



NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MAINE

Following tradition, the Spring meeting of the Geological Society of Maine offered students an opportunity showcase their work through poster or oral sessions. This year's meeting was held at Bates College. I would like to convey the Society's gratitude to the Bates College Geology Department, especially Marita Bryant and Brenda Pelletier, for hosting the meeting. The new Commons Building provided a beautiful meeting space with lots of room for talks, posters, and connecting with friends and colleagues from around the state. Students from Bates and Bowdoin Colleges, as well as the University of Maine at Orono and Farmington and Mt. Blue High School presented posters, while students from Bates spoke on their research. Also following tradition, the Walter Anderson Fund provided \$100 prizes for the best undergraduate poster and presentation. This year's oral presentation winner was Carter Kindley, from Bates College. The poster competition prize was awarded to Robin Arnold of the University of Maine. The posters and talks presented were excellent, and the prize committee had a difficult time choosing the winners!

The Society's annual field trip will take place July 15-17, and will be focused on the Deboullie area in Northern Maine (see announcement below). Leaders will be David Putnam and Chunzeng Wang of the University of Maine at Presque Isle, with Keith Taylor (GSM VP) coordinating logistics. We will have the opportunity examine the Deboullie Pluton, and grandiorite and syenite body. Glacial geologists and naturalists will be interested in the perennial ice features in the area and the associated Pleistocene refugium species. See the announcement in this newsletter and the website for more details. These yearly trips give members and their families a chance to visit interesting parts of the state and enjoy geology in a field setting.

Looking head, plans are already underway for the Fall meeting at Unity College and even for next year's Spring meeting at UMPI! We are fortunate to

have such an active group...and members so willing to help with arrangements and plans! Thanks to all who contribute their time and effort to keeping our Society a vital organization.

THE EDITOR'S MESSAGE:

Please send items of interest for the News from the Campuses and Member News columns, or other things you'd like to share.

Please check the date on your address label – members more than two years in arrears will be dropped from the mailing list. Send dues to Lois Ongley (see address on the last page).

Dan Belknap, Newsletter Editor (1998 – present)
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PLEASE CHECK THE DATE ON YOUR ADDRESS LABEL – THIS IS THE DATE TO WHICH YOUR DUES ARE PAID UP. MEMBERS MORE THAN TWO YEARS IN ARREARS WILL BE DROPPED FROM THE MAILING LIST.

GSM WEBSITE: www.gsmmaine.org

The GSM website has been changed to a new provider, which we expect will result in better service. The web address (above) is unchanged.



Geological Society of Maine

Summer Field Trip

Friday, July 15-Sunday, July 17
Deboullie.

The GSM summer field trip will be on the Deboullie Maine Public Reserved Land about a 1.5-hr unpaved drive from Portage, in the northernmost part of the state. According to the trip leaders, David Putnam and Chunzeng Wang of UMPI, the area is spectacular wilderness with many unique geologic

features. First is the Deboullie Pluton (granodiorite and syenite) ringed by quartzite and slate hornfels, located far from any other intrusive rocks. Minor mineralization is present in some areas. Also present are permafrost features and talus-derived rock glaciers at unusually low altitudes/latitude. These perennial ice features have persisted since the Younger Dryas and harbor relic boreal species such as blueback trout, northern bog lemmings, and a variety of rare plants. Also on the agenda are glacial striations from the “zone of confusion,” and syenite boulders transported by ice in a variety of directions as the northern Maine Ice Cap ice divide changed position and flow direction.

Visiting these locales will require a day trip in canoes or kayaks that require at least one short portage. Both types of watercraft can be provided by the Red River Camps. The Red River Camps currently have 4 cabins (each with between 2 and 8 beds) available that weekend, but these are non-kitchen facilities and require participating in their meal plan at \$130/night per person. One cabin with a kitchen is available on a nearby island and holds 8 at \$75/night per person. The cabins sound wonderful but these prices may be a little high for some of us.



There are about 10 public campsites in the area including a group site, but they all appear to be first-come first-serve. Some people may want to stay at Red River Camps, but a group campsite would also be needed. More information on lodging and logistics will be posted on the GSM website in the near future.

We anticipate having participants arriving Friday night, with field trips all day Saturday and on Sunday morning. While getting there is a long haul for most of us, this sounds like a once-in-a-lifetime experience combining fascinating geology with some of the best

terrain northern Maine has to offer. Bring your fishing gear and make a vacation out of it.

