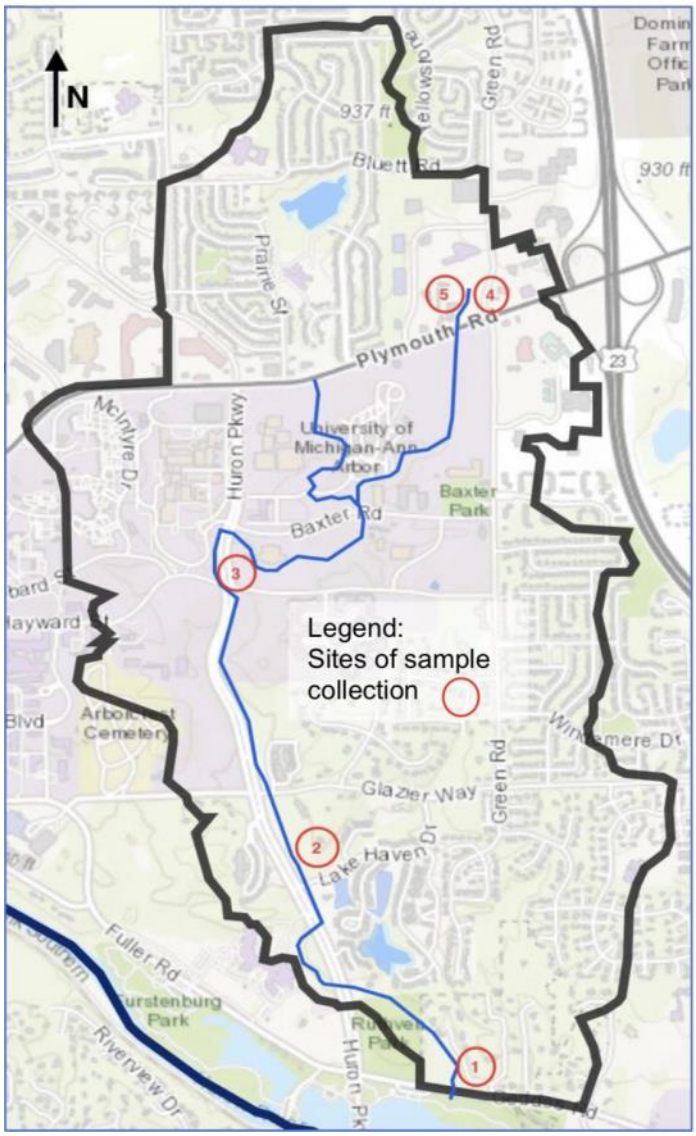
Mobile labs have supported thousands of site investigations and remediation projects over the last 20 years. Each project will have its own unique set of conditions and data quality needs therefore a custom analytical solution is often required. Having an early understanding of the project's needs so that an appropriate analytical program is brought to the site is often a key ingredient for executing successful projects.

Student Undergraduate Research Project: Source Tracking of Inorganic Chemical Contaminants in Millers Creek, Ann Arbor

By Morgan Bergren and Karlee Foster

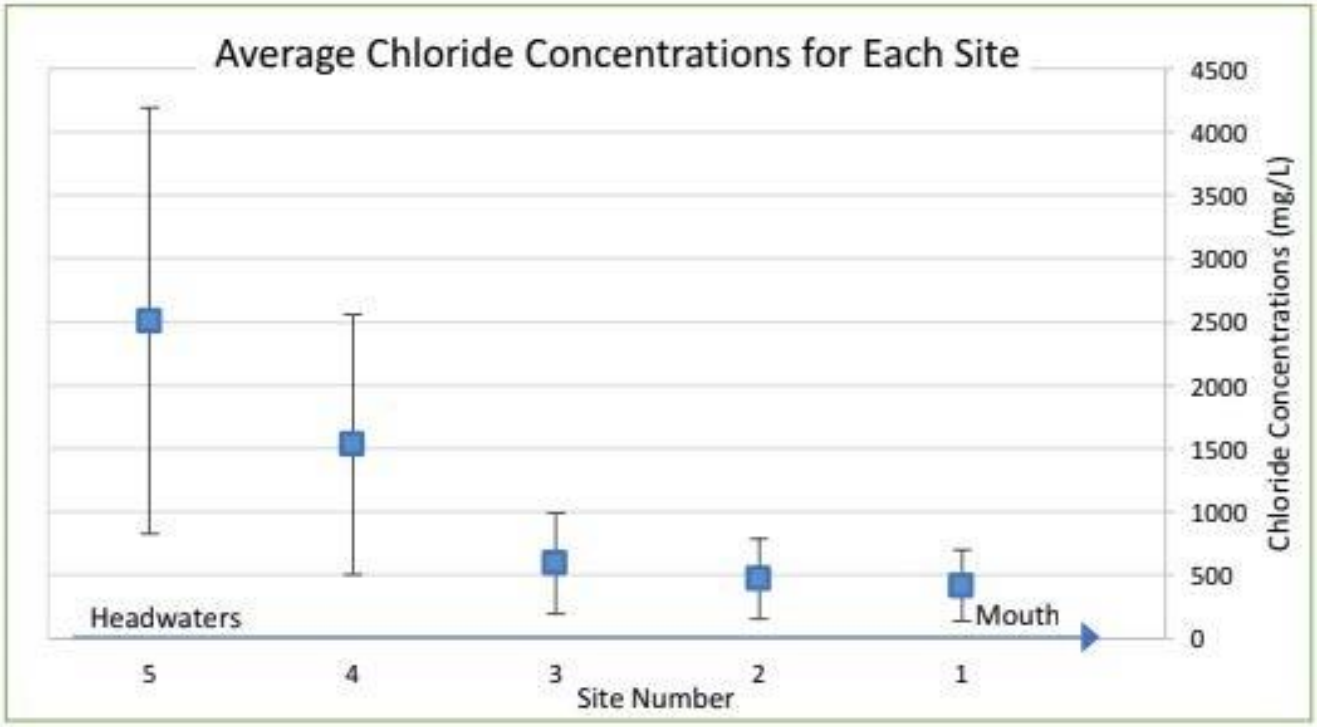
At the beginning of the 2020 winter semester, Morgan Bergren and Karlee Foster - the current Vice President and President of EMU AIPG Student Chapter - began working with fellow student Kelly Brown on taking over her undergraduate research project when she would graduate the following spring. Dr. Chris Gellasch - Associate Professor of Hydrogeology, Hydrology and Environmental Science at EMU - began the project in 2018 after the Huron River Watershed Council reported high concentrations of chloride in Millers Creek, a source of water for the Huron River (shown on Map 1). The purpose of sampling was to compare the temporal and spatial trends of chloride concentrations throughout the creek. After Dr. Gellasch appointed student Kelly Brown, the two began the project by sampling the surface water at five different sites for pH, conductivity, and water temperature. The samples were analyzed in Dr. Gellasch's laboratory for chloride, magnesium, iron, nitrate, and turbidity. Kelly and Dr. Gellasch came to the following conclusion: spatial trends indicate a source at the headwaters of the creek on the eastern branch while temporal trends indicated road salt as the primary source in the winter time. Data also showed higher than normal averages in the summer; this indicates there is most likely another source of contamination (shown on Graph 1).

After Kelly graduated in spring 2020, Morgen and Karlee continued the project with Dr. Gellasch. The new goals of the project are to determine what the other sources of contamination are. Once the research project was taken over, sampling continued at each of the five sites biweekly since the beginning of 2020. Unfortunately, in the middle of March 2020, sampling was stopped due to Eastern Michigan University's COVID-19 regulations. Undergraduate students were not allowed access to any labs or other Eastern facilities until the university opened once again in late August. Once the school year started, sampling was resumed on a biweekly basis. To further the research, potential sources of chloride entering the creek are being investigated, as well as comparing groundwater and surface water parameters.



Map 1- Provided by Kelly Brown (former student on the project). Map of Millers Creek in Ann Arbor, Michigan, detailing sites 1-5.

