



The Maine Geologist

NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MAINE

September 2022

Volume 48

Number 1

PRESIDENT'S MESSAGE

Greetings from Bar Harbor. After 10 years at College of the Atlantic, early September has a hopeful feel to me: sunny warm days with chilly beginnings and ends, the return of students and the lingering of tourists, fall CSA boxes brimming with cucumbers and tomatoes, Coastal Joe Pye Weed, cone flowers, and asters dotting the landscape. I'm even more excited about the coming months after meeting with GSM executive council members in August to plan our fall event. The **GSM Fall Meeting** is scheduled for Thursday, November 10, from 1 to 6pm at the Augusta Civic Center. We are very much looking forward to our first in-person meeting since 2019! The topic of the meeting will be *Critical Minerals in Maine*. More information will be sent out soon.

As the end of my second term of GSM President is approaching this fall, I am reminded to announce that Executive Council member positions are available - please get in touch if you would like to serve GSM as an executive council member. Students, faculty, and professionals are encouraged to apply for funding through the GSM Fund for Education and Professional Development by October 1. Find more information for how to apply on the GSM [website](#). Be sure to check out the campus updates from faculty at various Maine institutions highlighting some of the engaging in-person field learning and research opportunities geoscience students have been enjoying during 2022. I hope everyone has a wonderful fall season - I look forward to seeing you at the GSM meeting in November!

Sarah Hall, GSM President
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THE EDITOR'S MESSAGE

Apologies for the big gap in newsletter editions! The last newsletter published was the September 2021 special issue, volume 47, number 3. This is the first newsletter in 2022. I will echo the President's Message and say that the Newsletter Editor position can be available if someone would like to take over...

The newsletter is distributed through email in pdf format. Anyone with special needs please contact the Editor. Please send items of interest and photographs of GSM activities to:

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NEWS FROM THE STATE GEOLOGIST

Taking the Helm

Greetings fellow geoscientists. It is my privilege and pleasure to take on the role of State Geologist and lead the Maine Geological Survey. Since Bob Marvinney retired July 1, 2021, I have served in acting capacity both as State Geologist and Director of the Bureau of Resources Information and Land Use Planning (BRILUP) in the Maine Department of Agriculture, Conservation and Forestry. On November 15, 2021 I accepted the position of State Geologist and relinquished the role of Bureau Director to Judy East who was the former Executive Director of the Land Use Planning Commission. Both the Maine Geological Survey and LUPC are, along with the Maine Floodplain Management Program, Maine Natural Areas Program, Land for

Maine's Future and Municipal Planning and Assistance Program, part of BRILUP.

In the first session of the 130th Maine Legislature, Bob Marvinney was able to split the positions of Bureau Director and State Geologist into two. That change became effective October 18, 2021. The Bureau Director remains a political appointment of the current administration while the State Geologist position no longer is. In my opinion, this revised status for the State Geologist is a positive outcome for the Maine geoscience community.

I would like to recognize MGS Director of Earth Resources Information Christian Halsted for revolutionizing methods of mapping, geodatabase development, and geological data preservation. While at MGS, Chris has worked on creating an original geological database that helped him earn a M.S. degree from the University of Wisconsin. This was the first of its kind among geological surveys in the U.S. The MGS geographic information system and databases comply with and attain the USGS Geologic Mapping Schema (GeMS) for the National Geologic Map Database. MGS bedrock and surficial maps funded by the USGS STATEMAP program meet this standard. With a new grant to MGS, the GeMS process and functionality is being enhanced and will be shared with other states.

July 1, 2022, Daniel Locke retired from his position as hydrogeologist at MGS. Over his 37 years with the state, he worked both at MGS and DEP. He published over 550 maps and reports at MGS. Dan helped build the water well database that has over 1,200 users a month. In all kinds of winter conditions, Dan made measurements across the state for the snow survey maps MGS publishes with contributions from many other partners. Over the decades, Dan provided ongoing advice on groundwater and wells to municipalities and the public. His depth and breadth of knowledge will be greatly missed.

Here are just a few earth items of relevance both here in Maine and to the nation. From the summer of 2020 through the summer of 2022, Maine experienced periods of hydrologic drought and the state [Drought Task Force](#) met frequently. The past two winters saw a cumulative snow deficit of 2 to 7 feet below normal across the state. Dr. Sean Birkel, Maine State Climatologist, reported that calendar

year 2021 was the second warmest since 1895. More trends can be found in the [Maine Climate News](#). Since 1993, sea level in the Gulf of Maine rose 4 inches above the 20th century average. Recent trends are available from the Maine Geological Survey sea level rise [ticker](#) and [dashboard](#). Related trends and projections are available at the Maine Climate Council's climate science [dashboard](#). The Science and Technology Subcommittee of the Maine Climate Council released a [Maine Climate Science Update 2021](#).

There are many more topics deserving mention, but I will save a few for another newsletter. I look forward to carrying on the traditions and collaborations the Maine Geological Survey has with the GSM membership.

Stephen M. Dickson, Ph.D., State Geologist

NEWS FROM THE CAMPUSES

Bates College

Dr. Shreya Arora hosted a short term in Central Himalaya, India, over the summer for Bates College students.



Bowdoin College

This past spring, Rachel Beane and Emily Peterman led weekend field trips to the Maine Mineral and Gem Museum and Vinalhaven Island (photo below). Michèle LaVigne had a team of five students working in her lab at Schiller Coastal Studies Center this spring running experiments on the effects of [ocean acidification](#). Several of our seniors completed independent research projects and they [gave outstanding presentations](#) to our whole college community.



This summer, Emily Peterman co-hosted the [6th Biennial Structural Geology and Tectonics Forum](#) at Bowdoin College. Plenary sessions were complemented by field trips, including an afternoon exploring the geology at Giant Stairs in Harpswell (photo below). Collin Roesler hosted five summer research students focused on oceanography in Harpswell Sound -- two students will be continuing their research with her this academic year. Phil Camill traveled with honors student Ana Gunther to

Baffin Island in Canada for [field research this summer](#).



