THE MAINE GEOLOGIST

NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MAINE

June, 2013
Volume 39
Number 2

THE PRESIDENT'S MESSAGE

It's finally summer after a typical one week of spring, and that makes us think about field trips, our summer trip in particular scheduled for August 3-4. Elsewhere on this newsletter are details about the trip, locations, and lodging. The location (southern Maine) and venues (the beach and a quarry) should make for a pretty easygoing weekend—no long hikes or steep climbs. Rather than drone on about this or that, I thought I would share some geological humor with you. You know you are a geologist when:

- You can pronounce the word "molybdenite" correctly on the first try.
- You think the primary function of road cuts is tourist attractions.
- Your spelling checker has a vocabulary that includes the words "polymorph" and "pseudomorph".
- You have taken a 22-passenger van over "roads" that were really intended only for cattle.
- You find yourself compelled to examine individual rocks in driveway gravel.
- Your photos include people only for scale and you have more pictures of your rock hammer and lens cap than of your family.

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For the latest information and field trip updates Check out the:

GSM WEBSITE: www.gsmmaine.org

GSM SUMMER FIELD TRIP 2013

The 2013 Geological Society of Maine summer field trip is planned for Friday, Saturday, and Sunday - August 2nd, 3rd, and 4th.

Saturday, August 3rd, morning
Morse Mountain, Phippsburg, Maine

Saturday, August 3rd, afternoon
Popham Beach State Park

Sunday, August 4th, morning
Pike Industries Quarry, Wells, Maine

Field trips on Saturday will focus on coastal processes in the Popham Beach area. We will switch gears on Sunday and look at some great bedrock exposures at an active quarry in the Wells area. Details are provided below.

DETAILS OF THE GSM SUMMER FIELD TRIP

Field Trips

Saturday, August 3rd, AM
Morse Mountain http://www.morseriver.com/
Bev Johnson, Bates College, will update us on recent research on the Sprague Marsh by her students.

Saturday, August 3rd, PM
Popham Beach State Park http://www.maine.gov/cgi-bin/online/doc/parksearch/search_name.pl?state_park=22&historic_site=&public_reserved_land=&shared_use_trails=&option=search
Steve Dickson, Maine Geological Survey will show us the recent, extreme changes to the beach geomorphology.

Sunday, August 4th, AM
Pike Industries Quarry, Wells, Maine
Arthur Hussey, Bowdoin College emeritus, will share his knowledge of great exposures of rocks common to southern Maine.

Lodging August 2nd and 3rd

Recompence Campground, Freeport, Maine

www.freeportcamping.com

Eight water-front sites have been reserved for GSM. A single site is $38.52/night (includes tax). However, 7 of the 8 sites can hold two tents (their rules are a maximum of 4 adults or one family of any size per site) so sharing a site is possible. Camp sites will be assigned on a first-come, first-serve basis by notifying Keith Taylor (keitht@stgermaincollins.com) and mailing a deposit of half your cost via a check made out to GSM Keith Taylor, St.Germain Collins, 846 Main Street, Westbrook, ME 04092). Please let us know if you want to share.

If our sites fill up or you prefer to camp at another location there, here is their website: http://www.freeportcamping.com/ Rates range from $26-$46/night and many can take popup or small campers.

Saturday Dinner
The traditional Saturday night cookout will be in the form of a lobster bake that the facility hosts every Saturday night for campers (and non-campers). It is a full bake with lobster, clams, corn, etc. and dessert. We will be subsidizing this event so it will cost GSM members, friends, and families only $10/person. They also offer a kids meal of burgers and hotdogs with a subsidized cost of $5/child.

Transportation
GSM will be providing shuttle service during the day on Saturday. Parking is limited at both locations so we encourage your use of the shuttle. As with camping, shuttle use is first-come, first-

THE STATE GEOLOGIST'S MESSAGE

METALLIC MINERAL MINING: PART II
ROBERT G. MARVINNEY, STATE GEOLOGIST

Following much contentious debate, in its waning days the Republican-led 125th Legislature passed significant reforms to the laws that govern metallic mineral mining in Maine. The current rules were enacted in 1991 and since that time, no mines have been permitted, leading many to describe those rules as a defacto ban on mining. Since that time there have been many technological advances that have greatly improved the understanding and management of environmental impacts of metallic mineral mining, in particular those involving sulfide mineralization. The 2012 law directs the Maine DEP to develop new rules which will be vetted by the Board of Environmental Protection in the fall of this year and then sent to the Legislature in January 2014 for another round of review and approval.

With the seismic shift of the Legislature in the November 2012 election, the new Democrat-led 126th Legislature saw an opportunity to right the "wrongs" they perceived in the previous Legislature. To that end, several bills were submitted to revise last year's mining law, ranging from total repeal to charging a mining company $1 per gallon for polluted water. In the end, LD 1302 moved forward. Some key provisions of this bill are:

1. Require a third-party review of likely mine closure and reclamation costs.
2. Reinforce the financial assurances for mine closure.
3. Prohibit a permit for a mine that would require perpetual water treatment as part of mine closure.
4. Require wells for groundwater quality compliance to be within 100 feet of a mine facility.

Most people agree that points 1 and 2 make considerable sense. Most would further agree that avoiding perpetual water treatment and providing some sensible distance from mine facilities for monitoring also make sense, but the devil is in the details.