Feel free to contact Keith Taylor if you have questions or comments (keitht@stgermaincollins.com).



GSM Fall Meeting

Planning is underway for the GSM Fall meeting, to be held November 4, 2011 at Unity College. Keith Taylor and Gary Creaser are involved in program planning, and Lois Ongley will handle logistics. They would appreciate your input concerning content (professional and academic mix, topical sessions, etc.)

STAUROLITES

Kevin McCartney has received a request from a colleague in Utah for specimens of Maine staurolite with 45° and 90° twinning for a museum display of staurolites from the US. The colleague offers New Mexico specimens for trade or Kevin is willing to purchase specimens as a donation to the museum. Contact him at <Kevin.mccartney@umpi.edu>

GSM MEMBER NEWS

Bill Forbes, UMaine Presque Isle, retired professor. Bill passed away after a long battle with cancer on May 3, 2011. He had a long and productive career in paleontology with a strong emphasis on his beloved Aroostook County, but also spread all over North America and other parts of the world. One of his plant fossil discoveries was named *Psilophyton forbesii* in his honor. Bill was truly one of the founders of modern geology in Maine, and will be missed by his friends and colleagues. His complete obituary is available on the Bangor Daily News website:

<http://obituaries.bangordailynews.com/obituaries/bangordailynews/obituary.aspx?n=william-h-forbes&pid=150776325>

Please send member news to:

Carolyn Lepage, Member News Correspondent (1996-present) calepage@roadrunner.com or PO Box 1195, Auburn, ME 04211-1195 or Phone: (207)-777-1049

ABSTRACTS

From the Spring Meeting Friday, April 15, 2011, Bates College

(Your humble editor apologizes for the incorrect date in the February Newsletter)

Poster

HOLOCENE OSL AGE ESTIMATES OF PARABOLIC DUNES ALONG THE WESTERN SHORE OF LAKE MICHIGAN DOOR PENINSULA WI, USA: INSIGHTS ON THE COASTAL DUNES GEOMORPHIC HISTORY

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Aeolian geomorphology and geochronology was investigated for dunes on the northwestern shore of Lake Michigan at Whitefish Dunes State Park, Wisconsin. Three-meter LiDAR, aerial photographs, and field observations reveal a series of parabolic dunes and beach ridges super-imposed on an 800 m wide strand plain that

separates Lake Michigan from inland Clark Lake. The parabolic dunes show a paleowind direction of south-southwest. Particle Size Analysis (PSA) along with Ground Penetrating Radar (GPR) differentiate dune (~2.7% coarse sand) and beach (~18% coarse sand) sediment. Optically Stimulated Luminescence (OSL) samples were collected from paleo-beaches and dune crests. OSL ages of the dune crests ranged from 7.8 to 1.9 ka, correlating with the Nipissing Lake Level High (6.0-4.3 ka) and the Algoma Transgression (3.3-2.3 ka). The similarity between the dune and beach sediment ages suggests rapid dune formation and stabilization.

Poster

AEOLIAN DEPOSITS AT CAPE COD HILL, NEW SHARON, MAINE

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Research was performed to determine the composition and depositional origin of sedimentary land features in the Cape Cod Hill area of New Sharon, Maine. Hand-held GPS units were used to map the perimeter of each feature, profiles of two features were plotted, eight subsurface samples were collected from the two features, the general sediment composition was determined, and a standard grain size analysis was performed on each sample. The analysis indicates that the landforms are likely aeolian deposits. They are composed primarily of sand-sized sediments with traces of shell fragments. These were originally deposited into the ocean during postglacial melting and marine incursion, and then exposed to the wind as the result of isostatic rebound and marine regression.

Poster

ANALYSIS OF SEDIMENT TRAP YIELDS IN GLACIER FED LINNEVATNET, SVALBARD: CALIBRATING WATERSHED AND LACUSTRINE PROCESSES FOR PALEOCLIMATE ANALYSIS

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Annually laminated lake sediments provide valuable high-resolution records of paleoclimate in areas such as the High Arctic where detailed records are generally lacking. Studies of lacustrine sediment deposition and watershed dynamics allow for interpretation or calibration of the

annual sediment yields and the connection to climatic controls. Sediment-trap studies undertaken on Linnévatnet, a High Arctic glacial-fed lake on the largest island of the Svalbard archipelago, since 2003 provide a critical link from modern processes to the laminated sediment record.

