The Maine Geologist

NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MAINE

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PRESIDENT'S MESSAGE

You may have heard the report in January that 6-year-old Brooke Neitzel, by herself, ordered a dollhouse and some sugar cookies by asking "Alexa", a voice-activated internet device. (If you missed the story you can ask "Siri" to find it!) The innocent request of a child was immediately granted. It was an honest request with good intentions, and by all accounts when the items were delivered, Brooke was pleased. Life is good in the Information Age.

If we think of geologic information as a commodity like sugar cookies, some striking parallels emerge. Science is not immune from honest requests by people with good intentions that are pleased when information is delivered. But people don't always know where information comes from or how it was formulated. As geologists we have an important role in keeping track of how we know what we know, and in backing up conclusions with a trail of data, assumptions, and logic. What do I know, and how do I know it? It might be third-hand, learned from teachers or textbooks who synthesize the work of others. It might be second-hand, by being trained individually by mentors who teach us what they know. Or it might come from our own experience in collecting and analyzing information directly from the earth. Of the different ways we know what we know, our own first-hand experience is generally the most compelling. When you want information, would you rather ask someone who has read the encyclopedia, or someone who wrote it?

The GSM summer field trip is an annual opportunity to increase your first-hand knowledge of Maine geology. By visiting field localities you can get to know these places yourself. We are so fortunate this year to have Arthur Hussey's knowledge preserved in his 2015 book to guide us. Also, other geologists will lead us through places where they have worked. Next summer, in contrast to this year's tourist-enveloped adventure, the summer field trip will be a wilderness trek to the northeastern part of the Munsungun anticlinorium west of Ashland, being organized by Chunzeng Wang of UMaine Presque Isle.

Beyond attending GSM field trips, how can we as individuals spread what we know? One way is to take others in the field, especially geology teachers or non-geologists, to show them what you know and to interact. Another way is to keep good records, notes, and files, whether paper or digital, and find a way for them to be preserved. There is no central repository for geologic information, so we each need to be creative in finding a way that makes sense for what we have. Public digital databases are becoming established through DEP, MGS, and DOT. Special collections are maintained in most college and university libraries, the Maine State Library, and in local libraries, historical societies and museums across the state. Professor Hussey led by example in specifying where his geologic materials would be archived.

I have become aware of this issue as I have seen colleagues retire. Institutional memory is ephemeral unless we make a conscious effort to pass along what we know and how we know it. The information age is very efficient at sending sugar cookies from one place to another, but the fundamental value is in having the wisdom and experience to make the cookies in the first place.

Henry Berry, GSM President
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2017 SUMMER FIELD TRIP

In Arthur's Footsteps

Why did 400,000 people walk the Marginal Way footpath in Ogunquit last year? Because it's a wonderful place! And while most people go there to enjoy the beautiful scenery it is also "one of the most outstanding geological sites in the state of Maine," as proclaimed by the foremost authority on the subject, Arthur Hussey, in his 2015 book *A Guide to the Geology of Southwestern Maine*. His detailed mapping based on a plane table survey in 1954 displays twice-folded graded beds of the Kittery Formation intruded by several generations of Mesozoic basalt dikes and cut by faults. Arthur led many public evening walks here through the years because it's such a fine place to learn geologic principles. It's time the GSM went there, too.

Other things we will visit during the August 5-6 weekend include a gabbroic magma chamber at Cape Neddick, an array of coastal marine environments at the Wells Reserve at Laudholm, a large granite pluton in Biddeford, shoreline erosion and mitigation strategies at Camp Ellis, some previously unknown large landslides revealed by lidar imagery in Saco, pyroclastic volcanic rocks on the shore of Casco Bay, and an Ordovician stratigraphic section with two exposed formation contacts in the ledges at Spring Point, South Portland. These are all places that Arthur knew, and they tell stories that he loved to tell.

While the geology on the trip is guaranteed to be fascinating, the logistical aspects may be daunting. Anyone who wants to lead a field trip through Ogunquit on a weekend in the summer must be crazy! Or so I've been told (repeatedly). It will be an adventure in traffic survival and parking frustration. As long as we are prepared to be deeply embedded in the tourist experience and enjoy driving at walking speed, we will be OK. But we can't expect the same amount of individual flexibility and independence we have enjoyed in other years. The two most important logistical aspects of this year's trip are (1) you **must** register for the field trip by Friday, July 14. We need to know how many people to expect so we can finalize plans with local landowners; and (2) we will need to consolidate into as few vehicles as possible. Especially on Saturday, we won't be able to accommodate cars with just a few people in them, so coming and going during the day will not be possible except at designated consolidation points. If we have 25 cars like we did last year, it will be hopeless. Vans holding 7 to 12 passengers would be ideal.

I am grateful to the many people who have volunteered to help lead the trip, and who have first-hand knowledge of the localities, Wally Bothner, Dan Belknap, Pete Slovinsky, Steve Dickson, Lindsay Spigel, and Steve Pollock. Kelly Alden at the University of New England is working with us to provide accommodations and a Saturday evening cookout. Barbara Barrett, director of the Maine Mineral and Gem Museum, is providing us with copies of Arthur's book for the field trip at a discounted price. We will have T-shirts featuring our new GSM logo. Registration information including meeting times and cost options will be distributed by email and posted on the GSM web site. This will be an experience you won't want to miss!

Henry Berry, GSM President
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GSM LOGO CONTEST RESULTS

The results for GSM's first ever logo contest are in! We had one person enter the contest – Bill Noble. Bill is a certified geologist who has worked for the Maine Department of Environmental Protection for over 30 years. His work involves reviewing site locations of development projects for conformance with water supply, soils, groundwater, wastewater disposal, and blasting standards. He also runs a part-time business as a site evaluator, designing septic systems. Bill says about his entry: "I tried my hand at it because I enjoy dabbling with things like this. For example, I submitted a design for the Maine State quarter (the U.S. Mint's state quarters program). Recently, I completed a series of graphics for DEP's BMP Stormwater Manual, and Erosion & Sedimentation Manual."

Bill submitted two versions of a GSM logo. Attendees at the Spring Meeting on April 7 were asked to vote on their favorite, with the winning entry chosen with a 39 to 7 vote. T-shirts with the new logo will be available to order soon.

The winning entry of the first ever GSM logo contest!

THE EDITOR'S MESSAGE

The newsletter is distributed through e-mail in pdf format. Anyone with special needs please contact the Editor. Please send items of interest for the News from the Campuses and Member News columns, or other things you'd like to share.

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NEWS FROM THE STATE GEOLOGIST

Work of Arthur M. Hussey II and colleagues receives honors

As the Geological Society of Maine prepares for the summer field trip in southern Maine, it is fitting to celebrate the national recognition bestowed on the most authoritative work on the bedrock geology of this region. Together, MGS Bulletin 45 and accompanying MGS Geologic Map 16-6 have been selected to receive the Association of American State Geologist's Charles J. Mankin Memorial Award for 2017! The Award is given each year to a nominated geological map, compilation, or report on regional, energy, or mineral resource geology published by a state geological survey. Bulletin 45\Geologic Map 16-6 was judged to be the best publication in a very competitive field of nominations spanning the nation. The work marks the culmination of decades of mapping by Arthur Hussey in Maine, and Wallace Bothner in New Hampshire, with significant contributions by Peter Thompson.

This award honors the memory of Charles Mankin (1932-2012), who as Director of the Oklahoma Geological Survey for forty years (1967-2007) was a tireless advocate for geologic mapping. Charlie played a key role in establishing STATEMAP, the program administered through the U.S. Geological Survey that provides crucial funding to the state geological surveys for geologic mapping. Much of the work captured in B 45 and GM 16-6 was funded through this program.

Bedrock of the Kittery quadrangle records over 500 million years of earth history, from sedimentation and magmatism in the Iapetus Ocean through continental collision, accretion, and assembly of the supercontinent Pangea, to continental rifting and the evolution of the modern Atlantic Ocean. Bulletin 45 and Geologic Map 16-6 mark a quantum step in understanding the local geologic history of this region, including a new timeline established with high-precision U-Pb geochronology that documents a very rapid sequence of deposition, deformation, metamorphism and intrusion in the Merrimack Group.

Furthermore, the bulletin and map are designed to appeal to a broad audience. Geologists will find data and technical details in appropriate sections of the bulletin. Consultants will appreciate the internally consistent, systematic nomenclature and photographs of representative rock types. Educators will find that conclusions are justified by logical arguments tied directly to the data, including clear statements of alternative interpretations and uncertainties. The interested non-geologist will enjoy the narrative summary sections in the bulletin and the map sidebar text, which is written to a non-technical audience and illustrated with photos.

Praise from the authors' colleagues:

"My Bates geology students love to explore the diverse geology in this part of the State and we have spent many days with the Kittery map and report in hand looking at the rocks. I have the students lead various sections of our fieldtrips through the Kittery Quadrangle. Both the map and the report are so well portrayed and written, that all is accessible to my undergraduate geology students, making these excursions very successful."