Unfortunately, in making their case to support LD 1302, some environmental organizations have resorted to fear-mongering, by suggesting that without the 100-foot limit, some large landowners might call their entire million-acre Maine holdings the "mine site", thereby allowing groundwater contamination throughout. In presentations, these groups have flashed images of Utah's Bingham Canyon mine – the largest man-made hole anywhere on earth – as an example of what might happen in Maine, without noting that the Bingham Canyon deposit is 1,000 times larger than Maine's most recent open-pit experience at the Callahan mine.

One discussion on LD 1302 centers on what length of time constitutes "perpetual" for post-closure water treatment. One environmental organization brought in a mining expert from Montana who said that 10 years would be generous. On the other hand, I spoke with respected certified professional geologists and engineers in Maine who suggested 30 years as a more realistic timeframe. The current law already requires a minimum of 30 years of post-closure monitoring.

The second discussion centered on the monitoring issue. The 100-foot distance for groundwater monitoring comes directly from solid waste management regulations, and anticipates a fully engineered facility, with appropriate liners beneath. Since there is no way to install a liner below a mineral deposit, I and other professional geologists feel that the monitoring locations should be determined by the geology, not some arbitrary value. Because I have not supported the views of the mining professional from Montana (who has made a career of defending small communities from large mining corporations) and sought views from respected professionals in Maine (who have worked with mining interests), my views have been branded by some environmental groups as being biased toward industry.

I appreciate the very well balanced testimony and written communications on these issues by Alice and Joe Kelley, and Scott Johnson of the University of Maine. These contributed greatly to the discussion. At this writing, LD 1302 has failed due to inability of the House and Senate to agree on final language.

GSM SECRETARY'S REPORT

The GSM Spring Meeting was held in the North Dining Hall at the University of Maine at Farmington (UMF). The meeting featured a poster session of student research followed by one oral presentation. The GSM business meeting followed the student presentations. The keynote address was given by Dr. Charles Langmuir (Harvard University), and also served as part of the UMF forum "State of the Planet, Intergenerational Justice and Our Collective Future."

The Executive Committee met prior to the Spring Meeting, and discussed the summer field trip, distribution of grants from the education fund, planning for the fall meeting, and the possibility of holding a workshop on digital mapping.

Student Research Presentations

The poster session opened at 1pm, and featured presentations on current research by high school and undergraduate students. Abstracts of the posters are published in this newsletter. There were no undergraduate oral presentations at this meeting. Tim Arienti of the University of New England gave a presentation on his graduate research. The presentations were judged by volunteers from the Executive Committee, and an award for the best poster was presented during the business meeting.

Business Meeting Minutes

Following student research presentations, the business meeting was called to order by GSM President Keith Taylor.

Summer Field Trip

The timing and agenda for the summer field trip was presented and discussed. The trip will be held on Saturday, August 3 and Sunday, August 4 in southern Maine. On Saturday, we will visit Morse Mountain to view upper estuary processes and Popham Beach to view and discuss beach erosion. We will visit Pike Industries' quarry in North Berwick on Sunday, August 4. Art Hussey will provide a tour of bedrock geology. A detailed agenda and logistics (including camping areas) will be arranged, and further details

will be distributed by email and made available on the GSM website.

2013 Fall Meeting

The upcoming fall meeting is tentatively planned for Friday, November 15, in Augusta. Potential meeting locations are UMaine Augusta or the Civic Center. Digital mapping is being considered as a workshop topic for the fall meeting.

Educational Grant Program

Grants to support educational programs are available through the Walter Anderson fund. Grants up to $500 are available to support educational programs with missions that align with GSM's purposes, including awareness and understanding of Maine geology, and professional development of Maine geologists. An application form will be posted on the GSM website. Grants are available to any age-group, and are generally not intended to support meeting-related travel.

Financial Report

Treasurer Lois Ongley presented financial information. The Maine Metallic Minerals Conference was a great success, and resulted in an approximately $2500 net gain for GSM. In addition, GSM has taken in approximately $2500 in dues this year. GSM currently has 267 members, 40% of whom are up to date on dues payments. Our expenses are relatively modest, including about $325 for newsletter-related costs and $700 for the summer 2012 field trip, resulting in a net gain of $4,338.34. GSM's assets total nearly $27,000.

It was noted that, due to GSM's non-profit status, we should be aware of asset growth, and consider expanding educational grants. President Keith Taylor responded that GSM will assess the scope and level of interest in grant requests, and may consider increasing grants.

GSM Website

The website is maintained and kept up to date by Martha Mixon. The high quality and functionality of the website was noted, and is appreciated by members.

Student Membership

Current students are welcomed as Student Members of GSM, for annual dues of $5. Students represent the future professional membership of GSM, and are encouraged to join.

Poster Award Presentation

Cliff Lippitt and Dan Belknap judged the student posters, and noted that all the students did excellent work. They also noted the high quality of the high school projects, and that they wouldn't have known that these were not college-level projects. The award for outstanding student poster was given to Amanda Goss of Bates College. The award included a $100 prize from the Anderson Fund. There were no undergraduate oral presentations given this year, so no award was distributed. Graduate student Tim Arienti did an excellent job presenting his research, and his high-quality work was appreciated.

Other Business

It was noted from the audience that GSM membership is not growing appreciably.

Keith Taylor wrapped up the business meeting, which was adjourned at 3:15pm. GSM members and guests moved to the Lincoln Auditorium to attend the Keynote Address.

Keynote Address

The keynote address was given by Dr. Charles Langmuir, Higgins Professor of Geochemistry at the Harvard University Center for the Environment, and lead author of the 2012 book "*How to Build a Habitable Planet: The Story of Earth from the Big Bang to Humankind*." The presentation also served as part of the UMF forum entitled "State of the Planet, Intergenerational Justice and Our Collective Future," which was held during spring semester 2013. Dr. Langmuir's presentation, "*Humankind at the helm: Civilization in a planetary context,"* was well attended by GSM members, UMF students and faculty, and members of the Farmington community.