In the summer of 2010 a total of 31 traps were collected that were deployed in the summer of 2009. Their locations in relation to the glacial stream Linnéelva range from proximal (0.4 km away) to distal (3.3 km). Instrumentation in the Linné valley, including time-lapse cameras, temperature loggers, snow trees, and weather station data help facilitate understanding of climatic controls on glacial melt and stream discharge. Two sedimentation events occurred in the summer/ fall of 2009, accounting for 25% of total sediment accumulation. Spring 2010 sedimentation began on 6/15 with an event that accounted for 12.5% of total yearly sediment accumulation. The most significant event of the year occurred on 6/24-6/30. It was driven by nival melt and accounted for 50% of the total sediment accumulation. Two further events were recorded by the intervalometer, each accounting for 6.3% of total accumulation. The first of these was caused by settling of fine-grained particles and the second was a distinct event controlled by solar radiation and temperature.

The nival melt is determined to be the dominant hydrologic event in the Linné valley and responsible for the majority of sedimentation in Linnévatnet. The timing and intensity of this melt event is controlled primarily by melting degree days. Subsequently, further study is needed to determine the validity of using Linnévatnet's varved sediment for paleoclimate reconstructions.

Poster

DEVELOPING A METHODOLOGY FOR DIGITAL FIELD MAPPING LINKED TO LIDAR DATA PROCESSING FOR LINEAMENT ANALYSIS

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The purpose of this project is to perform a lineament analysis of Small Point using both 2007 and 2004 NOAA LiDAR digital elevation models and to map a small portion of the bedrock at Small Point using new digital mapping technologies. Hussey and Berry (2002) have mapped a broad region of Ocbu, undifferentiated Casco Bay Group, with the Cape Elizabeth Formation being prominent in our study area. This belt includes interbedded rusty and silver schists and granofels, amphibolites, calc-silicate granofels, and garnet cotecule. Swanson and Bampton (2009) have mapped a wide zone

of north striking distributed dextral shear through Small Point and called it the Phippsburg shear zone. The LiDAR data, in floating point grid format, was processed using IDW and hillshade models. COGO fields were used to determine lineament orientations of fractures (dominant NE-SW and minor E-W), contacts (NE-SW), and striations (NNW-SSE). A field-mapping component utilized a Trimble Juno PDA and ArcPAD 10. ArcPAD templates for bedrock and structural mapping from Pavlis et al. (2010) were used in the field. Silver schist± garnet cotecules (Ocess?) and rusty schist (Ocers?) were the predominant units with up to 7 interbedded 1-2 meter thick amphibolites and/or calc silicate granofels interbedded with the rusty schist unit. Deformation is dominated by a macro-scale upright antiform (F2?) plunging shallowly to the SSW. An exposure of fault gouge was observed in the rusty schist unit offsetting an amphibolite unit interpreted to be a N-striking Mesozoic fault. A previously unmapped fault is shown striking NNW to explain truncations of the amphibolites against the silver schist. Digital mapping technologies allow for the rapid collection of spatially referenced data that can be used for analysis and viewed in the context of aerial imagery, digital elevation models, and preexisting data sets.

Poster

FORMATION OF ELONGATED GARNETS IN THE SPRING POINT AMPHIBOLITE, HARPSWELL, MAINE

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Numerous garnet porphyroblasts ($\text{Alm}_{55-70}\text{Grs}_{20-25}\text{Prp}_{3-6}\text{Sps}_{6-12}$) in the Spring Point Formation have an anomalous aspect ratio ranging from 3:1 to 8:1. This is well beyond the 1:1 ratio typical for isometric garnets. These elongated porphyroblasts have the potential to expand our understanding of garnet growth and deformation mechanisms. The Spring Point Formation, part of the Ordovician Casco Bay Group, originated as backarc basin volcanics that were subsequently metamorphosed into garnet-bearing amphibolite gneiss during the Acadian Orogeny. Garnet-hornblende-plagioclase thermobarometry yields near-peak metamorphic conditions of 550°C and 4.8 kbar. Most garnets do not have pronounced major-element zoning; a few garnets show minor Ca and Mn concentric zoning.