We welcomed visiting assistant professor Evan Dethier to Bowdoin for this academic year (he just had [a paper come out in Science!](#)) and the College welcomed Holly Parker as our new director of the Schiller Coastal Studies Center. We are running a search for a new tenure-track colleague -- spread the word! Information about the position can be found here: <https://www.bowdoin.edu/earth-oceanographic-science/index.html>

Emily M. Peterman (she/hers)
Bowdoin College

College of the Atlantic

COA chemist, Reuben Hudson, and geoscientist, Sarah Hall, teamed up to teach a new course in scientific writing, *Topics in Research: Geoscience and Geochemistry*, offering students a chance to prepare a scientific manuscript over the course of the term. Several students developed papers related to their ongoing work in groundwater quality or watershed monitoring, others worked on previously collected sediment core data, a few worked on Origin of Life projects. The experience fostered new collaborations among geoscience and chemistry students. During the spring conference season, many COA students presented their research at regional meetings such as the [Geological Society of Maine Spring meeting](#) and the [Maine Sustainability and Water Conference](#). One student-authored

manuscript developed during the course was published this summer!

Just after peak spring flows, students in Ken Cline's *Hydrogeology* course and Sarah Hall's *Watersheds* course gathered for a float trip along the Penobscot River with Angie Reed and Jan Paul of the Penobscot Nation Water Resources team (photos). Students enjoyed paddling, swimming, making observations of the watershed, and engaging in discussion.



Many COA students are excited to work on projects at the nexus of geoscience and human society: Ben Capuano, Adam Feher, Lenka Slamova, Ludwin Moran Sosa, and Isidora Munoz Segovia have been assisting local researchers at COA and MDI Biological Laboratory with an ongoing groundwater quality study in the MDI region: offering free private well testing, analyzing spatial and temporal datasets, considering the effects of different filtration systems, and developing tools for

advocacy. With Reuben Hudson (COA Chemistry) and Kit Hamley (UMaine Paleocology), students MHD Mustafa Korzahm, Raheem Kahdour, and Kaitlyn Burke, have been exploring the paleoecology and human occupation history at three sites in Maine using sediment core analyses. Reuben is also working with two recent COA grads, now COA graduate students (Madi O'Brien and Ruvan de Graaf), to make STEM learning opportunities more accessible, equitable, and engaging through field and hands-on experiential learning pathways.

Sarah Hall
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Unity College



With one full year of teaching courses in 5-week blocks under our belt we were excited to welcome students back from their summer break last month and get them stuck into some field-based courses. In my first-year elective course this term we have been investigating stream hydrology, geochemistry, and ecology while learning skills associated with keeping a detailed field notebook.

At the broader scale, the College is also close to launching a new in-person bachelor of science degree program that will focus on natural resources, particularly wetlands. This will have the added benefit of expanding our geoscience course offerings, as soil science and hydrology/hydrogeology courses will reappear in the catalog after a brief hiatus. This year we are also exploring the potential for offering “expeditionary” and hybrid courses to the approximately 4500

students in the Distance Education arm of the College as well as those here at the Unity campus in the Hybrid Learning arm. I am hopeful that geoscience topics will form a part of those offerings.

Best wishes from Unity!

Tom Whittaker
Unity College

University of Maine at Farmington

GEY 304 Geochemistry students completed the Tour of Penobscot in 25 hours, departing Farmington at 4pm on 2022/4/13, overnight at the ski cabin in Camden Hills State Park, stops on Mt. Battie, Deer Isle, Lord’s Cove, Callahan Mine, and Condon Point, back by 5pm on 4/14. Following spring semester, Drs. Julia Daly and Rachel Hovel (Biology) taught a travel course in Iceland (see separate description). Summer research interns Kayleigh Brisard and Sadie Gray worked with Daly and Hovel on the Maine Mountain Ponds project (@mainemountainponds) focused on understanding the impact of climate change on remote lakes in western Maine. They also helped do some work in Temple Stream just before and after the removal of the dam in West Farmington. Students in GEY 251 (Sedimentology and Stratigraphy) will be investigating related sediment mobilization in the Temple stream channel this fall. Dr. Marlon Jean arrived in late August (1-yr Assistant Professor of Mineralogy-Petrology) with a wealth of experience (e.g., ODP drilling, Alaska ophiolites, Yellowstone, Sierra arc). This fall, senior Will Robert starts a project on the Plumbago North lithium deposit to establish an environmental geochemical baseline under the guidance of Doug Reusch, LeeAnn Munk, Dwight Bradley, Myles Felch, and Dyk Eusden.

In May, twelve UMF students traveled to Iceland with Dr. Julia Daly (geology) and Dr. Rachel Hovel (biology) for a two-week course linking geologic processes to different terrestrial aquatic habitats. We spent time at locations across southern and western Iceland, focusing our coursework on volcanic and glacial processes that impact stream habitat. With support from GSM’s Anderson fund, students were able to explore a lava tube, travel across part of Fjallsjökull glacier and learn about recent changes

there, and visit the geothermal energy exhibit at the Hellisheidi power plant.



UMF students traveling across Fjallsjökull where they learned about recent ice margin dynamics and saw active moulins.



UMF students inspecting VMS deposit at Callahan Mine, Harborside.

Doug Reusch
University of Maine at Farmington



UMF travel course at the spectacular columnar basalts exposed at Svartifoss.

GSM SUMMER MEETING

Summer 2022 Recap

Despite the sweltering heat, the 2022 GSM summer field trip to the midcoastal-area was a huge success! Over 40 participants attended, including four K-12 teachers.

The trip did not hang on a central theme this year and instead included many geologic aspects in the region. The response from attendees was very positive as this trip had something for everyone: bedrock, surficial, landslides, remediation, history, active quarrying, and more!