Submitted by Lisa Jacob, Secretary
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SPRING MEETING
April 10, 2013

ABSTRACTS (alphabetical by author)

A WATER CHEMISTRY COMPARISON: NATURAL AND ANTHROPOGENIC DRIVERS OF MAJOR ION CONCENTRATIONS IN TWO WATERSHEDS IN MAINE PLEASANT RIVER (BETHEL, ME) AND STETSON BROOK (LEWISTON, ME)

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This study compares the major ion water chemistry (Ca2+, Mg+, Na+, K+, HCO3-, SO42-, Cl-) and nutrient levels of two watersheds in Maine. Water chemistry is largely determined by rock weathering, and can be severely altered by humans in many ways including through inputs of road salt, detergents and fertilizers. The Pleasant River watershed near Bethel, ME is over 87% forested with less than 2% developed land. The Stetson Brook watershed in Lewiston, ME is 56% forested with over 24% developed land. Ca2+, Na+, HCO3-, and Cl- were the most abundant ions in both watersheds. There were higher concentrations of all major ions and increased levels of nutrients (NH 4+, NO3-, PO43-) in the Stetson Brook watershed relative to the Pleasant River watershed. Of particular interest is the fact that Ca2+ and Na+ are the dominant cations in both watersheds, and concentrations of these ions in the Stetson Brook are approximately 5x greater than in the Pleasant River. The differences in these major ion concentrations can likely be attributed to anthropogenic impacts because of the differences in land use between the two watersheds.

THE EFFECTS OF THE 2012 ALEWIFE MIGRATION ON NUTRIENT DYNAMICS IN NEQUASSET LAKE, WOOLWICH, MAINE

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Anadromous fish, such as alewives (*Alosa pseudoharengus*) provide an important link between coastal watersheds and the Atlantic Ocean along the Gulf of Maine. Alewives contribute marine-derived nutrients (MDN) in the form of nitrogen to freshwater lakes via excretion and mortality as they migrate upstream during spawning season. Previous attempts to detect MDN in the sedimentary record have provided equivocal results. Freshwater biota or the size of current alewife migrations may have a significant effect on the sedimentary MDN signal. The focus of this project is to determine the degree to which MDN were imported into Nequasset Lake, Woolwich Maine. These data represent the initial findings of an expanded, multi-institutional, multi-year study currently underway.

The Nequasset Lake watershed covers an area of ~50 square kilometers and provides drinking water to the city of Bath and three other communities in Maine. Every spring, alewives return to Nequasset Lake to spawn, accessing the lake through a fish ladder adjacent to the water control dam. In April and May 2012, alewife counts were performed at the top of the fish ladder by volunteers of Trout Unlimited and Kennebec Estuary Land Trust. Water samples were collected from the top of the fish ladder, and from the 4 major stream inlets, and analyzed for nutrient concentrations (TDN, NO_3^-, NH_4^+) to construct a nitrogen budget. Additional samples were collected for $\delta^{15}N_{NO3-}$ analysis from April to August to trace marine-derived nitrogen from the alewives in the lake.

During peak migration, TDN concentrations at the top of the fish ladder were correlated to fish counts, indicating that the fish were importing a significant amount of nitrogen into the lake. Furthermore, the $\delta^{15}N_{NO3-}$ of the lake shows an enriched signal during the spawning period, perhaps reflecting the presence of MDN in the middle of the lake. Increases in MDN have the potential to affect lake productivity as it is immediately available for uptake by primary producers. Thus, MDN observed in Nequasset Lake may have a profound effect on the lake's ecosystem. If labile MDN is used by biota right away little evidence may be stored in the sedimentary record. Analyzing lake sediments for $\delta^{15}N_{NO3-}$ may shed new light on the historic and archaic magnitude of alewife runs and MDN additions.

650 YEARS OF LATE HOLOCENE CLIMATE VARIABILITY INFERRED FROM A VARVED PROGLACIAL SEDIMENT RECORD LINNEVATNET, SVALBARD, NORWAY

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Varved sediments from proglacial lakes provide valuable long term, high resolution paleoclimate and paleoenvironmental records in regions where instrumental records are commonly short-lived and other proxy-records lack detailed temporal resolution. This study presents data from Linnévatnet, a varved proglacial, located in the maritime setting of Western Spitsbergen, Svalbard, Norwegian High Arctic. Surface cores (40-50 cm) and a modified Nesje percussion core (1.4 m) were recovered in spring 2012 from a distal site in the central basin at 34 meters depth.

Linnévatnet is a 4.7 km long basin at 12 m asl fed by an inwash delta 6 km from the margin of Linnébreen, a small polythermal cirque glacier. Linnévatnet sediments are made of finely laminated (mm to sub-mm) dark brown and tan clay-silt couplets that can provide valuable temporal and climatic information. This study aims to reconstruct paleoclimate conditions in western Spitsbergen by analyzing paleoclimate proxies within the sediment record at high temporal resolution. First, the annual periodicity of the brown and tan couplets was

confirmed in this study through plutonium ($^{239+240}$Pu) age determination. Second, measurements of grain size and varve thickness were made. These two variables are directly related to proglacial sediment transport and the position of Linnébreen, making them strong paleoclimate proxies. A high resolution paleoclimate record has been constructed from this insight into glacier dynamics through time. This reconstruction will be compared to other paleoclimate reconstructions from Linnévatnet and to climatic conditions in the Norwegian High Arctic back through time.