Electron backscatter diffraction (EBSD) maps reveal complex patterns of crystal lattice orientations for the elongated garnets. High-angle grain boundaries are common, and suggest that many – but not all – garnets are polycrystalline. Most polycrystal domains, as well as single crystal garnets, show evidence of low-angle subgrain boundaries, and gradual lattice orientation shifts

about a single axis. Field observations and backscattered electron images show brittle cracks, spiraled inclusion trails and deformed pressure shadows indicating dominant pre- to syn-kinematic growth of garnet. The elongated garnets appear to have formed through a combination of growth and deformation mechanisms. Some polycrystals seemed to have formed early in the growth history given the observed concentric major-element zoning and high-angle boundaries. Dislocation creep may explain subgrain formation and the observed gradual lattice misorientations about a common axis. Inclusion-poor terminations formed after deformation are likely the result of dissolution-reprecipitation processes. Post-kinematic brittle deformation further elongated the garnets at a later stage.

Poster

A CASE STUDY OF SPATIAL VARIABILITY IN SNOW-PACK: NORWEGIAN HIGH ARCTIC AND PRESIDENTIAL RANGE, NEW HAMPSHIRE

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Slab avalanches initiate on weak interfaces in snowpack where the internal stratification is predominantly controlled by meteorological events. However, little is known about how snowpack stratigraphy varies across a slope and what influences local topography has on the internal structure. Although snowpack on a slope can appear “uniform” (consistent aspect, inclination, curvature, exposure and relative altitude), the internal stratigraphy and stability are not necessarily consistent. This study addresses what roles rock outcrops, topographic lows and base irregularities play in internal snow structure. How does base topography and seasonal snow-infill change snowpack stratigraphy and stability? Is the snowpack around outcrops less stable?

This thesis is a two-part research project with field sites in Svalbard, Norwegian High Arctic and the Presidential Range of New Hampshire in New England. Initial research during the spring of 2010 on Svalbard’s biggest island, Spitsbergen was focused around the main settlement, Longyearbyen. Phase two of the project proceeded in the winter of 2011, at Tuckerman Ravine, flanking the eastern side of Mount Washington. The study was conducted on small uniform slopes during intensive field days where numerous snow pits were excavated, each providing sites for three snow stability tests (Jamieson, 1999; Simenhois and Birkland, 2006) and occasional snow profiles (Fierz et al., 2009). By conducting the tests on a small uniform slope, it is possible to isolate ground topography as the focus by normalizing other variables that drive spatial dissimilarity. The study focuses on the relationship between the uniform slope surface, the irregular ground topography and subsequently the overlying snowpack. A complete understanding of

snowpack and the processes involved in its formation is crucial in maintaining a seasonal record monitoring snowpack stratigraphy/stability.

Spatial variability of the snowpack is one of the key factors in avalanche formation (Kronholm and Schweizer, 2003). A greater understanding of snow stability will enable better predictions as to where and when slab avalanches will occur. This knowledge becomes increasingly important as more people visit avalanche terrain, directly driving up the number of avalanche-related accidents. Initial study results show that field tests on the small uniform slopes have successfully isolated base topography as the key component driving variable stratigraphy and stability in snowpack. Also, inconsistent slab sizes on the multiple weak interfaces suggest ground irregularities have diminishing presence as snowpack increases and infilling occurs.

Poster

NITROGEN ISOTOPES IN *ZOSTERA MARINA*: A POTENTIAL INDICATOR OF ANTHROPOGENIC NUTRIENT LOADING IN CASCO BAY, GULF OF MAINE

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Estuaries that are in close proximity to densely populated areas and/or receive run-off from populated watersheds are particularly susceptible to nitrogen loading, which can lead to anthropogenic-caused eutrophication. The stable nitrogen isotope ratios ($\delta^{15}\text{N}$) of dissolved inorganic nitrogen (DIN) and *Zostera marina* are enriched in ^{15}N in densely populated estuaries of Cape Cod, where there are high levels of anthropogenic nitrogen. Little is known about whether this technique for identifying the presence of anthropogenic nutrients can be used on the coast of Maine. In this paper, two areas in the Casco Bay were studied to see if a populated area (Mackworth Island, Portland) shows ^{15}N enrichment relative to a less populated area (Maquoit Bay, Brunswick). The DIN and the *Zostera marina* from Mackworth Island have $\delta^{15}\text{N}$ values $\sim 2.5\text{‰}$ enriched relative to Maquoit Bay, suggesting that nitrogen isotopes in *Zostera marina* can be used to detect the presence of anthropogenic nitrogen. This information has the potential to help indicate early signs of eutrophication and help prevent any further nutrient overloading in Casco Bay.