-- J. Dykstra Eusden, Professor, Bates College.

"I consider Bulletin 45 and MGS Map 16-6 to be among the most important contributions to understanding the evolution of the Northern Appalachians in Maine. Other works that belong in that category are broader in scope, dealing with state-wide features and processes, but this research focuses more narrowly and answers questions that broader scale publications can't. The research is world-class and the information invaluable for students of the Northern Appalachian orogeny."

-- Allan Ludman, Professor, Queens College.

"From the perspective of an educator in New England, I honestly cannot think of another geologic map and supporting materials with greater utility. …. The Kittery 1:100,000 map not only portrays the geologic relationship accurately, but it is visually stimulating and complemented by a colorized inset map, unit correlation chart, and a sidebar that provides numerous photographs with explanatory descriptions that are accessible to students of all levels. The accompanying bulletin takes this a step further by providing exceptional visual documentation of dozens of individual map units and geologic structures."

-- David P. West, Jr., Professor, Middlebury College.

I would be remiss not to mention the significant efforts contributed by staff at the Maine Geological Survey to make these publications truly exceptional. Chris Halsted maintained his positive outlook on life through innumerable map edits and expertly formatted the report into its highly readable format. Editor extraordinaire Henry Berry was primary liaison with the authors on both the map and report, ensuring that the geologic information and interpretations presented in each were literally on the same page!

We hope you will avail yourselves of the wealth of geological information captured in these publications by Art Hussey and colleagues. The report and map are available online:

http://digitalmaine.com/mgs_publications/132/
http://digitalmaine.com/mgs_maps/517/

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2017 NEIGC

Preliminary Announcement

Mark your calendars for the 2017 New England Intercollegiate Geological Conference or NEIGC! This year the dates are Friday, September 29, to Sunday, October 1, 2017, and the location is in Bethel, Maine. The "footprint" of the field trips will be the foothills and mountains of western Maine and the adjacent White Mountains of New Hampshire. Think of an area including Bethel, Farmington, Rumford, and Rangeley, Maine, and Gorham, Lancaster, and Berlin, New Hampshire. Your host this year is the Department of Geology, Bates College, with special help from the Maine Mineral and Gem Museum and Gould Academy.

Highlights:

Each day of the conference there will be 6 spectacular fieldtrips covering different aspects of bedrock and/or surficial geology. A total of 18 trips will be offered this year!

Friday night there will be a reception and tour of the Maine Mineral and Gem Museum. Learn about the history of pegmatite mining in Maine, see world class Maine minerals, and discover the otherworldly Stifler Collection of Meteorites. Led by the MMGM staff.

Saturday night is the banquet at Gould Academy's Ordway Hall featuring fine food at a reasonable cost and in a wonderful venue.

Formal trip descriptions and NEIGC registration materials are coming in late July. Plan now for

some great geology trips in Maine and New Hampshire. Visit the NEIGC web site for informal descriptions of the field trips.

http://w3.salemstate.edu/~lhanson/NEIGC/Conference.html

Preliminary list of trips by day:

FRIDAY TRIPS

A1: Lithium-boron-beryllium gem pegmatites, Oxford Co. Maine: Havey and Mount Mica pegmatites. *William B. Simmons, Alexander U. Falster, Myles Felch, Karen L. Webber and Dwight Bradley*

A2: Smalls Falls Revisited: a journey through a Silurian sedimentary basin. *Mark Van Baalen, Doug Reusch, and John Slack*

A3: Hydrogeology of the former Chlor-Alkali Facility Superfund Site, in Berlin and bed sediment mercury contamination in the Androscoggin River, NH. *James Degnan, Darryl Luce, and Andrew Hoffman*

A4: Possible Post-Laurentide Alpine Glaciation in the Great Gulf Cirque, Presidential Range, Pinkham Notch, NH. *Brian Fowler, Ian Dulin*

A5: Streams Under Pressure: Glaciers, Gorges, and Caves in Grafton Notch. *Alice Doughty*

A6: Stratigraphic and Structural Traverse of Mount Moriah and the Wild River Wilderness Area. *Tim Allen*

SATURDAY TRIPS

B1: Bedrock geology of the Bald Mountain-Saddleback Range, Maine: An arduous hike with great outcrops. *Douglas N. Reusch*

B2: Glacial deposits and late-glacial to postglacial alluvial fans in the northwestern White Mountains, New Hampshire. *Woody Thompson*

B3: Paleo-dunes and Other Post-Glacial Oddities in the woods and fields of New Sharon and Chesterville, ME. *Patricia Millette and students, Mt Blue High School*

B4: Bedrock Geology of Mt. Washington, Presidential Range. *Dykstra Eusden*

B5: Geology of the Lower Ellis River Valley and Rumford Whitecap Mountain, Andover and Rumford, Maine. *Lindsay Spigel, Amber Whittaker, and Ryan Gordon*

B6: Devonian granite melt transfer in western Maine: Relations between deformation, metamorphism, melting and pluton emplacement at the migmatite front. *Gary Solar, Paul Tomascak, Mike Brown*

SUNDAY TRIPS

C1: Testing the cosmogenic nuclide dipstick model for deglaciation of Mount Washington. *Thom Davis, Jeremy Shakun, Paul Bierman, Allie Jo Koester, Lee Corbett*

C2: Field relations, petrography and provenance of mafic dikes, western Maine. *David Gibson, Donald Osthoff*

C3: Transect from the Migmatized Central Maine Belt to the Bronson Hill Anticlinorium. *Dykstra Eusden, S. Baker, J. Cargill, E. Divan, I. Hillenbrand, A. Wheatcroft*

C4: The New Hampshire Spherulitic Rhyolites: Rocks of Importance to Prehistoric Native Americans. *Sarah Baker, Nathan Hamilton, Stephen Pollock, and Richard Boisvert*

C5: Return to the Sandy River: A decade of change and the impact of recent erosion management efforts. *Julia Daly and Tom Eastler*

C6: Migmatites in Pinkham Notch, New Hampshire. *Tim Allen*

Questions? Email Dyk Eusden.

Dyk Eusden
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NEWS FROM THE CAMPUSES

Bates College

As we all begin to dig in to our summer field and laboratory research we look back on a busy spring semester in the Bates Geology Department. We graduated twelve Geology majors this year, all of whom presented their senior thesis research at one or more professional conferences including Northeastern Section of GSA, International Arctic Workshop, and the Geological Society of Maine. On the last day of winter semester we hosted the

Geological Society of Maine Spring Meeting (see summary in this issue) and enjoyed excellent talks and posters presented by undergraduate students from across the state and a keynote presentation on pegmatites by Dr. Dwight Bradley. We're also looking forward to hosting NEIGC in Bethel this fall, described in detail in the article by Dyk Eusden in this newsletter. The department is pleased to welcome back Alice Doughty! Most recently Alice has been focusing on her postdoctoral research at Dartmouth College on glaciation in Uganda and she will join our staff as a visiting assistant professor for the coming academic year. She'll be teaching introductory courses and labs and will offer a new intensive short course next May. We're all looking forward to seeing you at NEIGC in the fall!

Mike Retelle

Bowdoin College

We are proud to announce that Erin Houlihan and Hannah Miller, two of our graduating seniors in EOS (Earth & Oceanographic Science), will be traveling to New Zealand and Switzerland as Fulbright Fellows to pursue research.

http://community.bowdoin.edu/news/2017/05/19-bowdoin-students-including-manygerman-majors-receive-fulbright-fellowships/

Erin Houlihan '17, researcher in New Zealand. "My project involves a latitudinal comparison of Antarctic and temperate larval sea urchins, available in New Zealand, to investigate the effects of ocean acidification on the swimming behavior of invertebrate larvae. Understanding the effects of changing ocean chemistry on a key organism is important for the future of marine ecosystems and aquaculture; this study would provide valuable information for predicting and responding to changes in the global oceans."

Hannah Miller '17, researcher in Switzerland. "My study looks at the impact of rapid glacial retreat and differences in regional temperature on alpine ecosystem succession. I will conduct fieldwork at two rapidly receding Swiss alpine glaciers at different altitudes analyzing sediments and vegetation succession. This research will inform future understandings and mitigation efforts in addressing climate change in alpine ecosystems."

Emily Peterman

Colby College

Prof. Robert (Bob) Nelson is retiring from teaching after 35 years of service. Bob will enjoy a final sabbatical leave next year before his official retirement from the College. We will all miss Bob, but we are excited to announce that Dr. Bess Koffman will join the Colby Geology Department next fall as an Assistant Professor. Bess earned her Ph.D. in 2013 under the supervision of Dr. Karl Kreutz at the University of Maine Orono. Subsequently, she completed a two-year postdoc at the Lamont-Doherty Earth Observatory of Columbia University, and she became a Dartmouth College Society of Fellows Postdoctoral Fellow and Lecturer in Earth Science in September, 2015. Bess specializes in reconstructing the record of atmospheric dust deposition from ice and marine-sediment cores. She will bring new expertise in paleoclimate reconstruction to Colby and will also play a key role in our new Environmental Sciences Initiative.