The geology always speaks for itself, but on a personal note, it was great to get back out into the field with society members and experience that collective appreciation we share for Maine's geology. Has it really been two years since we have done that together!?

Every successful trip has a group of dedicated people working behind the scenes. A **HUGE THANK YOU** to GSMs 2022 field trip organizing committee, members include Henry Berry, Bruce Hunter, Doug Reusch, Troy Smith, Lindsay Spigel, Keith Taylor, and Tom Whittaker.

Numerous leaders with varying backgrounds provided content and presented at the many stops, and several landowners and organizations provided access to sites. In no particular order, I would like to thank the following: Charlene “Sunshine” Hood and the staff at Camden Hills State Park for their hospitality. Landowners adjacent to Rockport Marine Park for permission to access their property. Harbormasters Abbie at Rockport and Ryan at Rockland for waterfront parking guidance. The Maine Coastal Heritage Trust for providing access to Clark Island and some historic images for the field guide. Outward Bound School and Caignair by the Sea for parking arrangements. Ryan O’Neill of Coastal Mountains Land Trust for allowing access to Simonton Quarry and Beech Hill preserves. Mike Martunas of Dragon Cement and Rich Fortin of Drumlin LLC., for providing site access and leading stops at their respective field sites. Doug Reusch for sharing recent work and insight on some of Maine’s oldest rocks. Lindsay Spigel and Steve Dickson for preparing the Rockland Landslide site guide. Doug Reusch, Cassy Rose, Will Robert, and Henry Berry for driving vans. UMF and MGS for providing multi-passenger vehicles. Lastly, a big thank you to Henry Berry for masterfully organizing the fields stops for the weekend, well done!

-Myles Felch



Professor Doug Reusch (UMF) expounding from atop Mt. Battie with a view of Penobscot Bay in the background.



Blueberries were in season on Beech Hill!



Group image from Saturday, inside the Dragon Cement Quarry.



Henry Berry (MGS) discussing the Benner Hill Formation.



Geologists on the rocks on Clark Island.

these projects and the faculty and staff who continue to mentor students and advise research projects.

Student Presentations: (listed in order of presentation)

Ludwin Rodrigo Moran Sosa (College of the Atlantic)

Influence of different water treatment systems on arsenic concentrations in private well groundwater: A view from MDI, ME

Ludwin Moran, College of the Atlantic
Sarah R. Hall, College of the Atlantic
Anna Farrell, MDI Biological Laboratory
Jane E. Disney, MDI Biological Laboratory

GSM SPRING MEETING

April 15, 2022
Virtual Meeting Recap

The Spring meeting of the GSM was held virtually on April 15, 2022. After a brief Business Meeting, the community heard a thorough update from State Geologist, Steve Dickson, about various ongoing and upcoming projects from around the state. We heard an engaging keynote talk by Dr. Shreya Arora, Visiting Assistant Professor at Bates College on her neotectonics research in the Himalaya: *How far we have come in Seismic Hazard Assessment: A case study from the Himalayas*. The video of the meeting may be viewed here:

<https://youtu.be/W1EcE2KMUSE>

Seven undergraduate students prepared abstracts and presentations to share with the community. Abstracts are provided below and posters/presentations can be viewed online:

<https://docs.google.com/presentation/d/1tS5ZCeure2xA4kmfDGRtHRpNikzzXGMmjzB87EvqoVw/edit?usp=sharing>.

Thank you very much to the students who took the time to put together a presentation of their work to share with the community. We also appreciate the many collaborators who contributed to

Arsenic (As) is an odorless, colorless, and tasteless carcinogenic metal commonly found in the groundwater of private wells in Maine due to the regional metasedimentary bedrock. Chronic exposure to As through drinking water, even at low doses, can lead to cancer of internal organs, damage to the cardiovascular and respiratory systems, and developmental issues in children. This study focuses on 55 wells in the Mount Desert Island area chosen for their various As concentrations and different styles of filtration. Filter types included particulate filters, filters to remove As and other dissolved ions such as Reverse-Osmosis (RO) systems, and other common components including water softeners and U.V. filters to remove bacteria. While we focus here on just arsenic, our analysis includes 14 total elements. Similar to prior studies, we found that particulate filters typically remove about 10% of arsenic, presumably when it exists as a solid phase or adsorbed to another solid metal. RO systems almost completely eliminate As from the groundwater and regularly reduce ~99% of the total element concentration when properly maintained. Other filters, like water softeners and radon mitigation systems, reduce some of the total element concentration but are not designed to remove As. Not surprisingly, RO systems were the most effective in removing contaminants from

private well water regardless of the total amount or the variability in As concentrations throughout the year. Regularly maintained RO systems successfully reduce concentrations below the current Maximum Contaminant Level (MCL) of 10 µg/L as well as more judicious 5 µg/L MCL for the states of NJ and NH. Although as we show, RO systems can fail to remove As when not regularly maintained. This study highlights some of the challenges and opportunities of different systems to reduce unwanted elements within drinking water in a real human-moderated environment.