Poster

IMBRICATED SEBOOMOOK GROUP, BALD MOUNTAIN, WEST-CENTRAL MAINE: TECTONIC, SLUMP, OR MIXED ORIGIN?

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Bald Mountain is composed of sillimanite-grade, pelite-rich turbidites correlated with the Devonian Seboomook Group. This site hosts several examples of imbrications, requiring the presence of a series of thrust faults. These are demonstrated by four distinct markers recognizable by “barcodes” of sand and pelite layers. The nature of the fault system is cryptic: in some places the shear surface is decorated by quartz veins, while other places lack an obvious shear surface where one must exist (i.e. between imbrications). This implies either that shearing was distributed over a wide area, or that metamorphic recrystallization has eradicated the fault surfaces. Bedding orientations on Bald Mountain follow an asymmetrical pattern of alternating subhorizontal, upright limbs and steeply dipping, southeast-topping limbs on subhorizontal, northeast-trending F_2 hinges. S_2 schistosity is displayed across the map area dipping 80° towards 293° . Beds in the footwall to the northwest are thin with similar abundances of sand and mud. Within the duplex beds are thicker and mud-dominated, and S_1 schistosity is displayed dipping 78° towards 330° within a refolded F_1 isocline. Higher in the hanging wall to the southeast, beds dip more moderately ($32\text{--}40^\circ$) and still top to the southeast. Both the quartz-decorated fault and ductile isoclines show F_2 folding; the close spatial relationship between them suggests the same D_1 event. Since the pluton-related heat that could have caused the ductile nature of F_1 isoclines and cryptic faults was post- D_2 , these structures indicate liquefaction of bedding during D_1 deformation. However, the quartz-decorated fault and early cleavage plane suggests at least partially indurated bedding during D_1 deformation. This leads to our conclusion of a syn-sedimentary fault, resulting either from down-slope movement in the foreland basin or thrusting/slumping at the Acadian deformation front.

Oral Presentation

PALEOSTRESS ANALYSIS OF MESOZOIC RIFTING IN FRACTURES AND BASALT DIKES, GREAT GULF, NH

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A brittle structural analysis was done in the Great Gulf Wilderness and Mt. Clay area of the Presidential Range, NH, to complete an understanding of the deformational history of the region and relate brittle structures and intrusions to the broader regional tectonic context. GPS/GIS mapping of basalts and joints in the Silurian Rangeley Fm. migmatites and Devonian Littleton Fm. schist and quartzite was done where excellent outcrop abundance and steep relief dominate. Three basalt dikes were mapped, and all strike approximately 55° and dip $65\text{--}75^\circ\text{SE}$. Four extensional joint sets were defined using Kamb's contour method. The oldest, basalt-parallel set

strikes 55° and dips 75°SE . This set is best defined in the Rangeley Fm., and dips near vertical in the Littleton. The other joint sets, in order of decreasing age, are: a set striking 100° and dipping 65°N ; a set striking 170° and dipping 65°W ; and a sheeted set striking 60° and dipping 20°W . These results confirm regional studies in New England and Quebec that show a NW-SE extensional stress related to rifting of Pangea, followed by local E-W then N-S extensional stresses related to New England-Quebec igneous province intrusions, White Mountain Magmatic Series intrusions, and later rift events.

Poster

A BIOGEOCHEMICAL STUDY OF DITCHPLUG AND NATURAL POOLS IN THE SPRAGUE RIVER MARSH, PHIPPSBURG, ME

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Many of the marshes in New England currently have a network of small, hand-dug ditches (put into place by the first European settlers 300+ years ago). These ditches are very efficient at draining and flooding the marsh surface during the tidal cycle. In an effort to restore these ditched marshes, the U.S. Fish and Wildlife Service plugged eleven ditches in the southern end of the Sprague River marsh beginning in the early 2000's. The purpose of this research is to study the biogeochemical cycling of carbon in ditchplug and natural pools in the Sprague River Marsh in Phippsburg, Maine. In the summer of 2010 mummichogs (*Fundulus heteroclitus*), surface sediment, vegetation, biomass cores, and other marine organicsms were collected for stable isotope analysis from three natural and ditchplug pools. General water quality parameters and nutrient data were also monitored. The vegetation surrounding the pools was mapped and the elevation of the marsh surface was analyzed using LIDAR. The natural pools were at a slightly higher elevation and were surrounded by more C4 vegetation than the ditchplug pools. Isotopic results indicate that the local vegetation composition plays a key role in determining the isotopic composition of mummichog diets, whereas nutrient concentrations and primary production rates play a key role in determining the isotopic composition of POM. The differences in biogeo-chemical cycling between the natural and ditchplug pools may, in part, be due to the location of the pools on the marsh, in addition to the nature of the ditchplug pools. Further work is needed to understand the impacts of ditchplug restoration on the salt marsh, and should focus on hydrologic and geochemical indicators in addition to carbon and sulfur cycling on the surface of the marsh.