A GEOMORPHIC AND SEDIMENTOLOGICAL STUDY OF THE PERIGLACIAL PROCESSES AND ENVIRONMENTS, VARDEBORGSLETTA, WESTERN SPITSBERGEN, SVALBARD

FARNSWORTH, Lauren[1], RETELLE, Michael [1], CHRISTIANSEN, Hanne [2], and COHEN, Sara Mollie [2], (1) Department of Geology, Bates College, Lewiston, ME 04240, lfarnswo@bates.edu, (2) Arctic Geology, University Centre in Svalbard, Longyearbyen, 9171, Norway

Periglacial environments in today's polar regions are highly susceptible to current and future climate change. In arctic regions, climate has warmed significantly as compared to mid-latitude regions. This study investigates geomorphological and sedimentological evidence of late Holocene changes in Vardeborgsletta, a unique high arctic periglacial landscape situated in karst terrain in western Spitsbergen, Svalbard. Fieldwork was conducted in the summer of 2012 and included geomorphological mapping and investigations of the current status of the active layer of the permafrost and karst hydrologic processes. In addition, two sediment cores were recovered from two lakes, informally named Lake 4 and Lake 7, within this periglacial terrain. Laboratory analyses of the cores shed light on recent changes in climate and in the karst hydrologic system. In Lake 4, field season measurements and geomorphic evidence (raised shorelines, outlet channels and exposed lake floor interbedded with fan-delta deposits) illustrate the dynamic nature of karst and periglacial processes. In Lake 7, the lack of similar geomorphic evidence indicates that lake level has remained stable in recent times.

Laboratory analysis conducted on two surface cores (up to 35cm) from Lake 4 and 7 include loss-on-ignition, bulk density, grain size analysis, and plutonium (239+240Pu) and radiocarbon age determination. In the Lake 7 core, the lower 20 cm interval is a massive organic-rich silt (10 to 18% LOI) overlain by a 15 cm unit (5 to 10% LOI) comprised of alternating minerogenic clay and silt layers, 1 mm to 1 cm thick. In the Lake 4 core, the upper 18 cm of the core consists of a laminated clayey silt unit. This banded unit overlies a massive silt-rich unit. A 2 meter-deep soil pit excavated at the margin of the delta fan on a section of former lake floor exposes alternating clay-rich and silty sand layers, similar to the Lake 4 core stratigraphy. The sediment core and pit stratigraphy likely reflect periodic (seasonal) input from snowmelt and slope processes as well as episodic fluctuations in lake level.

The development of a clear understanding of the modern and recent processes shaping the periglacial landscape in the Vardeborgsletta terrain will provide insight to the response of the high arctic periglacial environments to future climate change.

OBSERVATIONS AND INTERPRETATIONS OF BRITTLE DEFORMATION AT GIANT STAIRS AND BARNES ISLAND, HARPSWELL, ME

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Fault-related deformation from near the brittle-ductile transition is observed across five Casco Bay Group formations at Barnes Island and Giant Stairs in Harpswell, Maine. Sixteen north-south fault zones (191-216, 69-84°W) crosscut by twelve east-west, brittle faults (105-240, 68-76°W) were measured and mapped. The fault zones are 10-420 cm wide, subparallel to the outcrop foliation (202, 65°W at Giant Stairs and 207, 81°W at Barnes Island). A dextral shear sense on the fault zones was identified from adjacent, deformed quartz boudins and veins.

The deformation style varies among the five formations. The Scarboro formation, a muscovite-biotite-garnet-quartz schist, exhibits the widest, least cohesive faulting as identified by erosion, increased friability and narrowing of the foliation. The Spring Point formation, a garnet-quartz amphibolite, has thinner, nearly cataclastic deformation, identified by narrowing of the foliation and deformation of quartz boudins. For both, the foliation narrowed from 1-2mm to <1mm. The Diamond Island formation, a graphite-quartz-muscovite phyllite, exhibits fewer fault zones with deformation similar to the "Scarboro" end of the spectrum; the Spurwink metalimestone does not record faulting. The Cape Elizabeth formation, a quartz-plagioclase-biotite-muscovite-garnetschist, has a mix of incohesive and cohesive deformation; it is the dominant unit at Giant Stairs.

Most east-west faults are cm-scale offset, brittle faults in the Diamond Island formation and m-scale offset faults with drag folds in the Spring Point formation. Crosscutting relationships show the E-W faults formed after the N-S fault zones. In general, the Barnes Island area is interpreted as a shear zone based on deformation in the fault zones, marked attenuation of formations, and sheared quartz boudins and veins. The orientation and dextral shear sense of the fault zones at both sites are consistent with the Cape Elizabeth splay of the Norumebga Fault System and correspond with the regional transpressional flower-structure defined by Swanson (1999).