Ben Capuano (College of the Atlantic)
Precipitation-Mediated Fluctuations of Well Water Arsenic in Hancock County, ME

Benjamin Capuano, College of the Atlantic
Madalyn Adams, College of the Atlantic
Sarah R. Hall, College of the Atlantic
Jane E. Disney, Mount Desert Island Biological Laboratory

Arsenic (As) contamination presents a threat to households who rely on private wells for their drinking water. With ~80% of Hancock County, ME relying on wells, well water quality is a first-order public health concern for this area. Monthly well water samples collected 2020-2021 from private wells on Mount Desert Island and Trenton reveal seasonal fluctuations in arsenic during yearly water level changes. To consider fluctuations over shorter timescales, 32 wells from the monthly program were tested before/after rain events in October, February, May, and August. This subset includes wells with varying substrates, elevations, watershed positions, well types, and pre-rain arsenic concentrations from <1 to >50 ppb. In addition to As, samples were analyzed by ICP-MS for 13 other elements at the Trace Element Analysis Laboratory of Dartmouth College. Preliminary results suggest that most wells only fluctuate within ~1ppb of pre-rain concentration, however some wells show fluctuations >15ppb between the pre- and post-rain samples. No well

fluctuated more during rain events than during yearly sampling. Further, the maximum post-rain arsenic concentrations for many wells are similar to the maximum arsenic values measured at other points in the year. Some individual wells had concentrations below the Maine As MCL of 10ppb before a rain event and above the MCL after. As there were no consistent trends in As concentration across all 32 wells sampled during rain events, this speaks to the unique characteristics of each well. Well owners should be aware that their well water chemistry may vary throughout the year or through rain events and consider testing more frequently than the recommended once every 3-5 years to understand the As range of their well. Arsenic at any level is considered toxic, thus well owners with arsenic concentrations near to the Maine MCL might consider installing a reverse osmosis point-of-use filter to ensure clean water through changing conditions.

Elana Alevy (Colby College)
Unraveling the CV-CK Chondrite Relationship: Mineralogy and Texture of NWA 10588, a Primitive Meteorite

Elana G. Alevy, Colby College
Tasha L. Dunn, Colby College

Primitive meteorites like the carbonaceous chondrites (CC) accreted during the earliest stages of our solar system's formation. Two groups of CCs, the CV and CK chondrites, have similar bulk elemental abundances and isotopic compositions, which suggests that they originate from the same parent asteroid. However, distinct extents of metamorphism (alteration from increased heat) and mineralogies between the two groups could indicate that they originate from multiple asteroids. Identification of a meteorite that is transitional between CV and CK chondrites would imply that both CV and CK material formed within one asteroid. Such a sample can be identified by analyzing a chondrite's main components: chondrules, the spherical inclusions of cooled mineral droplets, and matrix, the host material that

encloses all inclusions. In this project, we revisited the initial classification of Northwest Africa (NWA) 10588 as a minimally metamorphosed (type 3) CK chondrite. CK3 chondrites characteristically contain coarse-grained matrix, low chondrule:matrix ratios, nickel-rich olivine (a common silicate mineral), and Cr-rich magnetite. However, classifiers additionally suggested that NWA 10588's observed CV-like, fine-grained matrix and CK-like olivine compositions were indicative of transitional material. In continuation, we analyzed NWA 10588's texture, mineralogy, and mineral chemistry using three methods: transmitted light microscopy, to describe the sample's texture, components, and appearance; Scanning Electron Microscopy (SEM), to generate images and compositional maps; and Electron Microprobe Analysis (EMPA), to precisely measure compositions of individual mineral grains. Comparison of this data with existing data from CV and CK chondrites allowed us to assess whether NWA 10588 is transitional.

MHD Mustafa Khorzom (College of the Atlantic)
Paleoecology of Little Long Pond, Mt. Desert Island, Maine

MHD Mustafa Khorzom, College of the Atlantic
Sarah Hall, College of the Atlantic
Reuben Hudson, College of the Atlantic
Kit Hamley, University of Maine, Orono
Sahra Gibson, College of the Atlantic, Land and Garden Preserve
Gaby Moroz, College of the Atlantic
Sneha Suresh, College of the Atlantic

In a paleoecological study, a lake sediment core can reveal many things about the history of the lake/pond and its surroundings. Different proxies reveal diverse sorts of data, ranging from fire activities in the area to changes in sedimentation and sediment types. Sedimentation rates in the pond can tell a lot about the pond's history and how it is formed; it can tell about the speed of the water flowing and how that impacts the formation of the pond. Geochemical analysis of heavy metals can

tell the story of birds, mammals, and humans, as well as being a proxy of determining general changes, even if not specifically known what has caused them. Both geology and humans have had a significant impact on the pond threatening the pond's existence. We aim to study reasons shown in the ~4300 year-long record which had impacted the pond's formation. Our record shows that the pond was impacted by the geology of seawall formation ~4000 years ago, which impacts sedimentation in the pond to this day. The record also shows the human impact on the pond starting ~1500 years ago and amplified the last ~400 years. This record is evidence that applies to every lake that is threatened by rising sea levels. We anticipate our study to be a starting point for any lake/pond to study pond formation in deglaciated areas.

Hallie Arno (College of the Atlantic)
The River Divides Us: Community Perceptions of Dam Removal on the Megunticook River, Camden, Maine

Hallie E. Arno, College of the Atlantic

Dam removals are an ideal case study of human-environmental interactions. Particularly in New England, dam removals can be contentious, as dams can be viewed as a part of a town's identity. Studying these conflicts provides insights into the values behind conservation in the community. The Megunticook River in Camden, Maine, has seven dams along the river's 3.5-mile stretch. These dams create a barrier to fish passage, modify water speed and temperature, and increase flood risk. The Camden Select Board is investigating options to restore the river, including the removal of four dams. This prompted controversy, including the formation of a group dedicated to saving the most visible of these dams. I administered an online survey and conducted structured interviews with community members about the Megunticook River watershed to better understand community perceptions of dam removal and restoration. This

revealed themes such as the subjectivity of “ecosystem health,” conflict between preserving history and conserving biodiversity, the role of local ecology in collective identity, the responsibility of conserving habitat in a changing climate, and the importance of stakeholder engagement in management decisions. The information gathered in the study can be used to inform future restoration projects by examining the values underpinning attitudes around ecological restoration and ways to incorporate those values into restoration planning.

Lenka Slamova (College of the Atlantic)
Do the orchard soils of the Mount Desert Island region harbor residuals of historical arsenical pesticides use?