Recently, Dr. Gellasch helped the new researchers build



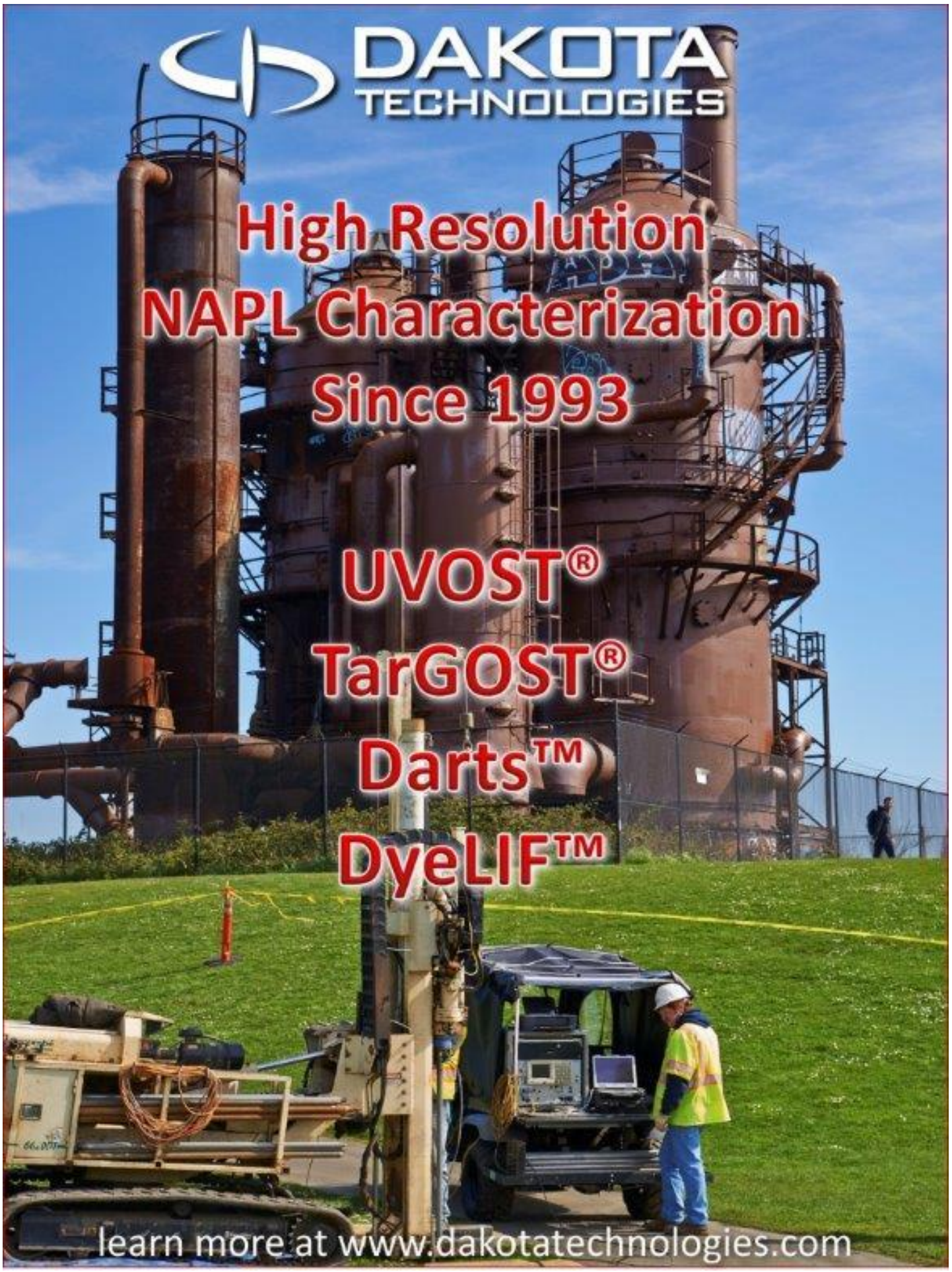
Graph 1 - Kelly Brown's graph of average chloride concentrations at each site from headwaters to mouth. Error bars are 1 standard deviation.

and install shallow (2-3 feet below surface) 1-inch diameter piezometers at two sites directly adjacent to Millers creek in order to compare groundwater and surface water chemistry (reference photo 1). The piezometers were made out of PVC pipe, each roughly five feet long. Twelve holes were drilled at the bottom of the PVC and covered with a fine mesh screen to allow water to flow through, but block sediment. The researchers then hand augered a hole at multiple sites until groundwater was reached. After inserting the piezometers, sand was placed around it for filter purposes. The hole was then compacted again. After a week, the students returned to each site and used a Waterra foot valve attached to tubing to sample the piezometers for groundwater. The groundwater will continue to be sampled biweekly along with the other sites and tested in the laboratory under the same parameters.

The current goal of the project is to continue testing the surface water as well as the groundwater for comparison. We also want to determine where the source of chloride is coming from in addition to road salt. Morgan and Karlee also plan on inserting more piezometers throughout the creek to refine the spatial and temporal changes in the creek. This is an ongoing project that will be continued after these current students graduate.

Not only are the researchers learning about the chloride in Millers Creek, the students are also developing key skills such as how to conduct research, construct and install piezometers, present their findings, and make real world connections from outside the classroom. Working outside the classroom has not only given Morgan and Karlee some field work experience, but it has helped them narrow down their career path. They have plans to present their findings in EMU's 2020 Undergraduate Symposium and publish a paper on the study.

Photo 1- Picture of recently added piezometer. Taken by Morgan Bergren, with Karlee and Dr. Gellasch in the picture.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Senior Design Project—Michigan Technological University

By Breeanne Heusdens SA-10444, MTU Student Chapter Vice-President

Seniors at Michigan Technological University are currently working on a senior design project titled "Acid Generation Potential and Mitigation of Low Sulphidation Deposit using Biologically Enhanced Systems." This team is composed of two geological engineering students, one mining engineering student, and the mining engineering advisor. The project itself is framed as a volcanic and sediment-hosted epithermal gold location that can be interpreted as a low sulphidation deposit associated with volcanic and intrusive volcanic activities related to a caldera. The goal of this project is to determine the acid mine drainage potential of minerals present in the lithologies in the gold zone, and then design and test methods to reduce the drainage potential. The team was provided with a drill hole data set that was used to find and analyze geochemical data and core samples that were later crushed as part of the laboratory testing sample preparation.

Sample preparation begins with crushing the core samples into aggregate. The aggregate is then passed through the mill in Figure 1 to create smaller particles. The particles are separated using a standard No. 4 sieve. Any particles not passing this sieve were put back into the mill until they passed through. The crushed particles were then used for test sample preparation.

Figure 1: The mill used to crush the lithology samples during the rock crushing preparation.

Seven different treatments of humidity cell samples were prepared with duplication. Each composition is shown in Table 1. There are two of each of the samples, so each sample numbered 1 goes in the left desiccation chamber, and each sample numbered 2 goes in the right chamber. Each sample is in a test flask pictured in Figure 2. The sample preparation was completed by leaching the samples with 50 milliliters (mL) of deionized water prior to beginning the first test cycle.

Table 1: The samples denoted by letters A-G and their composition. Each labelled sample variety has an identical sample for averaging and replication purposes.

Sample	Mass of Lithology	Mass of Chalcopyrite
A		50g
B	50g lithic tuff	
C	50g rhyolite	
D	50g tuff	
E	25g lithic tuff	25g
F	25g rhyolite	25g
G	25g tuff	25g

Figure 2: The sample flasks with each lithology composition. The filters from the post-leaching vacuum filtration are folded on top to analyze the loss of fine particles in the initial leach before the cycles begin.

The procedure used for testing the acid generation potential follows a modified version of the ASTM humidity cell procedure (ASTM International, 2006). The modification involves the use of two desiccation chambers to simulate a three-day dry-cycle; these chambers are set up at <5% humidity and sealed with petroleum jelly. The desiccation chambers can be seen in the left half of Figure 3. The wet-cycle uses an IsoTemp 220 water bath to maintain a constant temperature that is similar to the dry cycle and a >95% humidity level for an additional three days. The humidity and temperature are continuously monitored in the water bath setup using Govee sensors (#5074). The right half of Figure 3 shows the IsoTemp 220 water bath set up.