Bill Sullivan

College of the Atlantic

During the month of June, College of the Atlantic students, along with students from University of San Francisco and Mt. San Antonio College, will participate in an environmental geoscience field course set in the Sierra and Eastern Sierra Nevada of California lead by faculty from all three institutions. The course is designed to teach students standard field methods in geomorphology, hydrology, botany, and geology, and to give students a chance to practice professional interaction with environmental-STEM stakeholders in order to help them realize potential career paths. (https://www.coa.edu/live/news/909-national-science-foundation-awards-field-based)

COA Student, Spence Gray III, presented his work mapping and dating granites on two coastal

Maine islands (not previously dated) at the spring NE GSA meeting and GSM student meeting. He received funds from the GSA Stephen Pollock Undergraduate Research Program to enable him to continue to work on this project this summer. (https://www.coa.edu/live/news/1449-mapping-the-outer-islands-geology-project-digs)

During the 2017 Seminar on Climate Change at College of the Atlantic, 11 researchers from many different disciplines (anthropology, history, communications, sustainable energy, food systems, policy and social justice, archeology and geosciences) gave public talks on their work relating to the broad topic of climate change (http://www.coa.edu/shall/Geoscience/SCCSS_2017.html). The series was a huge success bringing together a wide range of people: students, faculty, community members, Acadia National Park personnel, and researchers yielding many new connections and potential collaborations!

Sarah Hall

Unity College

Unity College's Earth and Environmental Science program wrapped up another exciting year with a record number of new incoming majors (and geoscience minors) – and as a result we grew to more than 30 students! The year was packed with field trips in the intro courses, field labs in the advanced courses, installation of new field equipment, faculty research, conferences, additions to the wall of shame (forever cementing those minor "oops" that happen) and more! There was a flurry of activity in the Geo Lab with several students pursuing independent research projects on topics ranging from lake sediment charcoal records, freshwater microplastics, phosphorus loading in lakes, river discharge, forest fire fuels, biomass-fuel efficiency, salinity and turbidity levels in runoff, and soil fertility. In addition to these projects, students conducted two Classroom-based Undergraduate Research Experience (CURE) projects in the Surface and Groundwater Hydrology class working with community partners. In the first, students calculated sedimentation rates in an irrigation pond and developed a statistical model to be used for estimating water volume to help farm managers plan irrigation efforts. In the second project, students used fluorescent Rhodamine dye to determine if surface water was entering the local sewer system. Students compared sewer flow rates during peak and non-peak hours as well as pre- and post-rainfall to assess whether additional water was entering the sewer system. Our seniors moved on to graduate programs around the US and entered the workforce in environmental consulting firms and water quality labs. The summer will be packed with field reconnaissance for new field trip and research sites and a handful of students are continuing their research over the break.

Kevin Spigel

University of Maine at Farmington

This has been a busy winter and spring for the UMF Geology program. Right now, 15 students are on a three-week travel course in Ireland and Scotland with Drs. Gibson and Yates (UM). This follows a spring full of student research projects, including senior research projects presented by Sumaya Hamdi and Cody Smith at the spring GSM meeting. During the winter term, we offered a new short course on ground penetrating radar (GPR) field methods. All three faculty members are looking forward to leading trips at NEIGC this fall.

Julia Daly

University of Maine at Presque Isle

Chunzeng Wang, professor of Earth and Environmental Sciences at UMPI, is awarded a "Trustee Professorship" for school year 2017-2018. He will continue his bedrock geological mapping and research in the area around Round Mountain and Chandler Mountain in north Maine woods and Chemo Pond quadrangle of Eddington as well.

Chunzeng Wang

GSM SPRING MEETING
APRIL 7, 2017

Bates College, Lewiston, Maine

Keynote Speaker
Dwight Bradley, USGS
"Geochronology and tectonics of lithium-cesium-tantalum pegmatites of the Appalachians"

Student Poster and Oral Presentation Abstracts

POSTERS

(1) QUANTIFYING THE EFFECT OF FLUORINE ON THE VISCOSITY OF NEPHELINE-KALSILITE MELTS

BRUNO, Madeline S.[1], ROBERT, Geneviève[1] and SMITH, Rebecca[1,2], (1)Department of Geology, Bates College, Carnegie Science Hall, Lewiston, ME 04240, (2)Department of Geosciences, University of Massachusetts Amherst, Amherst, MA 01003, mbruno@bates.edu

We studied the effect of up to 2.15 wt.% fluorine on the viscosity and density of $(Na,K)AlSiO_4$ melts with Na:K ratios of 100:0 (Ne100), 75:25 (Ne75Kls25), 62.5:37.5 (Ne62.5Kls37.5), 50:50 (Ne50Kls50), 37.5:62.5 (Ne37.5Kls62.5), and 25:75 (Ne25Kls75). All reported volatile wt.% are nominal. These melts are analogs for natural alkali-rich magmas and have nominal volatile-free NBO/T values of 0. We measured viscosity by parallel-plate viscometry at temperatures between 680-945°C, representing a viscosity range of ~109-12 Pa s. We report T12, the temperature at which a melt has a viscosity of 1012 Pa s, to compare the effect of F on viscosity between the different melt compositions. The T12 value was obtained by fitting the viscosity data for each melt to a TVF equation. We measured density using the Archimedean method with ethanol as the immersion fluid. At constant temperature, the addition of fluorine reduces the viscosity of all melts studied. For nominal 2 wt.% F, the reduction in T12 is nonlinear but generally increases with decreasing Na:K ratios. The addition of 2 wt.% dissolved F results in a T12 reduction of ~55°C for Ne100, ~125°C for Ne75Kls25, ~140°C for Ne50Kls50, and ~88°C for Ne25Kls75.

At 2 wt.% F, the effect of Na:K ratio on T12 for fluorine-bearing melts mirrors what is observed for F-free melts, with the greatest reduction in T12 occurring at intermediate Na:K ratios and K-rich melts having a higher T12 than Na-rich melts. We tested additional actual F contents of up to 2.15 wt.% for the Ne50Kls50 melt only, and observed a greater reduction in T12 at greater F content. F reduces the density in all glasses studied relative to F-free glasses, but the effect is small, on the order of 2-3 kg/m3 for 2 wt.% nominal dissolved F. The effect of F on T12 reduction in $(Na,K)AlSiO_4$ melts is smaller than that observed for melts with higher SiO2 content in the same $(Na,K)AlSiO_4$-SiO_2 system, specifically along the jadeite-leucite and albite-orthoclase joins. Indeed, the addition of 2 wt.% F to Ne100 melts (SiO_2 ~48%) results in a reduction in T12 of only ~55°C, whereas it results in a reduction of ~130°C for both jadeite (SiO_2~67%) and albite (SiO_2 ~75%) melts.

(2) THE EFFECT OF FLUORINE ON MELT VISCOSITY IN JADEITE-LEUCITE MELTS

CARTY, Olin[1], ROBERT, Geneviève[1] and SMITH, Rebecca[1,2], (1)Department of Geology, Bates College, Carnegie Science Hall, Lewiston, ME 04240, (2)Department of Geosciences, University of Massachusetts Amherst, Amherst, MA 01003, ocarty@bates.edu

We synthesized glasses along the jadeite-leucite ($NaAlSi_2O_6$-$KAlSi_2O_6$) join with various amounts of dissolved fluorine (up to 4 wt.%). Na:K ratios synthesized include Jd100, Jd75Lct25, Jd62.5Lct37.5, Jd50Lct50, Jd37.5Lct62.5, Jd25Lct75, all of which have a nominal ratios of non-bridging oxygen to tetrahedrally-coordinated cations (NBO/T) of 0. For Jd50Lct50, we synthesized glasses with 0, 1, 2, 3, and 4 wt.% F. For all other Na:K ratios, we only synthesized glasses with 0 and 2 wt.% F. We measured the viscosity of each melt by parallel-plate viscometry at temperatures between 655°C and 980°C. We use the temperature at which the viscosity is 1012 Pa.s

(T12) to compare the effect of F on the different composition melts.

Although melt viscosity, and thus T12 temperature, increases with decreasing Na:K ratios, the change in T12 with the addition of fluorine is similar for each melt. The addition of fluorine decreases the density and T12 of each melt relative to its F-free equivalent. However, as more F is added to a given composition, T12 decreases at a decreasing rate. With the addition of 0.5 wt.% F, T12 decreases by about 75°C. With the addition of another 1 wt.% F (1.5 wt.% F total), T12 only decreases by around 50°C.