ANALYSIS OF BRITTLE PALEOGENE STRUCTURES IN THE SVEA REGION, EASTERN SPITSBERGEN, SVALBARD

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During the Paleogene rifting of Svalbard and Greenland along a dextral transform, deformation occurred in two stages. Initial transpression, which formed a fold-and-thrust belt in western Spitsbergen and a foreland basin in central Spitsbergen, was followed by transtensional rifting. Small-scale brittle structures are observed in the subhorizontal Paleogene strata on the foreland basin's eastern edge. This study analyzes the orientations and paleostress regimes of these structures in order to determine their tectonic origins. Orientation data from faults, joints, and slickenlines were collected within the Svea Nord mine and the surrounding area in order to resolve the paleostress regimes of these structures. An analysis of lineament orientations from aerial imagery was conducted to solidify these initial findings, based on the assumption that these linear erosional features are related to pre-existing bedrock fractures. Results show two populations of faults: NNW-SSE striking, west-dipping thrust faults and ENE-WSW striking normal faults. Joint orientation measurements reveal two dominant subvertical joint set orientations: ENE-WSW and NNW-SSE. The lineament data show a major NE-SW trend, and a minor NW-SE trend. Paleostress orientations of these structures suggest ENE-directed compression and NNW-SSE extension for the thrust faults and normal faults respectively. Both the joints and lineaments indicate a strike-slip setting. Given the age constraints on the faults and fractures, their orientations and paleostress determinations, they can be correlated with previously documented structures associated with fold-and-thrust belt deformation. That these small-scale extensional structures are likely related to the fold-and-thrust belt suggests that they formed in response to the larger dextral transpressive tectonic setting.

CHANNEL MORPHOLOGY SHIFTS FOLLOWING DREDGING OPERATIONS WITHIN THE SACO RIVER ESTUARY, MAINE {oral presentation}

Harder, T.M. [1], David, G.C.L. [2], Arienti, T.W. [1], Gill S.M.[1], Tilburg, C.E. [1], [1] – Department of Marine Sciences and Marine Science Center, University of New England, 11 Hills Beach Road, Biddeford, ME 04093, United States; [2] – Department of Earth and Oceanographic Science, Bowdoin College, 6800 College Station, Brunswick ME, 04011, United States

The Saco River estuary is approximately 10 km long. It is punctuated by a dam system at its head, and a mouth bordered by a rock jetty structure with geology in between varying from exposed granite narrows, to wide, silty marshes. The shape of the river channel varies by depth, material, and geometry within each of these areas, affecting the hydrology and sediment transport dynamics. The river experiences sediment shoaling in the harbor nearest the jetty; consequently, the system has been dredged periodically over the last 100+ years with the most recent, and largest taking place in 1996. This last dredging was executed by the US Army Corps of Engineers to mitigate infilling in the 6 foot harbor anchorage area, as well as to provide nourishment to the adjacent beaches which experience severe erosion. Cross sectional transects were conducted to examine the morphology of the river channel using an Acoustic Doppler Current Profiler, and when compared to previous work, reveal changes along the length of the estuary. The effect of this deepening may be most significant in the dredged areas near the mouth of the estuary, where an increased area has possibly increased the tidal prism of the system. This could have impacts on the hydrology of the system, and may need to be taken into account in further sediment management decisions in the region.

A GEOCHEMICAL INVESTIGATION OF LATE HOLOCENE LAKE SEDIMENT CORES FROM PYRAMID LAKE, FIORDLAND, NEW ZEALAND

David Harning[1], Beverly Johnson[1], Christopher Moy[2] and Philip Dostie[1], [1] Department of Geology, Bates College, Lewiston, Maine, [2] Department of Geology, University of Otago, Dunedin, New Zealand

Pyramid Lake is a small (c. 500 meters in diameter), semi-closed lake thought to have formed 12000 – 13000 years ago, following the Green Lake Landslide at the end of the last glaciation. Recent records of watershed history indicate regional climate variability from natural and anthropogenic sources. Biogenic silica, stable isotopes ($\delta^{13}C$ and $\delta^{15}N$), elemental carbon and nitrogen and compound-specific lipids (*n*-alkanes and carboxylic acids) were examined in two sediment cores, 28 and 36 cm, collected from Pyramid Lake to shed light on organic matter sources and primary production within the lake. Carbon isotopes ranged from -27.6‰ to -28.5‰ displaying a near constant trend up core while nitrogen isotopes ranged from 0.9‰ to 1.9‰, showing a slight enrichment up core. Biogenic silica ranged from 0.97% to 23.8% and increased towards to the top of the cores. Elemental carbon and nitrogen percentages both increase mid-core with values shifting from 7 to 14 percent and 0.5 to 1 percent, respectively. Compound-specific results suggest a high proportion of vascular plants with limited algal signatures. Ages were determined via $^{239+240}$Pu-dating and range from 1855 to 1963. These results in conjunction with C/N ratios suggest an increase in littoral sediment redistribution and possibly primary productivity beginning around 1923 in association with 20th century warming. By learning how the lake's internal processes and conditions have changed in response to its environment, we can gain an understanding of the extent of human impact and predict how it could change in the future in the face of human-induced climate change.

IMPACT OF ATYPICAL AIR TEMPERATURES ON DEVELOPMENT AND PERSISTENCE OF WITNER STRATIFICATION AND ICE COVER ON SUBALPINE LAKES, WESTERN MAINE

LAVORGNA, Sarah, DOUGHTY, Murphy, and DALY, Julia, Dept. of Geology, University of Maine at Farmington, 173 High Street, Farmington, ME 04938, sarah.lavorgna@maine.edu