After preparation, the cycles start with the leached samples being placed in an oven and dried overnight before

Figure 3: Desiccation chambers are on the left with flasks placed inside. The IsoTemp 220 water bath is set up on the right.

beginning the dry cycle. The dried samples are weighed and placed in the desiccation chambers associated with their labelled numbers. The samples are left in the chambers for three days as the dry cycle of the test. After the three days, the sample flasks are transferred to the water bath for three days as the wet cycle.

After the wet cycle is completed, the samples are leached with 50 mL of deionized water poured carefully down the sides of the sample flask to prevent hydraulic agitation. The samples are allowed to leach for an hour before being filtered, as seen in Figure 4. The leachate is filtered into a collection flask to be weighed using vacuum filtration. The filtered leachate is transferred from the collection flasks to beakers for weighing and sensor data collection. All solids on the filter are returned to the rock sample flasks. The lithology sample flasks are placed in the oven overnight to dry before beginning the cycles again.

Data collected in the Humidity cell test is used for comparative analysis of lithologies at the site to each other and the control group chalcopyrite. The dry mass is taken

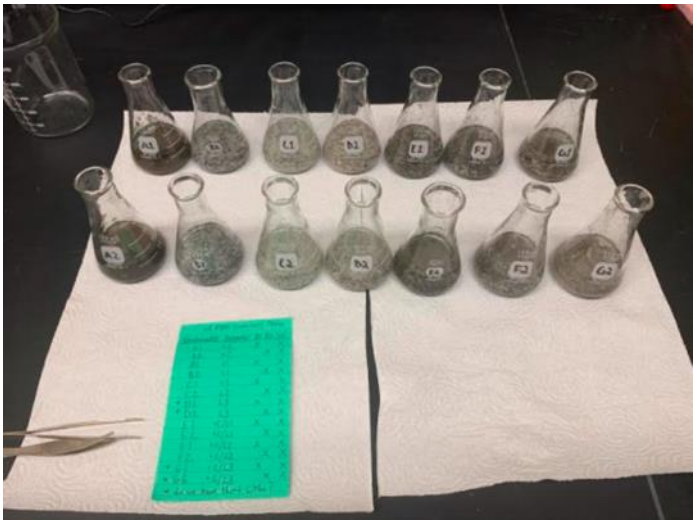

Figure 4: The leaching samples flooded with 50mL of deionized water. They were allowed to leach for over one hour.

before every dry cycle of each sample to determine the total mass loss over time. The mass of the leachate and water are measured because the difference between the initial leach water mass and leachate mass is the mass of water retained as pore water in the samples before drying. Data collected from the leachate includes pH, conductivity, total dissolved solids (TDS) in parts per million, and oxidation reduction potential. The pH change over weeks is the most notable parameter for determining acid rock generation; however, the ASTM humidity cell method warns that the first few weeks of testing will have uncertain or unexpected pH results.

The pH data is used later in the acid neutralization method being considered for this experiment, utilizing kilograms of calcium carbonate per ton of waste rock. The value of 6.4 pH serves as a cutover for the equations needed to determine the weight of calcite for neutralization. Figure 5 shows the exact chemical reactions used for either side of the 6.4 pH (Fey, 2003). Using the final pH and leachate data from the humidity cell testing, kilograms of calcium carbonate needed to mitigate the acid generation will be determined.

References

ASTM International. Standard Test Method for Accelerated Weathering of Solid Materials Using a Modified Humidity Cell. (2006, June 06). Retrieved September, 2020, from https://www.resolutionmineeis.us/sites/default/files/references/astm-1996.pdf.

Fey, D. L. (2003, June). Acid-Base Accounting. Retrieved October 11, 2020, from https://pubs.usgs.gov/of/2003/ofr-03-210/Section508/IX_Acid-base_Accounting-508.pdf.

above pH 6.4

$$CaCO_3(s) + H^+(aq) = HCO_3^-(aq) + Ca^{2+}(aq)$$

below pH 6.4

$$CaCO_3(s) + 2H^+(aq) = H_2CO_3(aq) + Ca^{2+}(aq)$$

Or

$$CaCO_3(s) + H_2SO_4 = CaSO_4(s) + CO_2(g) + H_2O$$

Figure 5: The equations used for the 6.4 cutoff pH to determine the calcium carbonate reactions needed to mitigate acid potential (Fey, 2003).

Stumbling into Geology

By Michael Roberts

When I started out at Western Michigan University, I thought I should try to be a civil engineer. Civil engineering majors at Western Michigan University are required to take an introductory level geology class. One day, as I walked out of the lecture hall, likely with my eyes juicing my phone screen for every drop of joy and stimulation the images in front of me could give, I almost walked into a table.

It looked like the gang from Scooby-Doo had given up on mysteries to sell confectionaries and fortune telling gear and gotten noticeably edgier on the way. I noticed them just in time to hear a complaint about the Blink-182 song that they were playing. I asked who they were. They told me they were the Geology Club.

What I had called fortune telling gear was actually a clutter of mineral samples, not just crystals, I was informed. The confectionaries were actually confectionaries, and they were homemade! They were fun and seemed like a good cause, so I bought a $3.00 sample of galena and they told me not to lick it and they told me when their meetings were. I told them I'd see because I was busy.

Then I went back to my dorm room with no roommate, nothing on the walls, crumbling tile in and out of a disgusting bathroom with a filthy toilet, and pretty much anything else you could add to drain the life from a person just by putting them in a room with it. I was not in fact, busy.

So that interaction was enough for me. From then forward I attended everything Geology Club I could fit in my schedule. That was a lot because I hated engineering and skipped class all the time. Geology Club always felt warm. People bringing in samples to show off created excitement fueled by curiosity. We would get together to watch and laugh at movies with bad geology. Everything felt so novel around geology and around the people who study it.

The Geology Club of Western Michigan University is also our AIPG Student Chapter. When I had been around for a while I went to my first AIPG event, a Michigan section dinner. I sat comfortably between friends. One of those friends found himself sitting next to a well-dressed stranger. The two talked about school, and about work, and after knowing each other for only 20 minutes the stranger had offered my friend a paid internship. I was again witnessing kindness where the only binding factor was geology.

One night toward the end of our chapter's 2018 trip to Iceland there was a particularly biting cold, and we had just set up camp. Our faculty representative provided a few tea lights and placed them lit around the picnic table a few were sitting around. The lights did not provide much heat, but warmed us with their charm. We all sat close together and spoke in hushed voices. It never got much darker than when the sun had just set, but the candles felt illuminating all the same. At the end of a late night each of the candles were blown out, and we all folded our arms, bowed our heads, and shuffled into the tents to sleep. We flew to another country to see natural wonder and active geology, and still the most impactful thing was the other geologists that I brought from home.

Left to Right: Raigen Blake, Erin Huggett, Michael Roberts, Stepanie Buglione. Photo by Genna Gotts.

During the COVID-19 pandemic the lease on my apartment ended. The next wouldn't begin for another three weeks. It wasn't my roommates that helped me out, or my coworkers from the restaurant I worked at, or even my family that I was able to turn to. I had a friend from geology class who had a bunk waiting for me for as long as I needed it.

I'm glad I'm studying geology in part because geology is an interesting topic. The best part of studying geology, however, is getting to spend all of my time around geologists. Thanks everybody for all of the help. I will probably need more, thank you for that too. I hope you have more to give others, and I promise I'll get to the helping side soon enough.

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…

The AIPG Code of Ethics states:

CANON 3. Obligations to Employers and Clients

Members shall serve their employers and clients faithfully and competently within their overall professional and ethical obligations.

STANDARD 3.1

Members shall disclose any actual or potential conflicts of interest which may affect their ability to serve an employer or client faithfully.

Rule 3.1.1 A Member shall disclose to a prospective employer or client the existence of any owned or controlled mineral or other interest which may, either directly or indirectly, have a pertinent bearing on such employment.