We conclude that increasing Na:K ratio and wt.% F both decrease the viscosity of the melts in this. Our results are consistent with the observed effect of Na:K ratio in more silica rich melts, with albite melt having a viscosity nearly 3 orders of magnitude lower than orthoclase melt at ~925°C. Our results also show a similar effect of F on the viscosity of jadeite and albite melts, with a reduction in T12 for 2 wt.% F of ~130°C in both melts. Further, as Jd50Lct50 becomes more depolymerized with the addition of F, the F has a smaller effect on viscosity.

(3) CALCULATING THE VOLUME OF WATER AND SEDIMENT IN AN IRRIGATION POND AT JOHNNY'S SELECTED SEEDS

CARULLO, Sally, CATES, Cassandra, DUBOIS, Morgan, HARRIS-JONES, Brian, MACDONALD, Emily, NORBACK, Gunnar, SILVIA, Alyssa, and STEWART, Sean, Geoscience, Unity College 90 Quaker Hill Rd, Unity, ME 04988, kspigel@unity.edu

The primary irrigation pond at Johnny's Selected Seeds (JSS) in Albion, ME had an unknown volume of water remaining after the dry summer of 2016. JSS had no method in which to determine the remaining volume of water in the pond. The administration at JSS was concerned that the overall storage capacity of the pond had been diminished by lack of snowmelt from the previous winter and sludge accumulation over time. The primary concern was that the remaining supply of water could be insufficient to irrigate the surrounding fields. To address this environmental concern, JSS sought a partnership with Unity College's Surface and Groundwater Hydrology class. The class determined methods in which the volume of water and sediment accumulation were determined. Information such as the length of perimeter, area, and depths of water and sludge were measured. Perimeter was measured at the high- water level which was determined to be the top of the elevation drain, and at 0.5 meter increments below this point. Sludge and water depths were taken at random locations around the pond. The mean depth of sludge was calculated and used to determine the loss of water storage capacity due to sediment accumulation in the pond. A linear regression model and a series of water usage scenarios were created to determine pond volume based on water depth and evaluate potential depletion.

(4) METHANE EMISSIONS ABOVE AND BELOW A DITCH PLUG, SPRAGUE RIVER MARSH, PHIPPSBURG, ME

CHENOWETH, Kelsey M, JOHNSON, Beverly, Department of Geology, Bates College, 736 Bates College, Lewiston, ME, 04240, kchenowe@bates.edu

This study investigates methane emissions behind a ditch plug installation in the Sprague River Marsh, Phippsburg, Maine. Ditch plugs are common man-made tidal restrictions that inhibit tidal flow in marshes. Previous work has shown that higher methane emissions are associated with lower salinities. However, the effects of ditch plugs on methane emissions are previously unknown. Static gas chambers were used to collect air samples above and below the ditch plug which were analyzed for methane concentrations using a GC-FID. Methane flux data were low and variable. There was no significant difference in methane emissions above or below the ditch plug. We conclude that the presence of the ditch plug did not result in an increase of methane emissions on the marsh.

(5) SALINIC TO ACADIAN DEFORMATION WITHIN THE MIGMATITE ZONE OF THE CENTRAL MAINE BELT IN WESTERN MAINE

DIVAN, Erik J, WHEATCROFT, Audrey, and EUSDEN, Dykstra, Geology, Bates College, 44 Campus Ave, Lewiston, ME 04240, edivan@bates.edu

Detailed bedrock mapping and new geochronology in the southern part of the Gilead 7.5' Quadrangle in Western Maine has revealed three phases of Salinic through Neoacadian deformation. The geology of the study area is dominated by the migmatized Silurian Rangeley, Perry Mtn. (?), and Smalls Falls Formations of the Central Maine Belt (CMB), which are intruded by quartz diorites from the Piscataquis Volcanic Arc, two-mica granites, and pegmatite. All of the metasedimentary rocks are migmatites with stromatic structures, part of the Migmatite-Granite Complex (Solar and Tomascak, 2016). The geochronology (Wheatcroft et al., 2017) brackets the cycle of deposition, metamorphism, migmatization, and deformation to between 435 Ma. to 352 Ma.

D1 is represented by cryptic pre-metamorphic faults that offset and truncate the stratigraphic units. Pre-metamorphic faults are observed outside of the study area in a contiguous section to the north. These faults are likely Salinic in age and developed synchronous with deposition or circa 435 Ma..

D2 deformation is characterized by nappe-scale, isoclinal folding of unknown vergence where bedding, S0, is parallel to schistosity, S2. Only a few F2 folds are present in the study area and in these places bedding, S0, is antiparallel to S¬2 schistosity. Gray schists and quartzites above Bog Brook in the study area preserve this fabric relationship and suggest the presence of a macroscale F2 hinge zone. Extensive migmatization has obscured most D2 fabrics that are likely Early Acadian in age.

D3 deformation is characterized by numerous open, reclined, upright to overturned, macroscopic folds with limbs striking 245, 87 and 345, 62, a calculated inter-limb angle of 83°, and a hinge line trend and plunge of 55, 60. Mesoscopic D3 folds of the composite S0/S2 fabrics are common but of diverse fold orientations due to the migmatization. S3 axial planar cleavage is characterized by a zonal crenulation in the F3 mesoscale folds. Stratigraphic age assignment supported by lithologic correlation and new detrital zircon geochronology suggests the stratigraphy is inverted due to D2 isoclinal folding. As such the D3 folds are best characterized as antiformal and are likely of Late Acadian or Neoacadian in age (pre-352 Ma.).

[Honorable mention student poster]

(6) NEW GEOCHEMICAL AND GEOCHRONOLOGICAL DATA FROM TWO GRANITIC ISLANDS OF DOWNEAST MAINE: MOUNT DESERT ROCK AND GREAT DUCK ISLAND

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Great Duck Island (GDI) and Mount Desert Rock (MDR) are two remote islands off the southern coast of Mount Desert Island (MDI), Maine. Maine Geological Survey maps both islands as Devonian granite. Through the support of Maine Space Grant Consortium and under the guidance of Dr. Sarah R. Hall, I have created new preliminary surficial and bedrock maps and geochemical and geochronological data for the granites of each island. In addition, new geochemical and geochronological data for the granites of each island has now been obtained. MDR comprises a fine to medium-grained light gray, phaneritic A-type granite with less than ~5% mafic minerals. GDI comprises a fine-grained, bright pink, phaneritic A-type granite, also quite low in mafic minerals, a welded flow-banded rhyolite, and a zone of altered metasedimentary rocks. Preliminary 238U/206Pb zircon ages from both islands suggest significantly younger ages than the Silurian and Devonian granites of nearby MDI and Swans Island with GDI, yielding ages of 313.3 +/- 3.0 Ma (Carboniferous) and MDR, 296.5 +/- 2.9 Ma (Permian). Taken

together, these new preliminary geochronologic, geochemical and field and remote-based spatial data suggest we may need to refine the volcanic and tectonic history of this portion of the easternmost edge of North America.

(7) FROZEN VOLCANO: QUANTITATIVELY SOURCING ICE CORE TEPHRA

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Paleoclimate reconstructions from multiple ice cores rely on an accurately developed time scale. The best ice core dating method available is based on annual layer counting, which can be verified by radiometric dating and volcanic-based time markers. Volcanic time markers are identified in ice cores as sulfate peaks that coincide in time with known tropical volcanic eruptions. It is assumed that a large sulfate signal represents a section of the ice core that also contains volcanic particulates. A common method to verify the affiliation of large sulfate peaks in ice cores with specific volcanic sources is geochemical fingerprinting of volcanic particles (tephra) extracted from ice cores. However, recent studies have suggested that there is a disconnect between the expected sulfate aerosol source and the tephra geochemical fingerprint. In this study we focus on the development of new methodology to improve quantitative geochemical measurements of very fine (<10 um) volcanic particulates (called cryptotephra). We have demonstrated that these methodological advancements allow us to extract and examine very fine volcanic particulates using SEM / EDS and quantify composition using the NIST DTSA II software. We've tested our method on 3 samples from the SPICE ice core from Antarctica at the 83.55-83.75 depth interval and have been able to identify 19 tephra particles (3-15 microns in size) with a composition that points to a volcanic source outside of Antarctica. Currently, we are working on refining a possible volcanic source that is responsible for the sulfate peak and tephra layer at this interval.

[Acknowledgment: NSF grants PLR–1543361, 1142007, ALSO SPICE core research and logistical support team.]