Unseasonably warm air temperatures experienced in the northeast during both late fall 2011 and mid-March 2012 resulted in a truncated seasonal ice cover of many large Maine lakes. Late ice formation (or incomplete ice cover) and early ice-out, determined visually, were a coherent regional response for these low elevation lakes. In combination with decreased snowfall, especially in December and early January, winter recreation and tourism industries in subalpine and alpine environments were negatively impacted. To assess the response of high elevation lakes in western Maine and northern New Hampshire to these anomalous warm air temperatures, we examined sub-hourly measurements collected at three depths (surface, 2m, and bottom) at more than a dozen sites and compared them to temperature signatures of major seasonal events from 2007-2011. Warmer November and December 2011 air temperatures resulted in multiple episodes of destratification following the end of fall mixing; typically, the lake maintains inverse stratification once it has developed and the bottom temperatures indicate that water is at maximum density. The development of permanent seasonal ice was also delayed; data loggers and a time-lapse camera at a single location show that ice developed and melted several times during December. In spring 2012, unusually warm air temperatures resulted in early thinning of the ice and early ice-out. Ice thinning and the accumulation of meltwater on the surface of the ice were recorded by surface data loggers at most locations that were frozen into the ice. Ice-out dates for our study sites were two weeks earlier than some previous years, and surface water warmed rapidly following ice-out but prior to the end of winter stratification. Both ice duration and the duration of winter stratification were truncated by warmer air temperatures. Continued monitoring of these subalpine lakes will build a rich dataset for this environment, and will help evaluate the frequency of early ice-out events and its impact on lake temperature and habitat quality.

VARIATIONS IN HYPOXIA AND PRODUCTIVITY ALONG THE OREGON MARGIN DURING THE YOUNGER DRYAS AND EARLY HOLOCENE

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While the cold Younger Dryas (YD; 12.9-11.6 kyr BP) and warm early Holocene (beginning 11.5 kyr BP) have been well observed in the Northeast Pacific, little work has been done off the coast of Oregon. In an effort to better understand variations in hypoxia and productivity in this region during these time periods, this high-resolution paleoceanographic study examined a sediment core collected off the Oregon Margin at a depth of 360 m. Methods included geochemical analyses of trace metals (Re, Mo), as well as carbon and nitrogen contents and their associated stable isotopes. A ^{14}C- and ^{210}Pb-dated age model noted two separate sections of the core (0-0.9 kyr BP; 9.8 to 13.0 kyr BP); the interim period likely corresponds to a slab lost due to seismic activity. Results suggest high levels of hypoxia and productivity into the early Holocene, likely as a result of increased upwelling and/or an intensification of the oxygen minimum zone along the Oregon Margin. As these occurrences were observed during the early Holocene warming, it is likely that, in our current warming climate, the system may be responsive to similar widespread events of hypoxia.

POST-GLACIAL AEOLIAN DEPOSITS ON CHESTERVILLE HILL, CHESTERVILLE, MAINE

MILLETTE, Patricia, ABBOTT, Sullivan, CHEN, Jennie, COHEN, Miriam, GLASS, Anna, GUILLAUME, Mitchell, HAYWOOD, Emma, HOYT, Devon, LAFFLIN, Park, LEFRESNE, Fiona, LUCHINI, Benjamin, LUICK, Roshan, MESERVIER, Justin, MINNS, Steven, MORRELL, Alexandar, MORRILL, Richard, PIRES, Nicole, PRATT, Charlene, ROBERTS, Dylan, ROGERS, Silas, SHERROD, Alan, ST PIERRE, Kayla, WITHEY, Taylor, Science Department, Mt Blue High School, 129 Seamon Rd. Farmington, Maine 04938 patti.millette@maine.edu

The purpose of this study was to identity and determine the origin of the mounds on the northwest side of Chesterville Hill, New Sharon, Maine. The mounds were mapped with a GPS, and several mounds were profiled with a stadia rod and transit. Sediment samples were also collected from the crest of one mound and analyzed for grain size distribution. The data collected generally show that the mounds are elongated west to east and are primarily sand with more silt and clay on the east side. These findings suggest that the mounds are dunes formed as the result of the recession of the Laurentide ice sheet. The melting caused a rise in sea level up through the Sandy River Valley. Subsequently, feeder streams carried sorted sediments into the ocean water and deposited them into the river valley. Over time, the sea level decreased due to isostatic adjustment of the continent. The exposed sand was carried by the prevailing northwest winds onto Chesterville Hill forming dunes.

SEDIMENT DEPOSITS AT CAPE COD HILL, NEW SHARON, MAINE

MILLETTE, Patricia, BAXTER, Gregory, CALDWELL, Sydney, CLOSE, Rebecca, DWYER, MacKenzie, FAY, Savannah, FRANCHETTI, Anthony, KAY, Max, LESKO, Daniel, LOEWEN, Matthew, MCINTOSH, Samuel, METTS, Mickala, MITCHELL, Rachel, NILE, Benjamin, PARSONS, Drew, WILLIAMS, Jacob, Science Department, Mt. Blue High School, 129 Seamon Rd. Farmington, ME 04938, patti.millette@maine.edu

Research was conducted to determine the composition and morphology of the mound located at the southeast end of Cape Cod Hill, New Sharon, Maine. The feature was mapped using handheld GPS (Global Positioning System) units and profiled using stadia rods and transits. Additionally, a total of six sediment samples were gathered, four on the ridge, and two on each side, a standard grain size analysis was conducted on each sample.

The feature was also compared to similarly shaped and oriented dunes mapped by previous researchers on the west side of Cape Cod Hill. Unlike the dunes, the mound is

comprised of till and located on the southeast end of the hill, sheltered from the prevailing northwest wind. This along with additional results suggest that it is most likely a drumlin, or drumlin like feature, deposited during the Pleistocene Epoch and subsequently shaped by further erosion.

ISOTOPIC RECONSTRUCTIONS OF SWORDFISH DIETS IN THE GULF OF MAINE

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Stable isotope tracers can be valuable tools for interpreting the way an ecosystem has functioned over time. Both modern and archaeological swordfish rostra spanning 4,200 years were collected from the Gulf of Maine and other parts of the western North Atlantic for ^{15}N and ^{13}C analysis to understand shifts in swordfish populations and reconstruct their diets through time. In addition, several selected whole rostra were subsectioned and analyzed for bulk carbon and nitrogen isotope analysis in order to evaluate the isotopic variability that can occur along the length of a rostrum.