Lenka Slamova, College of the Atlantic
Sarah R. Hall, College of the Atlantic
Adam Feher, College of the Atlantic
Anna Farrell, Mount Desert Island Biological Laboratory
Jane E. Disney, Mount Desert Island Biological Laboratory

Long-term low-level exposure to arsenic is linked to an increased risk of cardiovascular diseases, diabetes, several cancers, and developmental issues in children. As a known public health concern, especially for the New England region, it is crucial that we study arsenic in Maine to better understand the pathways of ingestion and exposure. Metasedimentary bedrock in New England is a known source of arsenic in soils and well water; surface soils in agricultural areas also may have been contaminated due to the extensive use of arsenical pesticides during the first half of the twentieth century. We investigated the near-surface soils in old apple orchards and two previously farmed properties in the Mount Desert Island region to determine concentrations of arsenic and other metals. Small family orchards revealed arsenic levels similar to the Maine average suggesting there are no residuals of arsenical

pesticides present. One larger orchard revealed elevated levels of arsenic in the soil, however the drilled well on the property yielded very low levels of arsenic. This suggests to us that the arsenic in the soil at this site may have come from pesticide use in the past rather than by weathering products of the local bedrock. Wells located in Trenton ME, a region where pesticide use was likely, revealed soil arsenic levels above background and elevated arsenic in drilled wells and low to trace amounts in dug wells. The source of the arsenic at these sites may be related to prior pesticide use, but it is also likely to be related to the underlying metasedimentary bedrock. As part of the larger NIH SEPA “All About Arsenic” project, which engages teachers and students as citizen scientists in well water monitoring, this pilot study developed methods for soil sampling and processing to be used by middle and high school students in a related citizen science project called “Orchards, Gardens, and Fields”.

Adam Feher (College of the Atlantic)
Arsenic Abundance in Arugula and Kale of Coastal Maine Farms

Adam T. Feher, College of the Atlantic
Sarah R. Hall, College of the Atlantic
Jane E. Disney, MDI Biological Laboratory

Arsenic, an element with a litany of negative health effects caused by chronic exposure, is widely abundant throughout New England. Known sources of arsenic in this region include arsenical pesticide application throughout the 20th century and naturally occurring arsenic leached from the metasedimentary rocks of the region. Exposure is most common through the consumption of private well water, however some studies show elevated arsenic levels in Brassica family plants when grown in former orchards where pesticides were applied. Further, arsenic concentrations in water from dug wells at a local farm has been shown to increase during the growing season due to irrigation by arsenic-rich water sourced from the local drilled

deep well. Thus, produce may be exposed to arsenic sourced from the soil or rock in the near surface or through irrigation waters. To understand if consumption of local arugula (*Eruca vesicaria*) and kale (*Brassica oleracea*) contribute to chronic arsenic exposure, 11 samples (8 kale, 3 arugula) from 10 farms located near regions where metasedimentary bedrock is present and arsenical pesticides were likely to have been used in the past were collected for trace metal analysis. The arugula samples yielded arsenic concentrations of 0.05-1.26 mg kg⁻¹ and kale yielded 0.02-0.17 mg kg⁻¹. When considering a serving of 1 US cup of arugula (20g) and kale (67g), the arsenic that would be consumed by ingesting this produce range from 0.09-2.27 µg and 0.17-1.95 µg, respectively. For adult individuals, normal consumption of arugula and kale fall well below the benchmark dose for a 0.5% increased incidence of lung cancer of 3.0 µg kg⁻¹ (of bodyweight) day⁻¹ based upon epidemiological studies. As these samples were obtained by shopping at local farmers markets and grocers, the next steps of this project will include testing these or other crops as well as the soil and well water arsenic concentrations of the agricultural areas from which these crops were harvested.

research associate at U. Maine and a professor at Georgian College in Ontario. He was a “hard rock” geologist whose research focused on the petrology and geochemistry of Maine’s igneous bedrock. He produced a steady stream of publications in this area, including a lead-authored field guide in 2017. In 2006, Dave organized the 98th New England Intercollegiate Geological Conference, which was enjoyed by hundreds of students and faculty from the region.

Yet Dave was particularly focused on involving UMF students in scholarship, as his philosophy of undergraduate education involved integrating research at all levels to effectively generate interest in geology. He strongly believed in teaching by having students apply for internal and external grants, getting them into the field to study Maine’s bedrock, and preparing them to make professional-quality presentations at the UMF Symposium and at regional conferences. He also supported students by advising the UMF Geology Club and by serving as a longtime member (and eventual chair) of the Undergraduate Research Council. His efforts helped many UMF students go on to graduate school, to careers in geology, or both.

In the classroom, Dave was a popular and respected instructor whose students saw him as clear, knowledgeable, enthusiastic, humorous, and supportive. Whether he was teaching general education courses or intermediate and advanced courses for geology majors, regular courses, or field courses to destinations such as Ireland and Scotland, he succeeded in both educating and inspiring. Above all, Dave loved being in the field with students, an approach that was absolutely central to his way of teaching geology. There was nothing he enjoyed more than being on an outcrop, getting students to look closely at the rocks, and talking about the geology in person. A recent student summed it up well: “Dr. Gibson: teaching and personality itself.”

Dave’s accomplishments did not go unnoticed by his peers. He was named UMF’s Trustee Professor for 2009-2010 and spent that year enhancing the capabilities of our X-Ray Fluorescence (XRF) lab, a facility he directed since its creation in 2004. But he might well have been proudest of two awards related to his mentoring of students. Here on campus he received the Walter Sargent Undergraduate Research

OBITUARY

David Gibson
December 28, 2021

Dear friends and colleagues,

We regret to inform you that Dr. David Gibson, Professor of Geology, passed away on December 28, 2021. During his UMF career of more than twenty-five years Dave was passionately devoted to sharing geology with our students, and despite his several-year battle with cancer he had hoped until the end to work with a new group of students this coming spring.