Poster

USE OF ARCHIVAL DATASETS TO DETERMINE
SEASONAL CHANGES IN ANDROSCOGGIN RIVER
WATER QUALITY: 1943-2004

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Beginning in 1930, scientists began studying the condition of the Androscoggin River due to both its economic significance and rising concern over deteriorating water quality. In 1943, Dr. Walter A. Lawrance was appointed Rivermaster by the Maine Supreme Court with the task of mitigating the effects of water pollution through effluent caps and legislation. Dr. Lawrance sampled water at sites from Berlin, NH to Lisbon Falls, ME from the summer of 1943 to the summer of 1977, testing a range of water quality parameters including dissolved oxygen (DO), biological oxygen demand (BOD), water temperature, pH, and methylene blue stability among others. The goal of this project was to convert materials from the Lawrance Papers, into electronic format for ease of analysis and use on the web. Presented here is the first compilation of DO data from Turner Center Bridge through datasets available from Muskie Archives and the Maine Department of Environmental Protection. Data analysis indicates a major shift in dissolved oxygen over the tenure of Dr. Lawrance, with DO levels on average 4 ppm higher than initial values. This increasing trend appears to be correlated to shifts in both the manufacturing process as well as major policy shifts such as the Clean Water Act. The long-term dataset will be presented in the context of both policy shifts and environmental significance.

Oral Presentation

THE VOGAR FISSURE SWARM, REYKJANES
PENINSULA, ICELAND: ASEISMIC KINEMATICS OF
AN OBLIQUE RIFT ZONE

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Exposure of the Mid-Atlantic ridge in Iceland offers a unique place to study hotspot-ridge interactions along an oblique rift zone. The Reykjanes Peninsula is a left-lateral shear zone characterized by a series of NE striking en echelon fissure swarms oblique to the rift axis, and N-S trending dextral strike-slip faults. This study focuses on the Vogar fissure swarm in southwest Iceland, in order to better constrain the mode of deformation within it. Movement of the faults and fissures that make up the fissure swarm is thought to either be related to seismic events along the ridge, or occur aseismically due to dike

injections during eruptive episodes. GPS measurements and field based mapping were employed to examine a 7 x 3 km cross section of the fissure swarm in order to constrain its kinematics. The faults tend to terminate at the contact of a historical fissure lava and an ~12,000 year-old shield lava. Cooling properties of the historical lava flow and overflowed pre-existing faults were concluded to contribute to its present day structure. The faults' termination at the historical lava supports the theory that movement along the faults occurs primarily aseismically during eruptive episodes. With this assumption a hypothetical cross section was created of the Vogar fissure swarm extending to the base of the crust, relating the normal faults at the surface to dikes at depth. The continued activity along the Reykjanes Peninsula suggests that it is still a very active spreading center, making it important to constrain the types of deformation that characterize it.

Poster

INDIRECT EFFECTS OF EXCESSIVE SHELLFISH
HARVESTING BY HUMANS ON BIRD PREDATORS
IN SALT MARSHES OF THE LITCHFIELD BEACH
AREA, SOUTH CAROLINA OVER THE LAST 1800
YEARS