Preliminary results show notable variability of both $\delta^{13}C$ and $\delta^{15}N$ along individual rostra, particularly between the outer edge and inner chamber regions. This variability may be due to differences in nutrient exchange throughout the internal bone structure, and may reflect natural changes in the diet of the swordfish throughout its life as the rostrum grows. The $\delta^{15}N$ of the archaeological rostrum collagen is relatively constant between 4.2 ka BP and 3.5 ka BP, and then becomes about 1‰ depleted in modern samples. These data may reflect (1) a decrease in trophic level of the swordfish, (2) a change in nutrients at the base of the food web, or (3) a fundamental shift in swordfish populations. Swordfish used to be an important resource to human cultures in the nearshore region of the Gulf of Maine; thus, the study of the dietary habits provides useful information on changes in their ecology as well as human exploitation.

PETROLOGY AND GEOCHEMISTRY OF FAULT AND SHEAR ZONE - RELATED ROCKS ASSOCIATED WITH THE NORUMBEGA FAULT ZONE, SOUTH CENTRAL MAINE

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Mylonites of the Whitten Hill mylonite zone and Sunny Side fault contain rocks which have equilibrated in the lower to lower – middle amphibolite facies. The Whitten Hill mylonite zone has a maximum width of approximately 600 m. Within this zone is a several meter wide band of amphibole bearing, lineated and banded striped gneiss. Hornblende suggests that this rock equilibrated in the lower to middle amphibolite facies. East of the Whitten Hill zone is the Sunny Side fault. The Sunny Side fault is commonly less than 100 m wide and ranges from phyllonite to ultramylonite. Locally, within the Sunny Side mylonite are well developed garnet - biotite coticules which display mylonitic foliation and lineation. Textures, mineralogy and geochemistry suggest that this coticule was derived from a metasedimentary protolith and equilibrated in lower amphibolite facies. Rocks between the Whitten Hill and Sunny Side mylonites are extensively sheared and exhibit mineralogies consistent with middle and upper -middle amphibolite facies (staurolite/andalusite and sillimanite zones). Where present, andalusite occurs as shear - modified porphyroblasts in the presence of fine – grained sillimanite.

East of the Sunny Side fault is a wide zone of ductile shear. This zone contains abundant pelitic migmatite with equilibrium assemblages consistent with upper amphibolite facies (sillimanite - k feldspar zone). An elongated belt of heterogeneous gneissic rocks (Mixer Pond gneiss) is included within the ductile sheared rocks. The Mixer Pond gneiss is a heterogeneous unit with diverse mineralogy and chemistry. These rocks range from hornblende - rich amphibolites to microcline granite gneisses containing minor accessory biotite. Field evidence together with trace element geochemistry suggests that this unit is an orthogneiss. The variation diagram suggests that part of the Mixer Pond was originally a pluton within a magmatic arc. Units similar to the Mixer Pond are the Lake St. George Granite gneiss and the Haskell Hill gneiss.

EXTENT OF EOLIAN DUNE DEPOSITS IN CHESTERVILLE, MAINE

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The purpose of this study is to discover if features on the west side of Old Bluff Hill, Chesterville, ME are dunes of similar origin to those on the adjacent Cape Cod Hill, in New Sharon, and to determine their extent. Features were mapped with a handheld GPS unit and the data were digitally superimposed onto both aerial photos and topographic maps in Google Earth. In addition, sediment samples were analyzed to determine grain size distribution, and a single profile was constructed from mound M-R-12 at the north end of the hill (also known locally as Chesterville Hill).

Data from these tests suggest that the features are dunes which formed post-glacially from prevailing winds first eroding and then redepositing glacial marine sediments in select locations along the Sandy River Valley. The dunes formed on Old Bluff Hill did so both directly downwind from the prevailing wind (similar to Cape Cod Hill deposits), but also out of a direct wind approach. It also shows that dune formation in this area is

more widespread than the one location on Cape Cod Hill (Bessey et al, 2010). From these results, it is further hypothesized that additional dunes can probably be located in local areas with similar wind approach along the Sandy River Valley.

EFFECTS OF COMMERCIAL DIGGING ON THE SEDIMENT DYNAMICS OF LOWES COVE, WALPOLE, MAINE

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This study investigates sediment size sorting and surface scouring in a controlled digging experiment, assuming a one-time digging perturbation event in Lowes Cove, Damariscotta River, ME. Lowes Cove is an ideal study site because it is harvested for soft-shelled clams and has experienced a drop in clam populations over the past few years. Digging causes harmful repercussions on benthic infaunal communities due to disturbances in the sediment regime. Three replicate digging plots were assembled at two sites along the northern side of Lowes Cove, (43°56'13.30"N, 69°34'22.09"W) and (43°56'15.65"N, 69°34'21.43"W). Each 0.2 m^2 experimental plot was equally spaced apart and dug with a long-handled shovel 0.3 m deep. The mound was placed adjacently to the dug hole and the mound-hole topographic profile was measured using a modified surface elevation table. Measurements were taken during 2.5 weeks from both sites in November for 6 non-consecutive days and in March at one site during 4 consecutive days at low tide. Pre- and post-digging sediment cores were taken from the 6 dug plots and were analyzed using an x-ray Sedigraph to quantify sediment size distribution. Within the first 7.5 hours after digging, there was a 16% average elevation accumulation of finer sediments in the depression of the dug hole. Over 2.5 weeks, there was a 68% increase in elevation of finer-grained sediment in the dug hole. The mound and depression were still visibly noticeable four months after digging, with seaweed and other debris materials trapped and buried in the hole. The sorting and displacement of sediment may interfere with the feeding of deposit feeders and suspension-feeding bivalves, but could also catch spat and enhance recruitment. Evaluating the changes in sediment dynamics due to commercial digging will strengthen management efforts to preserve harvested marine resources.