Rule 3.1.2 A Member having or expecting to have beneficial interest in a property on which the Member reports shall state in the report the fact of the existence of such interest or expected interest.

Rule 3.1.3 A Member employed or retained by one employer or client shall not accept, without that employer's or client's written consent, an engagement by another if the interests of the two are in any manner conflicting.

STANDARD 3.2

Members shall protect, to the fullest possible extent, the interest of an employer or client so far as is consistent with the public health, safety, and welfare and the Member's legal, professional, and ethical obligations.

Rule 3.2.1 A Member shall not use, directly or indirectly, any confidential information obtained from or in the course of performing services for an employer or client in any way which is adverse or detrimental to the interests of the employer or client, except with the prior consent of the employer or client or when disclosure is required by law.

Rule 3.2.2 A Member who has made an investigation for an employer or client shall not seek to profit economically from the information gained without written permission of the employer or client, unless it is clear that there can no longer be a conflict of interest with the original employer or client.

Rule 3.2.3 A Member shall not use his or her employer's or client's resources for private gain without the prior knowledge and consent of his or her employer or client.

STANDARD 3.3

Members shall serve their employers and clients competently.

Rule 3.3.1 A Member shall perform professional services or issue professional advice which is only within the

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.

SALE

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scope of the education and experience of the Member and the Member's professional associates, consultants, or employees, and shall advise the employer or client if any professional advice is outside of the Member's personal expertise.

Rule 3.3.2 A Member shall not give a professional opinion or submit a report without being as thoroughly informed as might be reasonably expected, considering the purpose for which the opinion or report is requested.

Rule 3.3.3 A Member shall engage, or advise an employer or client to engage, and cooperate with other experts and specialists whenever the employer's or client's interests would be best served by such service.

STANDARD 3.4

Members shall serve their employers and clients diligently and perform their services in a timely manner.

STANDARD 3.5

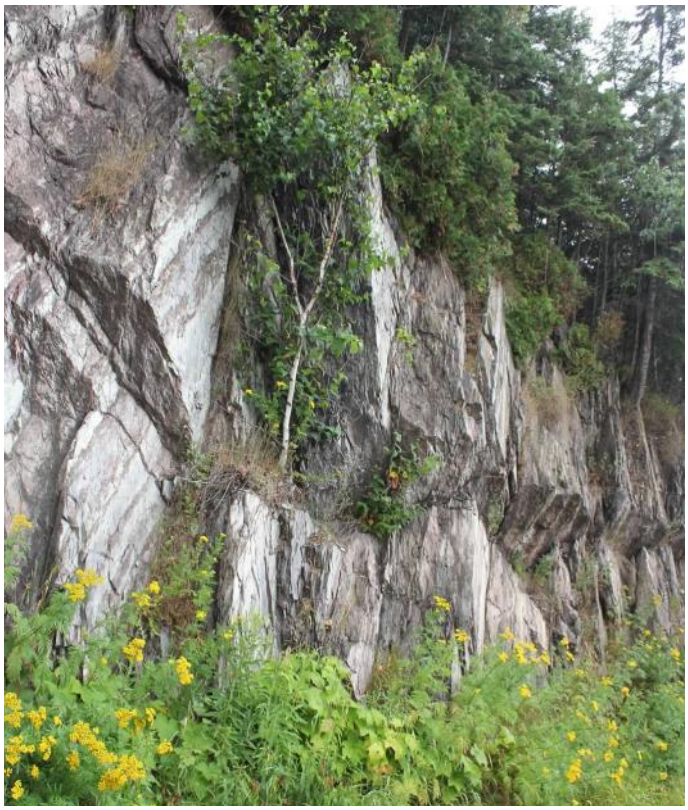
Members who find that obligations to an employer or client conflict with professional or ethical standards shall have such objectionable conditions corrected or resign.

Where in Michigan?

The January 2021 edition of *Geologically Speaking* featured a photograph of sandstone and a coal seam in the Saginaw Formation. The outcrop is located near the wastewater treatment facility at Fitzgerald Park in Grand Ledge. The Saginaw Formation is Pennsylvanian age. The photograph was correctly identified by Chris Gellasch and John Yellich simultaneously.

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 last several editions) that presents a geologic feature of interest 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 or country 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.



Regulatory Roundup

The first quarter of 2021 has come and gone, and there has been quite a bit of activity with many new bills related to environmental regulations introduced. When searching under the category of environment for the bills in the 2021 -2022 session, there are nearly 40. The topics include air quality, asbestos abatement, fracking, solid waste, oil spills, environmental cleanups, and more.

Many of these bills may never become law, but many may be considered and are worthy of discussion with input by experts on the topic. For example, two bills, Senate Bill SB 58 and House Bill HB 4314, related to environmental cleanup propose remediation be required to meet residential cleanup standards unless technically infeasible. They have no other activity to date other than being introduced. Another set of bills, HB 4454 through HB 4461, proposes modifications to solid waste regulations and has seen greater activity in the past quarter. The following is an article from Gongwer News Service dated March 25, 2021 regarding the bills.

House Panel Moves Recycling, Solid Waste Bills

Legislation that has been in the works for years to rewrite and reorganize the state's laws around solid waste, including coal ash and recycling, saw near unanimous approval by a House committee on Thursday as it moved the bills to the full chamber for further action.

HB 4454, HB 4455, HB 4456, HB 4457, HB 4458, HB 4459 , HB 4460 and HB 4461 were reported 7-0 with Rep. Beau LaFave (R-Iron Mountain) abstaining.

Before being reported, the House Natural Resources and Outdoor Recreation Committee from a broad array of stakeholders in support of the bills, including the Department of Environment, Great Lakes and Energy, the Michigan Chemistry Council, the Michigan Townships Association, the Michigan Environmental Council and the Michigan Waste and Recycling Association – though the last group did express concerns with two items in the package.

The two items cited by Kevin Kendall with the Waste and Recycling Association were provisions related to adjacent communities participating in county solid waste planning and preemption efforts over local ordinances governing disposal areas.

On adjacent communities, Mr. Kendall said HB 4461 would alter the autonomy and responsibilities and of host communities and county solid waste planning processes. The preemption price in the same bill could allow local ordinances to control certain aspects of the operation and construction of disposal areas, which are regulated by EGLE.

The bills would include the promotion of recycling and reusing materials, putting defined benchmarks on statewide efforts: a 30 percent municipal solid waste recycling goal by 2029, with the ultimate goal of 45 percent, through use of goals and timeframes for recycling efforts in certain areas of the state.

They would also call for the establishing of curbside recycling in municipalities of more than 5,000 people by 2028, with convenient drop-offs created for rural and urban counties by 2032.

The bills would do a variety of other things, including regulating compostable materials, material management plans and implementing various grant programs for multiple programs.