[Winner best high school presentation]

(8) HIGH ELEVATION AEOLIAN DUNE ON CHESTERVILLE HILL, CHESTERVILLE MAINE

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Previous studies in this area have found aeolian sand dunes between 400 and 500 feet asl on Chesterville Hill in Chesterville, Maine (Millette et al., 2015, Millette, 2014, Millette et al., 2014, Millette et al., 2013, Rogers and Millette, 2013). This mound, also located on Chesterville Hill, is different from the others because it's lowest point is at approximately 500 feet above sea level, 100 feet above the others, and it continues upwards from there. The purpose of this investigation was to establish a hypothesis about the origin and identity of this mound. Data for profiles were collected using homemade transits and stadia rods. Sediment samples were taken using an Eijkelkamp Dutch corer and post hole diggers, and a standard grain size analysis was performed on the samples from

each borehole. The general mineral composition of the samples was ascertained using a dissecting microscope. The perimeter of the mound was mapped using a Garmin GPSMAP 64 unit.
Evidence shows that the mound is most likely a longitudinal dune, similar to others on Chesterville Hill. The dune was formed at the end of the most recent ice age. Melting ice caused sea level to rise and ocean water flooded the Sandy River Valley. Meltwater from the glaciers deposited sediments into the ocean water. When sea level dropped, the sediments were left behind, and, after they had dried out, they were blown up Chesterville Hill by prevailing winds from the northwest. The winds came down the Sandy River Valley from the northwest, and probably formed an eddy into the flat area to the west of Chesterville Hill, where it slightly changed direction, coming more from the west. The two directions formed the longitudinal shape of the dune.

(9) CREATING A DIGITAL ATLAS OF THE AEGEAN SEA REGION

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The Digital Atlas of the Aegean project began 22 years ago, under the supervision of Dr. Irwin Novak (of the former Geosciences Department) with the goal of creating an easily understood map portal through which the geology of the Aegean Sea region could be widely disseminated. Through the years several additions have been added by previous students: vectors for plate movement, the regional geology, and heat flow through the crust. The current project has been multipart: one, to compile metadata for the previously added features so the presented data is backed up with sources and explanations; two, add new map data to show the magnetism and gravity of the region. The importance of this project lies in the availability of scientific data to the public. With the creation of a comprehensive data portal, the idea is that any individual could access and then use the fully sourced information.

(10) ROAD SALT EFFECTS ON THE LEWISTON ME, HART BROOK WATERSHED

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The Hart Brook is a small class B urban stream located in Lewiston Maine. It is impaired with respect to dissolved oxygen and has high specific conductivity values during the summer months. Previous studies found the specific conductivity of the Hart Brook range between 160 µS/cm and 990 µS/cm (Maine DEP 2013). On February 2nd 2017, the Environmental Geochemistry Class at Bates College analyzed waters from 6 sites in the Hart Brook watershed for specific conductivity and concentration of several major ions (Cl-, Na+, Ca2+, Mg2+, K+). The concentrations of Cl- were determined using Mohr titration and the major cations were analyzed using an ICP-OES. In this most recent study, specific conductivity ranged between 409 µS/cm and 1150 µS/cm. In some locations, Cl- concentrations exceed the EPA recommended limit of 250 mg/L which implies that the watershed water quality is more impaired than previously found. Molar Na+:Cl- ratios in all 6 waters were close to 1 with an average (± 1 stdev) of 0.89 (± 0.05), indicating that road salt (NaCl) is likely a major source of Na+ and Cl- to the Hart Brook. A strong linear correlation exists between Cl- concentration and specific conductivity (r^2 = 0.91) indicating specific conductivity is a good proxy for Cl- (and by inference road salt) in this watershed. Hot spots of road salt application appear to be located in the industrial area upstream of Westminster Street, around I95 and in the Dill Brook watershed.

(11) QUANTITATIVE MODEL OF PHOSPHOROUS INPUTS INTO LAKE WINNECOOK

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Lake Winnecook has a history of algal blooms in the late summer months and has been classified as the fourth most impaired lake in Maine as a result (Department of Environmental Protection 2004). In order for algae to thrive three factors must be met: low inflow of water, influx of phosphorous, and warm water temperatures (Rabalias 2002). This project quantifies three major pathways of phosphorous into Lake Winnecook: 1) The sediment water interface (Lakes Environmental Association 2011), 2) runoff after a storm, and 3) tributaries (Mainstone and Parr 2002). Lake Winnecook is a shallow lake, and shallow lakes tend to release more phosphate from the sediment because of the high sediment surface to water ratio (Sondergaard et al. 2003). The project has resulted in a dynamic systems model that can be used to determine which areas of phosphorous input require the most attention as well as areas that require more monitoring.

[Honorable mention student poster]

(12) A MID-LATE HOLOCENE MULTI-PROXY PALEOENVIRONMENTAL RECONSTRUCTION OF NORTHERN FINNMARK USING A SEDIMENT CORE FROM THE ISLAND OF INGØY, NORWAY

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The Arctic is responding to the current warming to a greater degree than anywhere else on Earth. For accurate predictions to be made regarding the response of the Arctic to current and future fluctuations in climate, a compilation of high-resolution marine and terrestrial paleoenvironmetal records encompassing the entire region must be achieved. This study aims to shed light on the environmental conditions of northern Finnmark, developed using a multi-proxy analysis of a 65 cm sediment core recovered from an isolation basin on the island of Ingøy, Norway. Due to its unique location within the North Atlantic, the climate of Ingøy has been greatly influenced by a number of climate forcing mechanisms such as ocean current systems, solar variability, atmospheric circulation patterns, and more. Through a multi-proxy analysis the geochemical, physical, and biological conditions of the area spanning the mid-late Holocene were reconstructed. Downcore elemental profiles were obtained using an ITRAX XRF core scanner at 500µm resolution, while stable carbon and nitrogen isotope analysis, percent loss on ignition and grain size analysis was performed at 1 cm resolution. Magnetic susceptibility values as well as measurements of chlorophyll were obtained at half cm and 1 cm resolution respectively. An age-depth model was created using AMS radiocarbon dates obtained from four terrestrial macrofossils of woody vegetation discovered downcore. The identification of a cesium-137 peak produced as a result of radioactive fallout and a lead-210 profile were used to infer sedimentation rates within the catchment.
Through the use of a multi-proxy approach it was concluded that no evidence of marine influence was observed in the sediment record. The lack of a marine lacustrine boundary indicates the age-depth model created using four AMS ages produces an overestimation of the history preserved within the sediment by approximately 5000 cal yrs BP. This is supported by measurements of stable isotopes, C/N molar ratios and ITRAX XRF elemental profiles, as well as the known sea level history of the region. Biological proxy data indicate a slight increase in organic content upcore, which is periodically interrupted by minerogenic inputs including fine-grained sand eolian deposits and mica fragments.

(13) WALKING ON MURKY WATER: USING GPR TO LOOK AT SEDIMENTATION IN WALTON MILL POND

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In this study, a 100 MHz GPR unit was used to investigate sedimentation in Walton Mill Pond, a small pond impoundment in the Temple Stream located in West Farmington, ME. Specifically, we

were looking for sediments that could be mobilized following dam abatement. The bathymetry of Mill Pond consists of a 4.0-3.0 meter deep central channel and associated <1.0 meter deep offshoot ponds, which may represent former channels of the Temple Stream. We discovered distinct layering in the stream bed, including a top layer of potentially mobile sediment underlain by Presumpscot formation, which was collected from the stream bed via grab sampling during summer 2016. Data processing included differentiating between fluvial sediment and Presumpscot formation, which was done by investigating bedding structure in the two layers. Fluvial deposits appear more hummocky, whereas Presumpscot reflections appear horizontal and continuous. Velocities were assigned to each layer to better estimate overall thickness, and a number of filtering methods were used to enhance data quality. These findings have implications for wetlands surrounding the pond, which may require further investigation through sediment cores and other methods.

(14) LOCATING HISTORIC BURIALS WITH GROUND-PENETRATING RADAR

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This study surveyed the Farmington Center Meetinghouse Cemetery, a historical cemetery with burials dating between the late 18th to mid-19th century in Farmington, ME. A 500 MHz ground penetrating radar (GPR) unit was used in order to determine two things: whether headstones marked their respective burials, and whether there were any graves unmarked by headstones. The cemetery is located on sandy marine nearshore deposits; these were characterized by continuous, parallel, inclined or sub-horizontal reflections in the GPR data. Discrete hyperbolae at consistent depth are interpreted to represent burials. The analysis of the cemetery shows that the layering remains mostly undisturbed unless a burial site is present. Careful measurement of our survey line, location and distance to headstones helped determine that burials, and not nearby headstones, were responsible for the appearance of hyperbolae. GPS locations of headstones were compared to interpreted burial locations to determine whether gravestones were present or absent over their respective burial sites. In doing so, it was discovered that there are a few instances of gravestones absent from an interpreted burial site.

[Honorable mention student poster]

(15) LATE-SEASON HIGH-SEDIMENTATION EVENTS IN A SEDIMENT TRAP RECORD FROM LINNÉVATNET, SVALBARD, NORWAY

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Linnévatnet is a proglacial lake in the high Arctic, on the western coast of Spitsbergen, Svalbard, Norway. Svalbard's climate is warm for its high latitude, with temperatures increasing in recent years and expected to continue rising. Given the longer and more intense melt season brought about by a warming climate, overall sedimentation may increase, and a large portion of that increase may be due to late summer and fall "shoulder season" storms falling as rain more often than as snow. This study utilizes the annual sediment trap record for the 2015-'16 accumulation year in order to document the effects of such late-season events on sedimentation in Linnévatnet, where sediment cores have yielded important high-resolution paleoclimate records.