Dave earned his degrees at Queen’s University Belfast, then came to UMF in 1996 after stints as a

Mentor award in 2018. Then, a year later, Dave received national recognition when he was given the prestigious Undergraduate Research Mentor Award by the Geosciences Division of the Council on Undergraduate Research.

We mourn the untimely loss of our dedicated colleague, and we extend our deep sympathy to his wife Hilary and to his daughters Emma and Hannah. The following arrangements have been made: Visiting hours at 6-8 pm Tuesday, Jan. 4, at Wiles Remembrance Center, 137 Farmington Falls Rd, Farmington; Funeral at 3 pm Wednesday, Jan. 5, at Trinity United Methodist Church, 612 Farmington Falls Rd, Farmington.

Chris Magri, Julia Daly, Jean Doty, & Doug Reusch

Online obituary:

<https://www.wilescremationcare.com/memorials/david-gibson/4813678/>

SECRETARY'S REPORT

Editor's Note: due to the delay in issuing newsletters, 3 secretary's reports are included here: September 2022, February 2022, and November 2021.

September 2022

The Executive Council (EC) met by Zoom in April 2022 to discuss to discuss plans education funding requests, spring meeting planning, and ways to increase student engagement with GSM. The EC met by Zoom in August 2022 to the successful July 2022 field trip, plans for the fall meeting, and possibilities for a fall field trip.

Spring GSM Business Meeting Minutes, Friday, April 15, 2022

1. GSM Sarah Hall welcomed all and called the meeting to order.
2. Treasurer's report – Treasurer Bruce Hunter provided an update on account balances: GSM has \$6,532 in the general fund. After funding

approved grants we will have about \$38K in the GSM Fund for Education and Professional Advancement at Bath Savings Trust, and \$12,618 in the McCartney Fund.

3. The EC formed a subcommittee to begin work on a Justice, Equity, Diversity and Inclusion (JEDI) statement for GSM. Cassaundra Rose provided an update from the subcommittee:
 - a. GSM does not currently have a code of conduct or code of ethics. A code of conduct is often the basis of a JEDI statement and it makes sense for us to start there.
 - b. The code of conduct and JEDI statement will provide guiding principles for our gatherings and interactions as a society.
 - c. Cassy offered a welcome for all GSM members to provide resources or considerations for this work, and/or to become involved in the work for development if they should like to. Please email suggestions to WebAdmin@gsmmaine.org
4. Student Involvement in GSM – Sarah provided an introduction and Keith Taylor gave some perspective on ways that we have been trying to keep the organization relevant, open, and dynamic. We often think about how we could be more relevant to students, but we don't have students involved in the work of the organization whom we can ask.
 - a. The EC has discussed creation of a paid student internship that would be competitive and involve interaction with the EC. This would not be a token position, and would provide students with professional interaction and also provide GSM/EC with a student perspective on experience and needs. Ideas from GSM members are welcome and can be sent via email to Sarah and Keith.
 - b. Sarah presented the possibility for a student field trip for the fall of 2022. Our summer field trip does not reach college/university students while they are on campuses. We look forward to exploring this for the fall.
5. 2022 summer field trip planning – Myles Felch is coordinating the July 2022 field trip. The trip will be to the mid-coast Rockland area. Surficial and bedrock geology sites will include Rockland

landslide, Dragon Products quarry, lime kilns in Rockport.

6. Ideas for informal summer interaction: Picnic or potluck, informal gathering as a way to meet casually in this season where we have only seen each other virtually for a long time. Suggestions and ideas are welcome.
7. ME Climate Council update – Cassaundra Rose, ME Climate Council Coordinator, gave an update on work of the ME Climate Council. There is a lot of investment and hard work going on to advance the Governor’s Climate Action Plan. Bills are working their way through the legislative session, and a report will be delivered shortly that provides updates on recent advancements, including bills that have been signed into law (codifying our carbon neutrality target and incorporating recommendations into law in ME statutes), and MEDOT’s open RFP for a hydrodynamic coastal flood risk that will help us understand sea level rise and flooding risk project for the next 80 years.
8. Announcement: Lindsay Spigel announced that the ME Geological Survey will have three student internship opportunities this summer: A mapping internship for surficial and bedrock mapping (with paid housing) and two GIS internships. Please keep in mind and circulate the opportunities; the ad is available on-line at <http://www.maine.gov/dacf/mgs/>
9. State Geologist Steve Dickson provided an update address from his time so far as the 15th State Geologist. His term began in November 2021, and Bob Marvinney, former State Geologist for 25 years, has been tremendously helpful in the transition. Steve reported on updates about the ME Geological Survey and interactions with Maine geologists: Developments in digital mapping, increasing access to historical aerial photos, snow survey mapping, a water use grant from USGS, surficial and bedrock mapping projects, and thoughts on metallic minerals mining in an increasingly green world. The zoom recording is available on the GSM member website – we recommend checking it out to hear Steve’s update on the exciting work going on at the Survey and around the state.

The meeting was adjourned and was followed by a keynote address from Dr. Shreya Arora, and student poster presentations.

February 2022

The EC met by Zoom in August 2021 to discuss plans for a celebration of Bob Marvinney’s career and retirement, the 2021 fall meeting, and fundraising for and distributions from the Walter Anderson Fund.

The EC met by zoom in November 2021 to discuss plans for the fall meeting, preliminary thoughts on the 2022 summer field trips, and to discuss expansion of scope for GSM education funding, and possibilities for a diversity, equity, and inclusion statement and policies for GSM.

The EC met by zoom in February 2022 to discuss eligibility and application information for GSM Fund for Education and Professional Advancement, DEI statement and code of conduct, and planning for the 2022 spring meeting and summer field trip.