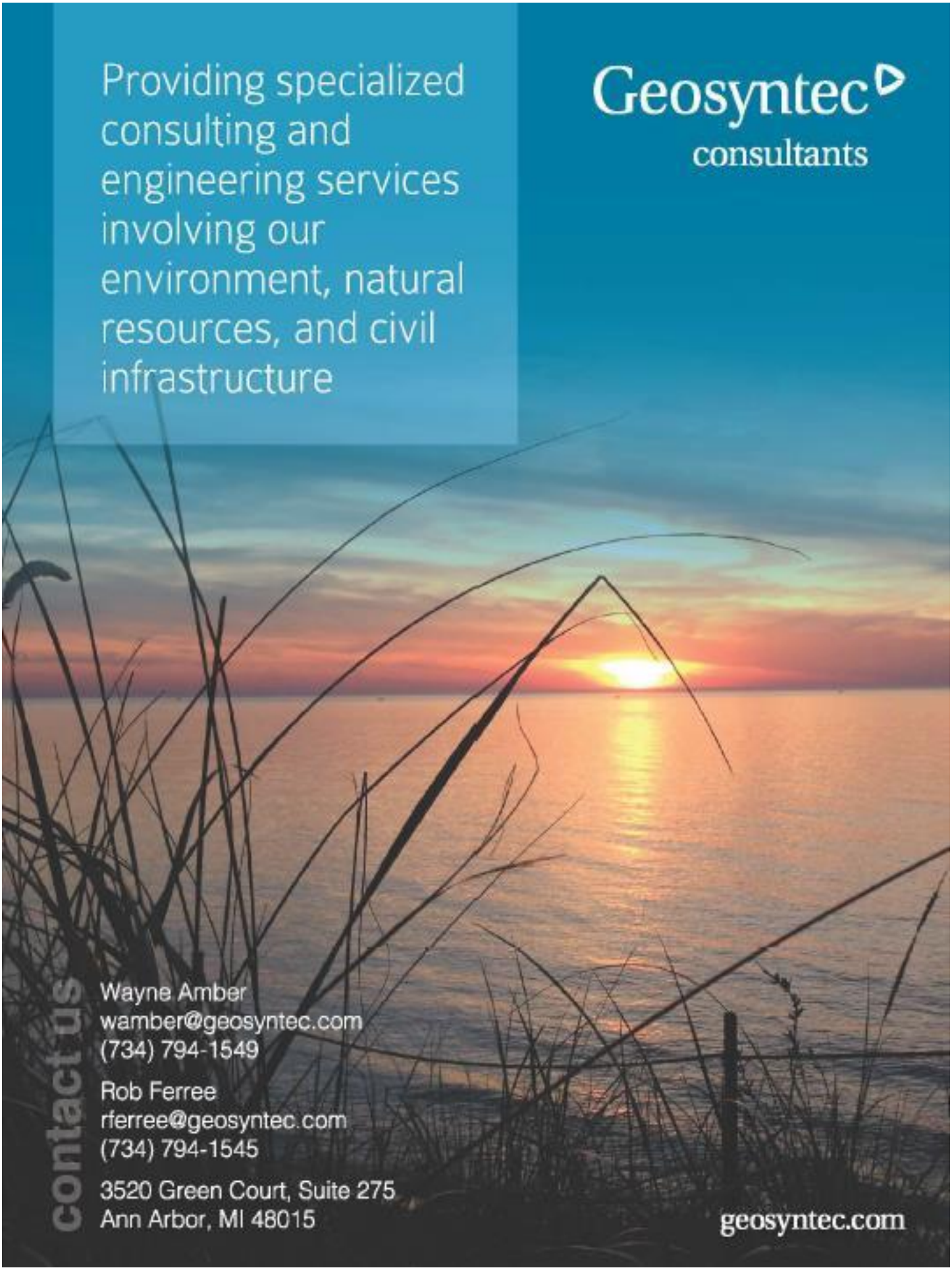
The article describes input from many stakeholders which is so important to ensuring that policy making includes input from experts on the topic. Be sure to click on the links below and follow legislation that you feel you could lend your expertise.

News from EGLE

Additionally, there has also been a lot of activity in the Department of Environment, Great Lakes, and Energy (EGLE) with the hiring of many new people and several retiring after a long career in our field. One such retirement was Steve Sliver, the Executive Director of the Michigan PFAS Action Response Team (MPART), who recently retired with EGLE's Remediation and Redevelopment Division's Abigail Hendershott taking on this role as the new director.

And speaking of PFAS, community updates around the state are ongoing to keep residents informed of the status of activities. The next event is scheduled for April 20, 2021 where an update will be provided to the residents in Oscoda, Michigan. Be sure to watch for news releases from EGLE on these types of events. They are also posted on the EGLE's homepage.

Be sure to stay safe, follow CDC guidelines, and observe social distancing practicing.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Geology in Michigan – Glacial Geology of the Leelanau

By Kevin Kincare*

***Note: The information in this article was excerpted from the 2007 Annual Meeting Field Guide to the Leelanau Peninsula, and includes two stops that are publicly accessible. The references in the text of this article were attributed in the 2007 Field Guide, but are not included here to save space.**

Introduction

Leelanau County is located in the northwest lower peninsula of Michigan (Figure 1). The county has its own peninsula extending up its northeast side as well as the two Fox Islands off its northwest coast. Much of the county's western coast is within the Sleeping Bear Dunes National Lakeshore (SBDNL). The surficial geology of Leelanau County is composed entirely of glacial and post-glacial deposits (Figure 2). Bedrock in this area (Devonian Traverse Group, Antrim Shale and Ellsworth Shale) is generally about 300 feet beneath the glacial deposits in the northern part of the county and around 600 feet deep in the south, according to logs from domestic-water wells and oil and gas wells (Reick 1981).

The glacial deposits in Leelanau County are all Late Wisconsin stage and, in fact, the surficial deposits are all Port Huron stadial or younger. The generally accepted sequence of events holds that glacial retreat from the outer Port Huron moraine (around 13,000 ^{14}C years B.P.) opened the county to deposition, probably a series of lacustrine and fluviodeltaic sediments. Readvance of ice to the Manistee moraine allowed deposition of fluvial outwash and ice-marginal deposits beyond and at the moraine edge, respectively. The lobate nature of the Manistee moraine (also called the inner Port Huron moraine (e.g. Blewett and Winters 1995)) probably reflects the location of preexisting valleys where salients in the moraine (and therefore the ice margin) show where the glacier was directed into preferential flow paths. Recent studies interpret these preexisting valleys as tunnel valleys that carried subglacial meltwaters under pressure to the ice margin (Shaw and Gilbert 1990). The standard interpretation is that these valleys result from the direct action of erosion by glacial ice.

Figure 1: Location of Leelanau County in Northwestern lower peninsula of Michigan.

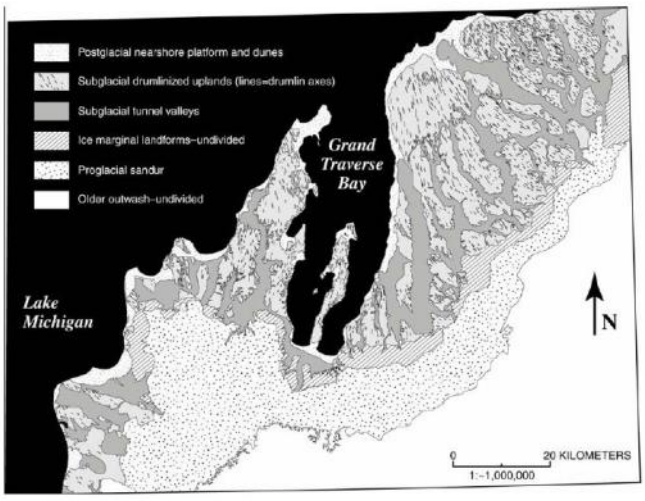

Figure 2: Glacial geomorphic map of Grand Traverse Bay region (from Lundstrom et al. 2003).

Retreat of the glacier from the Manistee moraine allowed the development of several minor deposits. These include ice-marginal channel, debris flow, diamict, and lacustrine deposits. A complex of deposits also developed on the outwash beyond the Manistee moraine. Buried ice blocks melted, creating localized lacustrine and debris-flow environments within the collapse zone. Groundwater sapping also allowed individual kettles to merge and channels to backcut.

The Greatlakean stadial (formerly called the Valders stadial) was the last ice advance into the southern peninsula of Michigan. The large drumlin field in the northern section of the county (locally known as the "pinky" finger of the Michigan "mitten") has traditionally been thought to be a subglacial till said to have been sculpted by the bottom of the glacier (e.g. Alden 1911). This occurred during the Greatlakean stadial, which has been age-dated to about 11,800 ^{14}C years B.P. based on organic material in the Cheboygan bryophyte bed of Cheboygan County (Larson et al. 1994). Recent studies have suggested that drumlins are evidence of erosion by subglacial meltwater (Shaw and Gilbert 1990) or from subglacial deformation (Boulton 1987). Boyce and Eyles (2000 p. 108) rejected the subglacial meltwater hypothesis for drumlins near Toronto, Ontario because they noted that the diamict had a "composite stratigraphy…not compatible with simple erosional sculpting."