Sediment traps have been deployed in Linnévatnet since 2003, along with weather stations, time-lapse cameras, and an intervalometer, which records the timing of sediment deposition. Sediment traps are positioned to capture sediment in important zones of the lake, with special focus given to a transect from the primary inlet to the main basin. Studies of modern sedimentation patterns in the lake allow for better understanding and interpretation of sedimentary records of past climate.

Meteorological and intervalometer data indicate that a rainstorm on September 11-12, 2015 yielded nearly 70% of the year's total sediment. This

contradicts the classic model of annually varved lake sediments, in which a nival pulse of spring snowmelt carries most of the year's sediment. Downcore profiles of grain size and XRF profiles of Ca, Zr, Fe, and K content distinguish sediment associated with the September rainstorm from that associated with the nival pulse. Sediment from the September rainstorm likely traveled in an irregular plume, not reaching all parts of the lake. Signatures of the nival pulse, however, were seen in all sediment traps, with some minor variations in composition representing variations in source lithology. With 70% of the year's sediment associated with the September rainstorm, the characteristics unique to the fall storm had a significant influence on Linnévatnet's sedimentation for the year. If shoulder season rainstorms are becoming more prevalent, it could drastically alter the sedimentation patterns in lakes like Linnévatnet.

(16) PETROGRAPHIC AND GEOCHEMICAL ANALYSIS OF CORES FROM HANCOCK, MAINE: NEW DATA ON THE ELLSWORTH TERRANE

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The peri-Gondwanan Ellsworth terrane of midcoast Maine comprises a structurally complex assemblage of Middle Cambrian bimodal volcanic and related sedimentary rocks. Metamorphic grade ranges from lower greenschist to lower amphibolite. A recent model proposes a rift setting within Ganderia (St. Croix terrane to the northwest) that became the northern margin of the Rheic Ocean. In order to evaluate this hypothesis, the current study examines six shallow (up to 71 feet) cores (MW 1-6) collected in 2001 by Maine DEP from the Hancock landfill site in the poorly documented area east of Ellsworth. Representative lithologies based on visual inspection include: 1) massive greenstone, present as thin horizons in cores MW 1 and 4; 2) fine-grained chlorite-rich, quartz-veined schist, with feldspars up to 2 mm, and 3) (tentatively) felsic volcaniclastic rock that makes up the bulk of cores MW-4 and 5. The predominant structure of the schist is a moderately-dipping foliation. Tight folds are present as are minor faults. The felsic volcaniclastics, as with the schist, also display tight folds and similarly dipping foliation. Significantly, our observations indicate a lower greenschist grade of metamorphism in contrast to amphibolite as shown by McGregor (1964). Detailed microscopic examination plus whole-rock geochemistry will further aid in the identification and classification of these rocks, and enable comparison with the results of Schultz et al. (2008).

[Winner best student poster]

(17) TRACKING SOURCES OF PREHISTORIC CHERT ARTIFACTS FOUND AT THE SAWYER FARM IN ASHLAND OF MAINE BY PORTABLE XRF ANALYZER

WARD, Caleb, SWALLOW, Daniel, PUTNAM, David, and WANG, Chunzeng, Environmental Science & Sustainability Program, University of Maine at Presque Isle, 181 Main St., caleb.ward@maine.edu

The Norway Bluff-Munsungan Lake area in the North Maine Woods is archaeologically well known as a source of high-quality chert and cherty tuff. Recent bedrock geological mapping in the Round Mountain-Peaked Mountain area, which is 17 miles northeast of the Norway Bluff-Munsungan Lake, revealed widespread, multiple layers of cherty tuff within the newly-named Round Mountain Volcanic Sequence (Wang et al., 2017). Field investigation suggests that both areas were frequented by Paleo-Indians and possibly later native peoples for lithic tool materials. Elemental analysis by portable XRF analyzer on the cherty rocks collected from both areas demonstrates that the volcanogenic formations that contain chert and cherty tuff at both areas have distinct petrological and geochemical features, suggesting that geologically they are two distinct formations rather than members of the Munsungan Lake Formation (Wang et al., 2017). This distinction makes it possible to track the source of the lithic artifacts found in other places if assuming

they were sourced from North Maine Woods. In this study, in addition to a large amount of elemental data obtained from samples collected from both Norway Bluff-Munsungan Lake and Round Mountain-Peaked Mountain areas, we used portable XRF analyzer and analyzed 41 bifaces collected from the Sawyer Farm in Ashland. We attempted to source the bifaces to either Norway Bluff/Munsungan Lake area or the Round Mountain-Peaked Mountain area by comparing the elemental data. For example, we used discrimination diagrams of Rb-Sr, Rb-Ba, Zr-Cr, and Rb-Rb/Sr. The results show that most of the bifaces were likely derived from the Round Mountain-Peaked Mountain area with some probably from the Norway Bluff-Munsungan Lake area. However, as many chert/tuff artifacts from the Sawyer Farm exhibit river cobble cortex, the provenance may be largely due to distribution through glacial and/or fluvial transport rather than direct human quarrying activity.

(18) PALEOENVIRONMENTAL RECONSTRUCTION FROM THE SEDIMENT RECORD OF THE VARVED PROGLACIAL LINNÉVATNET, SVALBARD, NORWEGIAN HIGH ARCTIC

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Arctic environments are highly sensitive to local climate variability, which can be reconstructed using a number of proxies. Linnévatnet is a proglacial deep lake located on Western Spitsbergen, Svalbard in the Norwegian High Arctic. The distinctly seasonal arctic climate and deep-lake setting allow for the deposition of annually laminated sediments. Sediments are sourced from glacier-fed Linnéelva at the southern end of the lake, a currently-stagnant cirque glacier to the West, and overland flow from alluvial fans that occurs mainly during melt and rain events.
Two sediment cores, each measuring approximately 26 centimeters in length, were collected from the East Basin of Linnévatnet at coring sites C (more proximal) and D (more distal) in July, 2016. The cores were subsampled for grain size, bulk density, and for the production of thin sections. Magnetic susceptibility and ITRAX X-ray fluorescence were measured on the archive halves of the cores. Lead 210 and cesium 137 geochronology and varve measurements from previous studies were used to corroborate the varve chronology.
Laminations were correlated between the two cores. Some laminations include complex structures which can be interpreted as non-cyclical sedimentation events. Core C extends back to approximately 150 years before present while the record in Core D extends to approximately 250 years before present. An increase in varve thickness during the past century correlates to the warming following the cool Little Ice Age. Calcium peaks can be seen in several cores taken from Linnévatnet at proximal and distal locations. Detrital calcium is sourced from the limestones and dolomites present in the bedrock geology of the eastern side of the valley. Other relevant element geochemistry was used to identify sediment provenance and possible events leading to deposition.

ORAL PRESENTATIONS

(1) COMPOSITIONAL VARIATIONS AND MICROSTRUCTURES IN KYANITE ILLUMINATE THE EXHUMATION HISTORY OF METAPELITES

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Kyanite grains from the Goshen Dome formation in western Massachusetts retain several compositional and microstructural features that can be used to examine the exhumation history of these rocks. Within the same thin section, kyanite grains display multiple zoning patterns in cathodoluminescence (CL), including sector zoning and inwardly propagating reaction fronts that are interpreted as evidence of interface-coupled dissolution-reprecipitation in the presence of a fluid. Chemical data measured by electron probe microanalysis confirms that the variations in CL are driven by changes in trace element concentration across grains, with Fe, Mg, and P displaying the strongest

correlation and no apparent correlation with Cr or Ti. The preservation of fine-scaled compositional zoning indicates that Fe, Mg, and P might preserve insight about the conditions of metamorphism. For example, experimental work by Konzett (2016) found unexpectedly high P (0.17-0.20 wt% P_2O_5) and Mg contents (0.20-0.56 wt% MgO) in ultrahigh-pressure (UHP) kyanite, indicating that P may preferentially enter orthosilicate structures through the coupled substitution [4]Si4+ + [6]Al3+ = [4]P5+ + [6]Mg2+. Preliminary data suggests that the cores of kyanite yield substantially higher P concentrations and additional data are currently in progress to determine the highest P concentrations preserved within these kyanite grains to evaluate if some kyanite domains preserve a potentially UHP origin.

Optical petrography confirmed by electron backscattered diffraction (EBSD) analysis indicates the preservation of a variety of microstructures, including: kink bands, undulatory extinction, and twinning in kyanite. We use the CL and crystallographic data to construct a relative geochronology for the formation of post-growth zoning patterns and deformation in these grains.