Fall 2021 Annual Business Meeting Minutes, Friday, December 3, 2021

1. GSM President Sarah Hall welcomed all and called the meeting to order.
2. Councilor Nomination and Election: The Nominations Committee reported that Keith Taylor is willing to serve a three-year Councilor Term, following the completion of the one-year term he took on last year. Keith was elected by membership vote. Thank you to Keith for his service to GSM.
3. Treasurer’s report
 - a. Dues of over \$4,000 were collected in the fiscal year (August 2020 to July 2021). This was the first year we collected dues through the website. Thanks to all for paying dues and for embracing on-line payments.
 - b. Individual donations were received to the Walter Anderson Fund and the Kevin McCartney Fund. GSM also transferred money into both accounts from dues income (refer to Treasurer’s report).
 - c. Bruce reported on other expenses, including student awards. A \$100 award was given to

each of the seven students who participated by presenting at the spring meeting.

- d. Refer to the Treasurer's report for additional details regarding income, expenses, and account balances.
4. Walter Anderson approached in the EC summer of 2021 with a proposal to change the name of the Walter Anderson Fund, and to widen the scope and reach of funding provided by GSM to support education, research, and professional development. Walter's suggestion was to include all the funds dedicated to research and education under a larger umbrella. The EC took action to create a new fund that will include the Walter Anderson Fund, the Kevin McCartney Fund, and any potential future funds established for the purpose of education or professional advancement, to be called the GSM Fund for Education and Professional Advancement. Updated information on the fund, eligibility, and application information will be added to the GSM website. The Treasurer will work with Bath Savings Institution on any formalities associated with the trust account.

The GSM business meeting concluded at 1:20pm and was followed by a message from State Geologist Steve Dickson. Steve reported on transitions in the ME Geological Survey, discussed projects underway and planned, and expressed thanks to the people that work at and with the survey and academic partners who address the needs of the people of the state of Maine. Keith Taylor followed Steve's address with a recap of the 2021 virtual field trip: Amber Whittaker and Bob Marvinney were the 2021 field trip heroes. They each did a great deal of exploring in the summer of 2021 and contributed beautiful photos from many sites.

November 2021

GSM held no formal business meeting since the latest Secretary's Report, provided in July 2021. There are no minutes to report at this time.

The EC met by Zoom in August 2021 to discuss plans for a celebration of Bob Marvinney's career

and retirement, the 2021 fall meeting, and fundraising for and distributions from the Walter Anderson Fund.

The next business meeting of GSM will be held virtually during our fall meeting, December 3, 2021.

Respectfully submitted,

Lisa Jacob, Secretary
ljj@smemaine.com
207-829-5016

TREASURER'S REPORT

Editor's Note: due to the delay in issuing newsletters, two treasurer's reports are included here: FY2021–2022 first, followed by FY2020–2021.

FY2021-2022

This was again another year with COVID-19 protocols so we only had Zoom meetings in the fall and spring. I want to thank members for keeping up with their dues in this difficult time. As a result of low cost Zoom meetings our general account has grown. We gave \$100 awards to each of the seven students who presented their research at the spring meeting. Finally after two summers without field trips we had an in-person summer field trip on the mid-coast of Maine. Thanks to your dues we were able to subsidize most of the expenses, making the trip affordable to our members. We are currently working on an in person fall meeting at the Augusta Civic Center. If this goes well we will hold the spring student meeting in person, bringing our activities back to normal. That will bring our expenses back to normal.

During the pandemic we were able to add funds to our endowment accounts, the Walter Anderson Fund and the Kevin McCartney fund to support field trips, student research and other geologic education projects. This year we gave larger than usual grants to Prof. Julia Daly at the University of Maine Farmington to help fund a field trip and to Prof. Shreya Arora at Bates for student research.

Thank you for your donations to our funds. Our long-term goal is to make them endowment funds where they will be large enough to fund grant requests without depleting the funds. Please take note that Walter Anderson asked us to change the name of his fund to the GSM Fund for Education and Professional Development.

Annual Asset Summary July 31,2022

Account	Sub-Account	July 31, 2022
General Fund	Maine State Credit Union	
	Business Savings	\$26.84
	Checking	\$8,734.16
	Sub-Total	\$8,761.00
Anderson Fund		
	Bath Savings Trust	
	Managed Account	\$36,512.56
	Sub-Total	\$36,512.56
Kevin McCartney Fund	Maine State Credit Union	
	Business Savings	\$0.06
	12month CD 0.896%	\$14,166.10
	Sub-Total	\$14,166.16
All Funds	Total Assets	\$59,439.72

Fiscal Year August 1, 2021 to July 31, 2022	
	Actual
Income	
Dues Paid	\$5280.00
Donations received by the Anderson Fund	\$465.00
Donations received by the Kevin McCartney Fund	\$2,010.00
Registrations for Summer Field Trip	\$190.00
Subtotal	\$7,945.00
Expenses	
<i>Meeting Expenses</i>	
Spring Meeting Student Awards	\$700.00
Summer Field Trip	\$1,424.51
<i>Awards for a Field Trip and Research</i>	
Field Trip – UMaine Farmington – Julia Daly	\$1,223.46
Research – Bates College- Shreya Arora	\$1,376.00
<i>GSM Website</i>	
Annual hosting plan cost	\$280.40
Online payment processing costs	\$454.99
Subtotal	\$5,459.36
Net Increase	\$2,365.64

FY2020-2021

Fiscal Year August 1, 2020 to July 31, 2021

	Actual
Income	
Dues Paid	\$4,229.00
Donations received by the Anderson Fund	\$4,155.00
Donations received by the Kevin McCartney Fund	\$1,765.00
Subtotal	\$10,149.00
Expenses	
GSM Donation given to the Walter Anderson Fund	\$2,500.00
GSM Donation given to the Kevin McCartney Fund	\$1,500.00
<i>Meeting Expenses</i>	
Spring Meeting Student Awards	\$700.00
Bob Marvinney Retirement	\$150.00
Gathering	
Corporate Report Fees for 2020 & 2021	\$70.00
<i>GSM Website</i>	
Programming update	\$160.00
Annual hosting plan cost	\$280.40
Online payment processing costs	\$431.10
Stamps – 2 books	\$22.00
Check order	\$17.29
Subtotal	\$5,830.79
Net Increase	\$4,318.21