Final retreat of the glacier from Leelanau County allowed fluctuations in lake level to become the dominant agent of landform change. These fluctuations in the Lake Michigan basin caused numerous changes in lakeshore areas (which this county has in abundance) to a distance of up to four miles inland of the present shoreline. Lake Algonquin, the oldest preserved lake phase at around 11,000 ^{14}C years B.P., carved wave-cut bluffs at an original elevation of 605 feet, but are higher today due to post-glacial rebound. Lake Algonquin shorelines are at about 627 feet in the southern part of the SBDNL and rise to 656 feet at Leelanau State Park, the northernmost point in the county. Lake Algonquin gave way to the extreme low Lake Chippewa by 9,800 radiocarbon years B.P. Lake Chippewa's level was probably around 230 ft. This low level rejuvenated the lower portion of streams that drained directly into Lake Chippewa. Rejuvenation is probably the main reason why streams were able to backcut through the Manistee moraine and capture drainage on its east side.

There are some issues with this chronology, in part due to its reliance on morphology. Blewett (1991) points out that the Port Huron moraine was defined in southeast Michigan where it is more of a classic moraine composed of till and generally a single landform (though sometimes containing multiple ridges). Here in northwestern lower Michigan, the Port Huron moraine is said to have inner and outer ridges separated by as much as 16 miles of outwash in the Leelanau reentrant. This certainly indicates different glacier dynamics between the Lake Michigan lobe (that formed our fieldtrip area) and the Huron/ Erie lobe that formed the Port Huron moraine type area. These follow the trend of the outer Port Huron moraine but lie between the outer and inner moraines. This is either a partially buried fluvial terrane or an eroded moraine remnant. Either way, this landscape represents an event that has yet to be explored and placed within the existing chronology. Blewett et al. (1993) reported an age of 12,960 ^{14}C years B.P. in gyttja associated with the inner Port Huron moraine just northeast of Traverse City. This fits other ^{14}C ages correlated to the Port Huron stadial (Fullerton 1980) east of the type area in Ontario, Canada.

Lake level rose along with the rebounding outlet, culminating at the Nipissing phase lake around 5,000 ^{14}C years B.P., also at an original elevation of 605 feet. Nipissing wave-cut bluffs engrave the land surface at 605 feet in SBDNL and are raised a little higher in Leelanau State Park to 607 feet. In many places bluff recession during the Nipissing phase wiped out the Algonquin strand, leaving Nipissing as the only shoreline despite its lower elevation.

Finally, shoreline processes and climate around the time of the Nipissing phase initiated a cycle of eolian activity that resulted in an alternating pattern of dune building and stabilization (Arbogast et al. 2002) along the western and northern margins of the county that continues to this day. Current low-lake levels that began around 1997 have caused deflation of the nearshore areas and accumulation of sand in the backshore along with partial burial of backshore vegetation. Simultaneously, the process of infilling, spit extension, and beachridge development closed the deep embayments in the Manistee moraine creating, among others, Glen Lake and Little Traverse Lake.

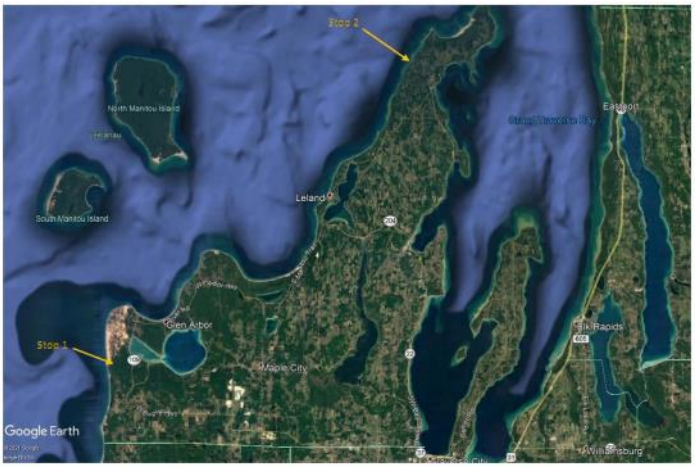

Figure 3: Map of Leelanau County showing the two stops. Map modified from Google Earth.

Stop 1: SBDNL Lake Michigan Overlook

Latitude: 44.8584°N; Longitude: 86.0670°W

Section 1, T28N, R15W, Leelanau County

Directions

From Empire, Michigan, take M-22 northeast for approximately 1.9 miles to M-109. Turn left onto M-109, and head north for 1.2 miles. Turn left onto Pierce Stocking Scenic Drive, and follow it for approximately 5.2 miles to the Lake Michigan Overlook (Point of Interest #9 and 10 along the drive). Park in the lot, and walk up the trail to the dunes.

Introduction

The overlook at this location stands 450 feet above Lake Michigan and makes for an excellent photo opportunity. Note that this location is within the Sleeping Bear Dunes National Lakeshore, and collection of any materials is prohibited. Disturbance of the dunes requires special permission from the park service.

Geology

The dunes at this location are known as a perched dune because the well-sorted dune sand at this part of the park is only the uppermost 24 feet of the 450 foot section here. Long cut-and-fill trough sets pointing in multiple directions, common to windblown deposits, are plainly visible in this section.

Below the dune sand is a six foot thick layer of massive to cross-bedded sand and pebble gravel with a buried soil horizon at the contact with the dune sand (Figure 4). The soil is relatively well-developed with a four to six-inch thick, gray A horizon and iron-staining in the B horizon.

Below the sand and gravel is a pale pink, sandy diamict commonly associated with the Greatlakean stadial (though there is a danger in correlating any unit based on color). This diamict is relatively loose in the upper six feet and does not have an internal structure characteristic of a till.

Figure 4: Buried soil horizon at Lake Michigan overlook in SBDNL. Paleosol is in fluvial sand and fine gravel below the dune-sand layer but above the diamict layer.

Stop 2: Peterson Park

Latitude: 45.1536°N; Longitude: 85.6468°W

Section 29, T32N, R11W, Leelanau County

Directions

From Stop 1, return along Pierce Stocking Scenic Drive to M-109 and turn left. Follow M-109 into Glen Arbor, and continue straight on M-22. Go through Leland, and continue north/northeast past state road 637. Continue another 1.68 miles and turn left onto Carlson Road. Follow this north to Johnson Road and turn right (follow the pavement). Follow it about 1.25 miles to Clausen Road and turn left, then turn left onto Melkid Road at the "T". The road bends to the right (north) and is now Foxview Drive. Follow this north about 1.4 miles to the hairpin bend to the right, but continue straight into Peterson Park.

Geology

The area to the south and including this stop are within a drumlin field. There is a steep wave-cut bluff here along the lakeshore that is as much as 150 feet high and cut directly into drumlins which should show a proper cross-section of the drumlins intersected by the bluff. While it is difficult to tell how much of the lower slope is slopewash from above, there are a number of places that can be seen where vertical prows of diamict 50 feet tall stick out from the high-angle slope. The beach is littered with rocks as much as four feet in long axis. Many of the limestone cobbles are striated due to differential movement in the diamict (Figure 5a). Striated pebbles found in-situ generally show a striation direction concordant with the direction of the long axis of the drumlins. The diamict at this location is thicker than seen anywhere else on the Leelanau Peninsula, yet it is without any visible bounding

Figure 5a: Striated limestone cobble in diamict at Peterson Park with striations pointed generally southeast.

surfaces and also lacks the distinctive, blocky texture that we will see later today farther to the southeast. For those of you in search of adventure, a prominent diamict prow (Figure 5b) lies about 100 yards south of the staircase to the beach. Vague horizontal banding and gradation can be seen in this prow that is reminiscent of structures described by Eyles et al. (1983) as originating from rainout into a body of water beneath the floating margin of a glacier or an iceberg field. At this time, much more work needs to be done in order to answer the question as to the origin of this diamict unit, its internal characteristics

Figure 5b: Diamict cliff in Peterson Park. Faint layering may indicate a rain-out accumulation process.

(which are not uniform over its outcrop area), and the process that created the drumlinized surface.