(2) FIELD RELATIONSHIPS, PETROGRAPHY AND GEOCHEMISTRY OF THE EASTERN PART OF THE FLAGSTAFF LAKE COMPLEX, NORTHERN MAINE

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The Flagstaff Lake complex (FLC), located in northern Maine, is a composite intrusion, and is exposed from just east of Rangeley through Stratton continuing to eastern side of Flagstaff Lake. It covers an area of approximately 450 km2 and is composed of many different igneous rocks, including granite, gabbro and diabase. The relative ages of these rocks, their field relationships, and geochemistry is unclear. They may be related in time and space with generally contemporaneous pulses of magmas emplaced at the same crustal level, or the FLC may have been "assembled" by an amalgamation of separate intrusions over a longer time frame.

The western and central areas of the FLC are mapped as predominantly mafic rocks whereas in the eastern portion, the focus of this study, granite, diorite and diabase/gabbro are observed. Toward the outer eastern margin of the FLC all these rocks are observed juxtaposed in a complex mixing zone, which is uncommon for plutons of the central Maine belt. Field relations suggest they are contemporaneous and the amount of mixing between these two disparate magmas is questionable. Geochemical data for the eastern portion of the FLC along with new age dates will enable a critical assessment of the crystallization history and emplacement of this composite intrusion.

(3) NEWLY DISCOVERED ALBEE FORMATION IN NORTHERN NH: DETRITAL ZIRCONS, STRUCTURE, AND TECTONICS

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New mapping and detrital zircon geochronology in the northern part of the Jefferson 7.5' Quadrangle have revealed a previously unknown region of Cambrian Albee Formation. The region, near Lancaster, NH, contains two Appalachian lithotectonic units: 1) a section of the Bronson Hill Anticlinorium including the Ordovician Ammonoosuc and Cambrian Albee Formations and intrusive rocks of the Ordovician Oliverian Dome and Lost Nation Pluton; and 2) Jurassic igneous cone sheets of the Pliny Range Caldera Complex.

Detrital zircon U/Pb data were generated for four samples of thinly bedded to pin-striped quartzites. Two samples came from lower elevations near Tug Mtn. with one previously mapped as Albee and the other as Ammonoosuc (Lyons et al., 1997). The other two samples were roof pendants in a Jurassic

granite from the higher peaks of Terrace Mtn. previously mapped as Albee (Chapman, 1942).

Both lower elevation samples yielded youngest zircon ages of circa 500 Ma., supportingtheir designation as Albee and therefore expanding the mapped region of that unit. Population density plots show similarities to other Cambrian Ganderian units (e.g. Dead River, Ellsworth, and Moretown). By contrast, the roof pendants yielded youngest zircon ages of circa 400 Ma., suggesting a Devonian age and possible correlations to the 3rd Acadian DZ cycle, outboard-derived, Tarratine Formation (Bradley and O'Sullivan, 2016).

The Albee is likely in unconformable (Penobscottian?) contact with the Ammonoosuc and is significantly more deformed showing classic pin-striping and transposition. Newly discovered quartzite units in the Ammonoosuc are interlayered and gradational with the more typical mafic Ammonoosuc amphibolites. Both the Ammonoosuc and Albee units are complexly folded by NNE plunging reclined folds of Acadian (?) age and then deformed by the Oliverian Jefferson Dome

Lyons et al., (1997) show the Ammonoosuc Fault juxtaposing the Lost Nation and a sliver of Albee against the Ammonoosuc then continuing east through the Pliny Caldera Complex. Our mapping shows instead a chilled intrusive contact between the complex mafic intrusive rocks of the Lost Nation Pluton and the Albee that extends south to become folded with the Ammonoosuc. No Ammonoosuc fault was recognized there or in the Pliny Complex.

[Winner best student oral presentation]

(4) BEDROCK GEOLOGY, STRATIGRAPHY AND GEOCHRONOLOGY IN THE MIGMATITE TERRAIN OF THE SOUTHERN GILEAD 7.5' QUADRANGLE, WESTERN MAINE

WHEATCROFT, Audrey[1], DIVAN, Erik J.[1,2], EUSDEN Jr., J. Dykstra1,[3], and O'SULLIVAN, Paul B.[4], (1) Department of Geology, Bates College, Carnegie Science, 44 Campus Ave, Lewiston, ME 04240, awheatcr@bates.edu, (2) edivan@bates.edu, (3) deuseden@bates.edu, (4) GeoSep Services, 1521 Pine Cone Road, Moscow, ID 87872-9709, p.osullivan@geoseps.com

Updated bedrock geology mapping and geochronology work in the southern portion of the Gilead, Maine 7.5' Quadrangle provides relevant data in developing the stratigraphy, paleo-depositional setting and geological timeframe of the study area. The revised bedrock map consists of four units (proposed youngest to oldest): Pine Mountain Unit, Bog Brook Unit, Peaked Hill Unit and Chapman Hill Unit. The lithology of the units consists mostly of interbedded schists and quartzites with discontinuous layers of granofels and calc-silicate pods. The units alternate from gray to rusty in appearance. Detrital zircon geochronology of the Bog Brook granofels returned an age of 422 Ma placing the maximum age of deposition within the Late Silurian. Correlation to past work indicates the Bog Brook granofels is equivalent to the Rangeley Formation and supports the previously suggested revision of the traditional ages within the Rangeley Stratigraphy. Crystallization zircon ages of the two-mica granites returned ages of 349 and 355 Ma, Early Carboniferous. The two-mica granite ages constrains the deposition of the metasedimentary rocks, metamorphism and deformation from 422 to 349 Ma, a 73 Ma span. Rusty to gray lithologic contacts within the stratigraphy indicates the depositional basin went through a series of oxic to anoxic transitions while turbidity currents deposited sediments, aiding in understanding the paleo-depositional setting. Through detailed mapping and geochronology this study better constrains the exact stratigraphy, depositional setting and magmatic influences present in the Gilead, ME 7.5' Quadrangle to further understand both the local and regional geology.

(5) SHACKLETON'S ENDURANCE: A GLIMPSE OF ICE SHEET BEHAVIOR IN A WARMER WORLD

THOMAS, Holly, Earth and Climate Sciences, The University of Maine, 16-40 Grove St. Extension, Orono, ME 04473, holly.thomas@maine.edu, BROMLEY, Gordon R., Climate Change Institute, The University of Maine, 16-40 Grove St. Ext, Orono ME 04473, gordon.r.bromley1@maine.edu

The East Antarctic Ice Sheet (EAIS) contains approximately 60 meters of sea level rise equivalent. Establishing its response to our warming climate is integral in predicting the trajectory of sea level rise. This project exploits Antarctica's terrestrial record to resolve the configuration of the EAIS during previous periods of warmer climate. Specifically, it employs cosmogenic nuclide dating of relict glacial deposits within the Transantarctic Mountains (TAM). The TAM form a topographic barrier between the interior of the EAIS and the Ross Sea embayment, therefore, glacial deposits in these mountains are direct indicators of past ice sheet configuration. We employ He3 surface exposure dating of a moraine transect to provide the first high resolution geologic record of the EAIS configuration during the Pliocene. He3 dates from the transect place the oldest moraine at 3.07 m.y.a. during the mid-Pliocene, 300m above present day surface. Temperatures during this period were up to 8℃ warmer than present. The record demonstrates ice sheet stability in warmer periods and affords a likely analogue for greenhouse gas effects on modern ice sheets. Additionally, these data will be available as robust constraint for future ice sheet/climate models.

SECRETARY'S REPORT

Fall 2016 Business Meeting Minutes

GSM President Marty Yates opened the meeting, and acknowledged Bob Marvinney, State Geologist.

Update from State Geologist

Bob Marvinney has been pleased to fill positions over the years at the Maine Geological Survey with capable geologists. The most recent hire, Lindsay Spigel, followed Bob Johnston's retirement. In addition to land and marine mapping, the Survey is working on cataloging water use and agricultural use, and working with the Maine Department of Environmental Protection to improve the state's groundwater level monitoring network.

There is a new round of discussion on mining rules, which are now in the hands of the Board of Environmental Protection. The rules were put before the Board in August 2016 for a comment/revision period, and will be available for additional comment soon, before going back to the legislature.

Acknowledgements

Marty thanked today's speakers for their excellent presentations. He thanked the Executive Council for their service to GSM: Vice President Henry Berry, Treasurer Bruce Hunter, Secretary Lisa Jacob, Newsletter Editor Dan Belknap assisted by Amber Whittaker, and Directors Keith Taylor, Steve Kelley, and Chris Morrell. Marty recognized Keith Taylor to present nominations for officer and Director positions.

Nominations and Elections

Keith thanked Marty for his service as President of GSM. Nominees for officers and Directors are: Henry Berry, President; Sarah Hall, Vice President; Bruce Hunter, Treasurer; Lisa Jacob, Secretary; Dan Belknap, Newsletter Editor; Amber Whittaker, Assistant Newsletter Editor; Marty Yates, Director. Tom Eastler moved to nominate the slate of officers and Directors as presented. Cliff Lippitt seconded the motion, which passed.