TRACKING SEASONAL AND STORM INDUCED RECESSION OF THE POPHAM-SEAWALL BARRIER BEACH COMPLEX, PHIPPSBURG, ME

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The Seawall-Popham complex, located at the mouth of the Kennebec River in Phippsburg, midcoast Maine, is a dynamic, transgressive barrier beach system. In recent years, the migration of two main tidal inlets in the barrier system has played a major role in increased beach erosion at Popham Beach State Park and on the pocket beaches of Cape Small. Changes in the Seawall barrier in recent years have been minimal, however since 2010, landward recession of the frontal dune ridge has become apparent. The purpose of this study is to document physical changes along the barrier complex, pocket beaches and associated tidal inlets, from summer 2012 through winter 2013.

Detailed seasonal and storm-induced changes on the beach system were documented by topographic profile survey, high resolution GPS tracks, and time lapse photography. Longer term (annual) changes were documented using high resolution georeferenced satellite imagery and air photographs.

Beach front at Popham Beach State Park has undergone sustained, documented erosion since 2007 when the Morse River migrated towards State Park beaches with the eastward longshore growth of the Seawall Barrier spit. Although the long Seawall spit was breached by avulsion of the Morse River in 2010, erosion has continued along the beach front.

Likewise, pocket beaches at Cape Small are continually eroded by the westward shift of the Sprague River, forced against the Cape Small headland by the westward development of the southwestern Seawall spit. Recent changes in the 2.25 km-long Seawall barrier beach are evident with up to 15m of landward migration of the frontal dune ridge in many sectors of the beach since 2009.

UPCOMING MEETINGS OF INTEREST

Summer & Fall 2013

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GSM Summer Field Trip & Meeting
Early August 3-4, 2013
Sewall & Popham Beach, Phippsburg, Maine and Pike Quarry, Wells, Maine

www.gsmmaine.org

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2013 New England Intercollegiate Geological Conference
North Central Maine - Katahdin Region
October 11-13 Columbus Day Weekend
Big Moose Inn, Millinocket Lake, Maine

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

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In Memoriam
Robert B. Neuman
1920-2013

Our great friend, Dr. Robert Neuman passed away on May 24, 2013 at the age of 93. He is fondly remembered by many members of Geological Society of Maine for his passion for geology, his contributions to our understanding of Maine's tectonic history and his animated eyebrows. His was a recognized expert in fossilized brachiopods and his geologic endeavors took him to northern Maine as wells as Canada, Ireland, Scotland and Norway.

Impressions of the brachiopod Platytoechia boucoti *in a hand sample. The well-preserved fossil at left center is about 1/2" across (source MGS website)*

Bob earned his bachelor's degree at the University of North Carolina, Chapel Hill and his Doctor of Philosophy in Geology from Johns Hopkins University in 1949. Beginning in 1949 Dr. Neuman was a scientist for the U.S. Geological Survey at the U.S. National Museum, Washington D.C. After his retirement in 1985 he was an emeritus scientist of the Geological Survey and the Smithsonian Institution. Much of his field work and research focused on Lower Ordovician marine brachiopods found in northern Maine. Neuman conducted field work in Maine for more than 30 years. His research is recognized by a broad spectrum of the scientific community and is published in numerous national and international publications. In addition he introduced many students to geology through field expeditions; he was frequent participant in GSM and NEIGC trips often accompanied by his wife, the late Arline Neuman. He is survived by two daughters, Elizabeth Reichman and husband, David, and Martha Welsh and husband, Dr. Michael. He has four grandchildren; and six great-grandchildren.

A band of geology enthusiasts wending their way through the woods of northern Maine. Geological Society of Maine summer field trip, July 2005. (Photo by Robert Johnston.)

Many members may recall the 2005 annual Summer Field Trip of the Geological Society of Maine that was held in his honor at Shin Pond Village Campground. The 2 day meeting was attended by geologists, friends, and family members. Even though he was in his mid-80's at the time Bob was able to get to every outcrop along the way and provide a geologic interpretation at each stop.

For more information on the Shin Pond locality go to the link on the MGS webpage: http://www.maine.gov/doc/nrimc/mgs/explore/bedrock/sites/jul12.htm

After the meal, the late Bill Forbes recounted highlights of Bob's career and especially of his work in Maine. Bob was then awarded a plaque, which read "**The Geological Society of Maine presents this plaque to Robert B. Neuman in recognition and appreciation of his contributions tothe geology of the State of Maine, July, 2005**" Bob accepted the honor with sincere thanks, graciousness and a beaming smile. He will be greatly missed by us all.

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 modem 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 Sept. 1 to Aug. 31. Annual dues and gift or fund contributions to the Society are tax deductible. There are four classes of memberships:

FEE SCHEDULE AS OF February, 2008

$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.
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2012/2013 SOCIETY YEAR BEGAN SEPTEMBER 1 - PLEASE SEND DUES TO TREASURER.
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c/o Carol White, Newsletter Editor
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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:

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Correspondence about **membership** in the Society, **publications** and **dues** should be mailed to:

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