In some places the surface is capped with three to four feet of sand. While a thin sand unit among the drumlins was not actively pursued during mapping, it appears that the sand accumulated in swales between drumlins and the drumlin peaks are sand-free. It seems incongruous that perched sand dunes developed at Stop 1 while here, in a seemingly similar environment (steep bluffs composed of diamict on a shoreline open to wind and wave action) very little sand has accumulated at the top. The answer to this may be the composition of the diamict. The sand component of the diamict here is both of a smaller average size and a lower percentage of the cumulative grain size. The beach here is armored by gravel and there is a vegetated slope here.

References

Google Earth, www.google.com/earth/.

Kincare, Kevin, 2007, Glacial Geology of the Leelanau Peninsula, Michigan, Field Trip Guidebook as part of the 2007 AIPG Annual Meeting, Traverse City, Michigan.

Sleeping Bear Dunes National Lakeshore Website: https://www.nps.gov/slbe/index.htm.

Invitation to Our Members!

Do you have a case study to share?

The Michigan Section AIPG promotes knowledge sharing and would like to feature 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.

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.

This Edition of Geologically Speaking features our 2021 Section Secretary, Poonam Rameshbabu:

I am an environmental geologist at The Mannik & Smith Group, Inc. with over 13 years of experience and a focus in geophysical techniques, environmental investigation and remediation, feasibility studies, and project management. I graduated from Michigan Technological University with a bachelor's degree in Applied Geophysics and am also currently pursuing a graduate certificate in NEPA from Utah State University. In addition to my involvement in AIPG, I serve on the board of the Michigan Association of Environmental Professionals, and am involved in the Academy of Board Certified Environmental Professionals, and the National Association of Environmental Professionals. Outside of work, I enjoy hiking and travel. I've been to all the continents; six for us geologists or eight for those who include Zealandia.

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:

Hunter Golat, SA-10904; Collin Oborn, ECP-0739; Dean Fassero, SA-10965; Jessica Slagter-En, MEM-3271, Carolyn Hernandez, ECP-0772; Jenna Senda, AS-0183; Joseph Klumpstra, MEM-3283; and Beth Place, MEM-3284.

To each of our new members, welcome to our Section. We encourage you to attend Section meetings and other events. You are also invited to provide information for the Member's Corner articles.

Coming Events

April 29, 2021: Remediation and Risk Management Series: 2020 Voluntary Volatilization to Indoor Air Pathway Screening Levels. https://www.michigan.gov/egle/0,9429,7-135-3308_3333-549843--,00.html.

May 27, 2021: Remediation and Risk Management Series: Michigan PFAS Action Response Team Update. https://www.michigan.gov/egle/0,9429,7-135-3308_3333-549843--,00.html.

RESCHEDULED:

June 15-17, 2021: Michigan Section's 10th Annual Environmental Risk Management Workshop: "The Data Tell the Story" at the Ralph A. MacMullan Conference Center, Roscommon, Michigan.

October 23-26, 2021: Rescheduled 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.

August 6-9, 2022: 58th Annual AIPG Meeting to be held in Marquette, Michigan. See article in this edition of *Geologically Speaking* regarding meeting planning.

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

How US Presidential Elections are Impacted by Geology: https://www.forbes.com/sites/davidbressan/2020/11/03/how-us-presidential-elections-are-impacted-by-geology/?sh=499fdaa92b90.

Landslide in Japan: https://www.youtube.com/watch?v=eR77MhKwAew.

Volcanic Eruption in Iceland: https://www.youtube.com/watch?v=f3BD8vqYTho.

REMEDIATION SERVICES

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Annual Meeting Planning

The Michigan Section AIPG will be hosting the 2022 Annual Meeting in Marquette on August 6-9, 2022. 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 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.

Here is a preliminary list of potential field trips currently under consideration:

- Eagle Mine/Mill: Surface tour (underground tour if possible)
- Pictured Rocks: Miner's Castle, Miner's Falls, Munising Falls, and boat tour
- Tilden Mine/Mill, includes a visit to the main mine pit
- Historic Iron Mining: Michigan Iron Industry Museum, Jackson Mine Park, Cliffs Shaft Museum
- Republic Mine and Reclamation: Overlook, rock piles, tailings reclamation
- Keweenaw Stamp Sands: Lake Linden, Torch Lake, Historic Mills, Quincy Smelter, Gay, redevelopment of stamp sands
- Keweenaw Copper: Quincy Mine and Seaman Mineral Museum

Other possible trip locations could include:

- Champion Mine
- Back 40 Mine
- Iron Mountain Iron Mine
- Fayette/Big Spring
- Gulliver/Gould City Limestone Quarries
- Lake Ellen Kimberlite
- Wind Farm Power Production

Potential Guest Trips

- Pictured Rocks National Lakeshore
- Waterfall Tour
- Brewery Tour
- Lake Superior Fishing Charter

Field Trips are being evaluated by Allan Blaske and Dave Adler, with input from Mark Petrie.

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

I Want To Publish Your Articles!

Hey everyone, I would like to encourage you to submit your articles for publication! As the Michigan Section Editor, and also the 2021-22 National Editor, I am working to put together two top-quality publications for our members. This is nor a one person job. This is where you come in. I welcome your technical articles, case studies, opinion pieces, mini field guides, and letters to the Editor.

The guidelines are pretty simple for articles for *Geologically Speaking*. All submissions must be professional and may not violate the AIPG code of ethics. They also may not have been submitted for publication elsewhere. While most submissions will be accepted, we do not accept articles that are a sales pitch for a product or company.

The deadline for submitting articles for TPG is two months before the start of the quarter for which the TPG edition is published. Thus, February 1 is the deadline for the Apr/May/Jun edition.

Please submit your articles of no more than 3,200 words in MS Word format directly to me or to Dorothy Combs at National Headquarters at aipg@aipg.org. All graphics (photos, figures, or tables) should be submitted in .jpg, .tiff or other standard format at 300 dpi. Please ensure your graphics are clean and easy to read to make things easier for the editorial staff. Complete information on submitting an article may be found on National's website at: https://aipg.org/page/TPGInformation.

I'd like to encourage our members to consider submitting an article related to Michigan geology in advance of the Annual Meeting that will be held in Marquette in 2022.

ASBOG Exam Update

Eleven individuals took the ASBOG FG exam at Central Michigan University on Friday, March 19th. Registration is now open for the next exam, which will be administered on October 1, 2021. Relevant dates for taking the exam this October are:

- August 4 – apply to CMU
- August 15 – register with ASBOG
- October 1 – FG exam at CMU