President-Elect Henry Berry recognized the diversity of the organization and the various backgrounds, strengths, and interest among members. Henry offered thanks to Marty for his great leadership as President.

Announcements

Bruce Hunter asked for two volunteers to assist with logistics for the 2017 summer field trip.

Keith Taylor announced tentative plans for the 2017 spring meeting to be held at Unity College.

Dan Belknap announced that he will retire from the University of Maine at the end of the 2016-2017 academic year. He announced upcoming additions to UMO faculty: Alicia Cruz-Uribe, Aaron Putnam, and Katherine Allen.

Marty adjourned the meeting at 5:12pm.

Spring 2017 Meeting

The GSM Executive Council met on April 7, 2017, prior to the GSM Spring Meeting. Topics of discussion included educational funding requests and grant decisions, the GSM Spring Meeting, creation of the new Communications Committee, and planning for the GSM 2017 Fall Meeting.

The GSM Spring Meeting was held in the afternoon of April 7, 2017 at Bates College in Lewiston. The GSM business meeting was first on the agenda, and was followed by student poster presentations, a keynote address from Dwight Bradley (USGS), student oral presentations, awards for best presentations, and a social hour. Student presentations (abstracts presented in this newsletter) were judged by GSM members. Alice Kelley thanked fellow poster judges Fred Beck, Amber Whittaker, and Liz Champeon and oral presentation judges Bob Marvinney, Chris Morrell, and Sarah Hall. They had a very hard time deciding among the excellent presentations. Alice presented awards to:

- Audrey Wheatcroft of Bates College for the best oral presentation.
- Caleb Ward, Daniel Swallow, David Putnam, and Chunzeng Wang of University of Maine, Presque Isle for the best poster presentation.
- Honorable mentions for undergraduate poster presentations were given to:
  - Spencer Gray and Sarah Hall, College of the Atlantic; Dave Bailey, Hamilton College; and Melanie Michalak, Humboldt State University,
  - Claire Markonic and Michael Retelle, Bates College; and Alan Wanamaker and Siperg, Iowa State University, and
  - Noel Potter and Michael Retelle, Bates College.
- Award for high school participation to Mount Blue High School.

Spring 2017 Business Meeting Minutes

Acknowledgements

GSM President Henry Berry extended thanks to the Bates College Geology Department and the college's events staff for setting up and hosting this Spring Meeting. Henry acknowledged and thanked the student presenters for their participation, hard work, and preparation of excellent posters and talks; the Executive Council for their behind-the-scenes work; and judges of poster and oral presenters.

Education Funding

The Executive Council approved two education grants from the Anderson Fund. Damien LeFavor (University of Wichita, KS) will be awarded $500 to support his research on the structural geology and geochemistry of the Mixer Pond Gneiss, and the University of Maine – Farmington Geology Club will be awarded $750 to support their field trip to Ireland and Scotland.

Henry made an appeal for support to the Anderson Fund. GSM member dues go into the general expense fund to support operation of the society. Education grants come from the Anderson Fund, and all are asked to consider a donation to this worthwhile fund.

GSM Fall Meeting

The 2017 fall meeting date has been selected: Friday, 11/3/2017 [***Editor's note: the date has been changed to 11/17/2017***] at the Augusta Civic Center. Content is still under consideration, potentially LiDAR and geographic information systems.

Communications Committee

The Executive Council established the Communications Committee, which will consider policies and methods to organize and improve ways in which the society can communicate, including becoming more digital.

Executive Council Transitions

GSM Treasurer Bruce Hunter will be spending six months in California. Steve Kelley has agreed to serve as Acting Treasurer for the duration of Bruce's trip. Many thanks to Bruce for his outstanding work as Treasurer, and thanks to Steve for filling in at this important job!

Dan Belknap will retire as GSM Newsletter Editor. The February 2017 newsletter was his final edition. Many thanks to Dan for many years of

excellent newsletters and service to GSM. Amber Whittaker has been acting as assistant Newsletter Editor, and will take over from Dan.

New Business

Bob Marvinney announced two summer internships at the Maine Geological Survey, in coastal geology and GIS.

Steve Dickson provided an introduction to ME GIS mapping tools available through the Maine Geological Survey.

Announcements

Henry proposed in the February newsletter the "Rediscover Your Passion" campaign. All are encouraged to submit photos to the GSM Facebook page. The campaign will build community and share information about interesting geology.

Henry also proposed a logo contest in the February newsletter. The logo is intended to be used on a GSM t-shirt and/or other materials in 2017. Please review the two logo submittals at the registration table.

Walter Anderson announced that Arthur Hussey's things are preserved in several locations: Bowdoin College Archives (papers, maps), Maine Gem and Mineral Museum, and Maine Geological Survey.

Henry adjourned the business meeting at 1:53pm.

Respectfully submitted by,

Lisa Jacob, Secretary
ljj@smemaine.com

TREASURER'S REPORT

Steve Kelley will be interim treasurer while I take a leave of absence to California for six months to provide child care for my new granddaughter when my daughter-in-law returns to work after maternity leave. Send your annual dues for 2017-2018 to Steve after September 1, 2017. He will also be collecting fees for the 2017 summer field trip. I am thankful that Steve offered to help. In January, 2018, I will return to the Treasurer's position when I come back to Maine.

Steve's address is:

Steve Kelley
102 Staples Road
Limington, ME 04049

This is a good time to applaud all the members who have maintained their membership by paying dues to September 1, 2017, the end of membership year 2016-17. (The GSM fiscal year runs from August to August for those who may be confused.) We currently have 191 members who are paid up. Some members have paid for future years; one has paid far ahead to September, 2021.

Bruce Hunter, Treasurer on leave

UPCOMING EVENTS

Date	Event	Location	Organizer
August 5-6	2017 Summer Field Trip	Southwestern Maine	Henry Berry
November 17	2017 Fall Meeting	Augusta Civic Center	Executive Council
April 6	2018 Spring Meeting	Unity College	Kevin Spigel
TBA	2018 Summer Field Trip	Northern Maine, west of Ashland	Chunzeng Wang

GSM IMAGES

(Clockwise from top left) 2017 Spring Meeting Awards:

Winner of the best student oral presentation, Audrey Wheatcroft (*left*), with Henry Berry (*right*) at the 2017 Spring Meeting;

Mount Blue High School participants, Chelsea Seabold (*left*) and Phoebe Haslam (*middle*) with Henry Berry;

Caleb Ward (*left*) and Daniel Swallow (*right*), best student poster presentation winners.

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:

2017 FEE SCHEDULE

$ 20.00	REGULAR MEMBER	Graduate geologists, or equivalent, with one year of practice in geology, or with an advanced degree.
$ 20.00	INSTITUTIONAL MEMBER	Libraries, societies, agencies, businesses with interests in or practicing geology and related disciplines.
$ 10.00	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	$ 20.00	$_____	Name _____	**Make checks payable to:**
Institutional Members	$ 20.00	$_____		Geological Society of Maine
Associate Member	$ 10.00	$_____	Address _____	Steve Kelley, GSM Treasurer
Student Member	$ 5.00	$_____		102 Staples Rd
Contributions to GSM		$_____	_____	Limington, ME 04049
(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)

2016/2017 SOCIETY YEAR BEGAN August 1 - PLEASE SEND DUES TO TREASURER.

THE GEOLOGICAL SOCIETY OF MAINE
c/o Amber Whittaker, Newsletter Editor
Maine Geological Survey
93 State House Station
Augusta, ME 04333-0093
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PLEASE PAY YOUR DUES

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.

Correspondence about **membership** in the Society, **publications,** and **dues** should be mailed to:
Steve Kelley, skelley@haleyaldrich.com, GSM Treasurer, 102 Staples Rd, Limington, ME 04049
Items for inclusion in the **Newsletter** may be directed to:
Amber Whittaker, Maine Geological Survey, 93 State House Station
Augusta, ME 04333-0093, amber.h.whittaker@maine.gov

President	Henry Berry	(2018)	Maine Geological Survey, henry.n.berry@maine.edu
Vice President	Sarah Hall	(2018)	College of the Atlantic, shall@coa.edu
Secretary	Lisa Jacob	(2018)	Sevee & Maher Engineers Inc., ljj@smemaine.com
Treasurer	Steve Kelley	(2017)	Haley & Aldrich, skelley@haleyaldrich.com
Newsletter Editor	Amber Whittaker	(2018)	University of Maine, belknap@maine.edu
Directors	Keith Taylor	(2017)	St. Germain Collins, keitht@stgermaincollins.com
	Steve Kelley	(2018)	Haley & Aldrich, skelley@haleyaldrich.com
	Martin Yates	(2019)	University of Maine, yates@maine.edu