Annual Asset Summary July 31, 2021

Account	Sub-Account	July 31, 2021
General Fund	Maine State Credit Union	
	Business Savings	\$26.84
	Checking	\$5,426.85
	Sub-Total	\$5,453.69
Anderson Fund		
	Bath Savings Trust	
	Managed Account	\$41,904.07
	Sub-Total	\$41,904.07
Kevin McCartney Fund	Maine State Credit Union	
	Business Savings	\$1,770.24
	12month CD 0.450%	\$10,848.70
	Sub-Total	\$12,618.94
All Funds	Total Assets	\$59,976.70

Respectfully submitted,
Bruce E. Hunter, GSM Treasurer

UPCOMING EVENTS

<u>Date</u>	<u>Event</u>	<u>Location</u>	<u>Organizer</u>
September 30–October 2	New England Intercollegiate Geological Conference	Central Massachusetts	Five College Geology Consortium & Westfield State University. In Dedication to Professor Sheila Seaman
October 15 (extension)	Anderson Fund grant proposal deadline		GSM
October 9–12	Annual Meeting of the Geological Society of America	Denver, Colorado, and virtual	Geological Society of America
October 9–15	Earth Science Week	Check the AGI website for events	American Geosciences Institute www.earthsciweek.org
October 23–25	47 th Annual Exploration, Mining and Petroleum Conference	Fredericton, New Brunswick, Canada	New Brunswick Department of Natural Resources and Energy Development
November 10	2022 GSM Fall Meeting	Augusta Civic Center	GSM
December 12–16	2022 American Geophysical Union Fall Meeting	Chicago, Illinois, and virtual	www.agu.org

Please submit events to include on the calendar to the Newsletter Editor: amber.h.whittaker@maine.gov

MEMBERSHIP DUES STATEMENT

The **GEOLOGICAL SOCIETY OF MAINE, INC.** (often referred to as **GSM**) is a non-profit corporation established as an educational Society to advance the professional improvement of its members; to inform its members and others of current and planned geological programs in Maine; to encourage continuing social contact and dialog among geologists working in Maine; and to further public awareness and understanding of the geology of the State of Maine; and of the modern geological processes which affect the Maine landscape and the human environment.

The Society holds three meetings each year, in the late fall (Annual Meeting), early spring, and mid-summer (usually a field trip). A newsletter, *The Maine Geologist*, is published for all members three times a year. The Society year runs from Aug. 1 to Jul. 31. Annual dues and gift or fund contributions to the Society are tax deductible. There are four classes of membership:

2022 FEE SCHEDULE

\$ 30.00 REGULAR MEMBER	Graduate geologists, or equivalent, with one year of practice in geology, or with an advanced degree.
\$ 30.00 INSTITUTIONAL MEMBER	Libraries, societies, agencies, businesses with interests in or practicing geology and related disciplines.
\$ 15.00 ASSOCIATE MEMBER	Any person or organization desirous of association with the Society.
\$ 5.00 STUDENT MEMBER	Persons currently enrolled as college or university students.

THE GEOLOGICAL SOCIETY OF MAINE ANNUAL RENEWAL / APPLICATION FOR MEMBERSHIP

Regular Member	\$ 30.00	\$ _____	Name _____	Make checks payable to: Geological Society of Maine Bruce Hunter, GSM Treasurer 44 Old Fairgrounds Rd Readfield, ME 04355
Institutional Members	\$ 30.00	\$ _____	_____	
Associate Member	\$ 15.00	\$ _____	Address _____	
Student Member	\$ 5.00	\$ _____	_____	
Contributions to GSM (please write gift or fund on check)		\$ _____	_____	
TOTAL ENCLOSED		\$ _____	_____	

Email Address _____

(GSM funds include the Walter Anderson Fund _____, and discretionary gifts as noted by contributor)

THE MAINE GEOLOGIST is the Newsletter of the Geological Society of Maine, published three times a year, in mid-winter, summer, and early fall, for members and associates.

Items for inclusion in the **Newsletter** may be directed to:

Amber Whittaker, Newsletter Editor
amber.h.whittaker@maine.gov
207-287-2803

2022/2023 SOCIETY YEAR BEGAN August 1
PLEASE SEND DUES TO TREASURER.
(or pay online at our website: gsmmaine.org)

THE GEOLOGICAL SOCIETY OF MAINE
c/o Bruce Hunter, GSM Treasurer
44 Old Fairgrounds Rd
Readfield, ME 04355

PLEASE PAY YOUR DUES!

THE GEOLOGICAL SOCIETY OF MAINE EXECUTIVE COUNCIL

President	Sarah Hall	(2022)	College of the Atlantic, shall@coa.edu
Vice President	Myles Felch	(2022)	Maine Mineral and Gem Museum, mfelch@mainemineralmuseum.org
Secretary	Lisa Jacob	(2022)	Sevee & Maher Engineers Inc., ljj@smemaine.com
Treasurer	Bruce Hunter	(2022)	Maine DEP (retired), bruce.e.hunter@gmail.com
Newsletter Editor	Amber Whittaker	(2022)	Maine Geological Survey, amber.h.whittaker@maine.gov
Website Admin	Cassandra Rose	(2022)	Governor's Office of Policy Innovation and the Future
Councilors	Keith Taylor	(2024)	Wood PLC, pccetcedce@gmail.com
	Troy Smith	(2022)	Maine DEP, Troy.T.Smith@maine.gov
	Geneviève Robert	(2023)	Bates College, grobert@bates.edu
Historian	Bob Johnston	(2022)	Maine Geological Survey (retired), rajohnston73@gmail.com