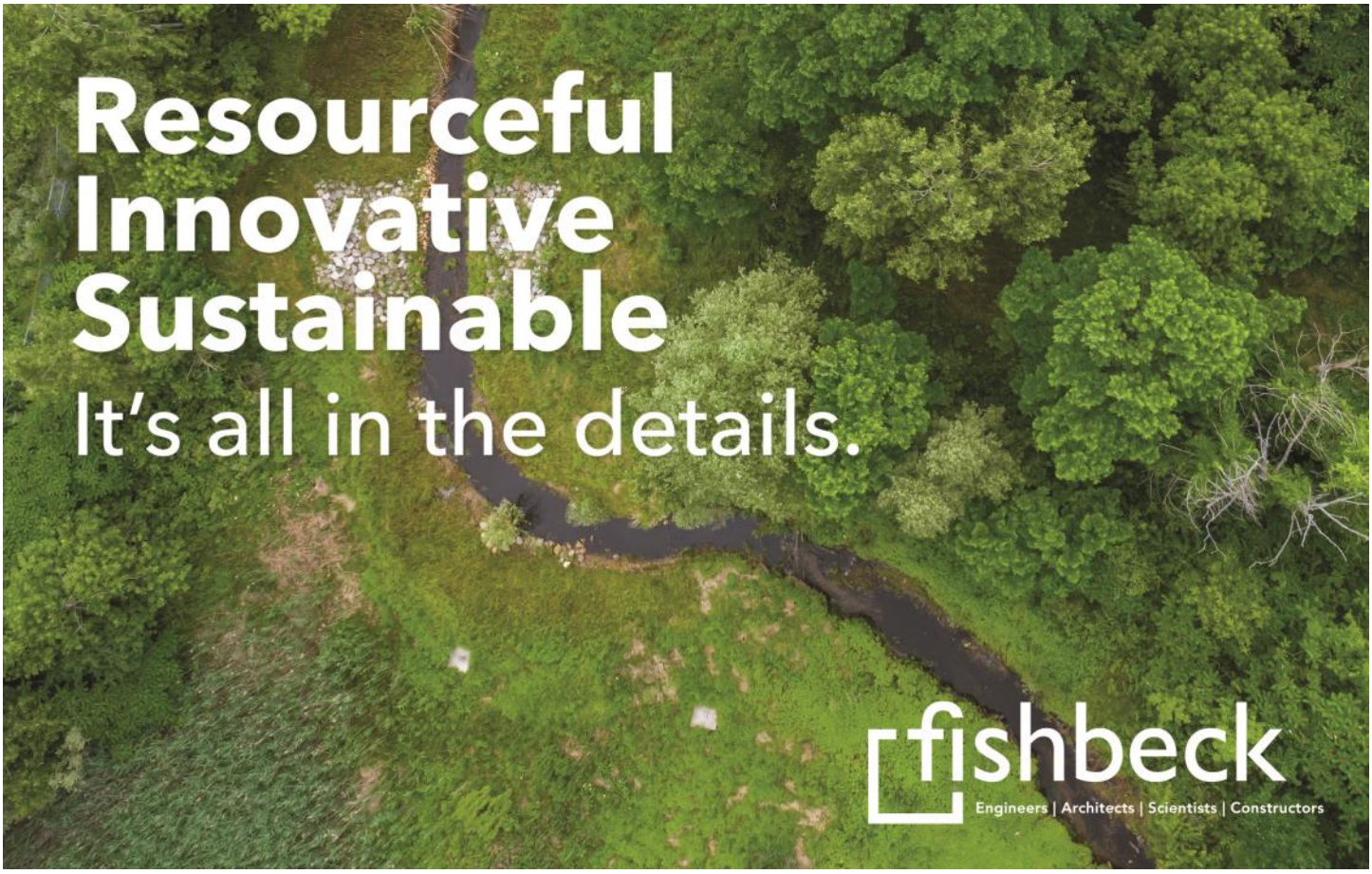
Details are available at: se.cmich.edu/asbog and will be provided in the next edition of *Geologically Speaking*.

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 companies, and when you speak with their representatives, let them know that you saw their ad in the Michigan Section AIPG publication *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!

Remediation and Risk Management Series - 2020 Voluntary VIAP Screening Levels, April 29, 2021 (12:00 to 1:00 p.m. EST)

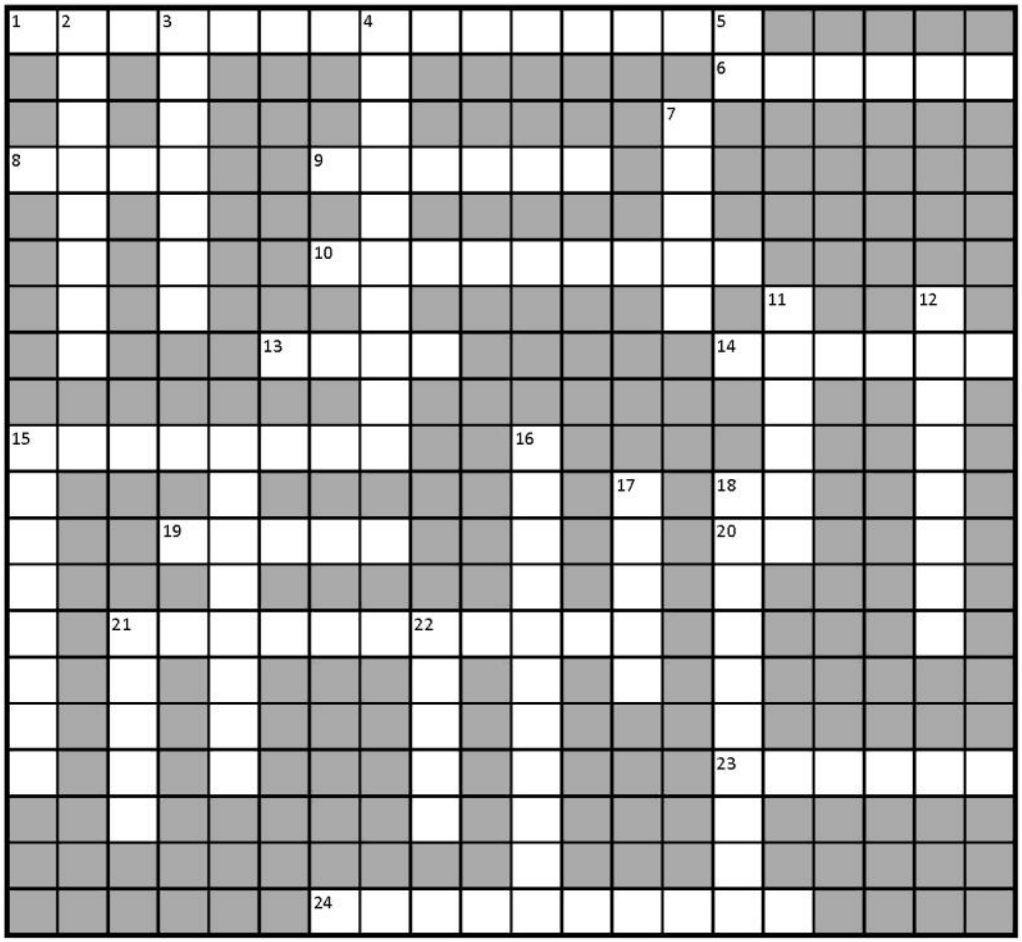
In September 2020, EGLE replaced the rescinded Appendix D.1 of the 2013 Guidance Document for the Vapor Intrusion Pathway – Volatilization to Indoor Air Pathway (VIAP) Screening Levels with Residential and Nonresidential VIAP Screening Level Tables. The VIAP screening levels are provided as a voluntary tool that may be used to determine that site conditions do not present a risk and allow a quick regulatory closure or that site conditions warrant a more site-specific evaluation, at common residential and nonresidential sites. This webinar will cover the purpose behind the VIAP screening levels, the basic exposure assumptions used in their development, what documentation is needed for their voluntary use, and their use.

Speaker Biography: Dr. Shane Morrison is a Toxicologist with Remediation and Redevelopment Division responsible for providing highly technical toxicological and risk assessment expertise for the volatilization to indoor air pathway (VIAP). Shane joined the department in 2016 as a classically trained chemist from a BS degree program with approval from the American Chemical Society. He has earned a Certificate in Interdisciplinary Toxicology along with MS and PhD degrees emphasizing environmental toxicology and the relevance of short-term or pulsed exposures. His research and collaboration has produced 11 peer-reviewed publications. Favorite quote: "The difference between science and fooling around is writing it down" – Adam Savage

How to attend the Online Webinar:

To attend the online webinar register at https://attendee.gotowebinar.com/register/16509579260218380. After registering, you will receive a confirmation email containing information about joining the webinar.

Geology Crossword #5



Across

1 Basal Chocolay Group
6 Lowest Formation at Stoneport
8 Lowest Formation at Kelly's Quarry
9 Not swimware
10 Basal unit of the RASA Project
13 Common evaporite
14 Seventh day quartzite
15 Quartzite equal to Mesnard
18 Abbreviation; geologic time
19 No criminals here
20 Not out
21 Uppermost formation at Kelly's Quarry
23 Gassy shale
24 Form the ledges

Down

2 Oronto Group shale
3 A tree found in Michigan
4 Lowest Cataract Group
5 Viagra is the cure for this
7 Eastern equivalent to the Ellsworth
11 Roman god of fire
12 Law enforcer?
15 Light bulb manufacturer
16 Ordovician shale
17 Mid-grade metamorphic
18 Very widespread formation
21 Oronto Group siltstone/sandstone
22 Tropical tree

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