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Shell middens are refuse deposits of discarded materials. Salt marshes in the Litchfield Beach area of South Carolina contain sixteen archaeological shell middens (dated 1770-1590 to 300-80 cal. years B.P.) dominated by the bivalve mollusk *Mercenaria mercenaria*. Jones and Quitmyer (2008) found a declining trend in mean ontogenetic age of *Mercenaria* from 1770-320 B.P. followed by a rebound; the decline in ontogenetic age has been attributed to population growth and/or intensification of harvest. To assess possible human impacts on other salt-marsh predators of *Mercenaria*, this study focused on diagnostic, posteriorly located, v-shaped scars found on many *Mercenaria* specimens from the same samples used by Jones and Quitmyer (2008) in their study. These scars represent failed predation attempts on *Mercenaria* by *Haematopus palliatus*, the American oystercatcher. Oystercatchers attack bivalve prey using a strong, elongated beak, which they pierce into the sediment to search for prey and pry open shells. Predictably, trends in body size (a proxy for ontogenetic age) of *Mercenaria* matched those found by Jones and Quitmyer (2008). Body size of *Mercenaria* specimens peaked at 1770-1590 cal years B.P. (avg. height at death = 66 mm, n=134) and was smallest from 660-320 cal years B.P. (avg. height at death=54 mm, n=232). The frequency of shell repair (the percent of shells with at least one v-shaped scar) prior to the rebound also followed this same trend (predation scar frequency = 18% (n=134) and 7% (n=232) for middens dated 1770-1590 and 660-320 cal years B.P., respectively).

The declining frequency of shell repair implies that excessive shellfishing (1770-320 B.P.) by humans may have depleted *Mercenaria* as a prey resource for oystercatchers, forcing these predators to switch to a different prey item. However, when repair-scar frequency is standardized by *Mercenaria* size (because the accumulation of shell repairs is often size dependent), the patterns are no longer correlated, suggesting that oystercatcher foraging behavior was not affected by overharvesting pressures. These divergent interpretations highlight the importance of the standardization of repair-scar data.

Poster

NITROGEN ISOTOPES IN LAKE SEDIMENTS FROM THE ANDROSCOGGIN WATERSHED: A PROXY FOR ANADROMOUS FISH RUNS?

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The connectivity between fresh water and marine ecosystems is well illustrated by the life cycle of anadromous fish species (e.g., alewife). Alewives mature in marine systems and migrate to freshwater lakes to spawn, after which they return to the ocean. Northern New England rivers have a long history of human alteration (e.g., dams, industry, pollution), which has interfered with anadromous fish runs in freshwater systems. Little is known about the extent to which anadromous fish-derived nutrients contribute to freshwater lakes in northern New England, nor the importance of marine-derived nutrients prior to human alterations of these river systems.

Nitrogen isotopes in lake sediment cores have been used to track the historic presence of nutrients derived from anadromous fish in settings with minimal anthropogenic watershed disturbance (e.g., Pacific Northwest; Finney et al. 2000; 2002; 2010). This study investigates nitrogen isotope composition of sediment cores over 500 years from the Androscoggin watershed. Surface cores were analyzed for ^{15}N composition from four lakes: Basin Pond (no known alewives, serving as a baseline); Thompson Lake (no modern alewife runs but uncertain historical records); Tripp Pond and Taylor Pond (modern sea-run alewife runs).

A plutonium-isotope age model was determined for sedimentation in Tripp Pond (1.4 mm/yr), and applied to Thompson Pond. The oldest sediments were recovered from Basin Pond, extending back to 1688. In Taylor, Tripp and Thompson Ponds, the nitrogen isotope data become progressively more enriched in ^{15}N from 1700 AD to the present, whereas in Basin Pond, the ^{15}N data remain relatively constant through this time period. Given that the first major dams on the Androscoggin River were installed during the late 1600s, and that anadromous fish runs have declined over the recent past, the ^{15}N enriched sedimentary

signals likely reflect localized land use patterns within each watershed. Future work should concentrate on extracting longer sediment cores from lakes thought to provide good spawning habitat for anadromous fish. Only then will the question of whether $\delta^{15}\text{N}$ values can be used as a proxy for anadromous fish be answered.

Finney, B.P., Gregory-Eaves, I., Sweetman, J., Douglas, M.S.V., Smol, J.P. (2000) Impacts of Climatic Change on Pacific Salmon Abundance Over the Past 300 Years. *Science* 290: 795-799.

Finney, B.P., Gregory-Eaves, I., Douglas, M.S.V., Smol, J.P. (2002) Fisheries productivity in the northeastern Pacific Ocean over the past 2,200 years. *Nature* 416: 729-733.

Finney, B.P., Alheit, J., Emeis, K.C., Field, D.B., Gutiérrez, D., Struck, U. (2010) Paleoecological studies on variability in marine fish populations: A long-term perspective on the impacts of climatic change on marine ecosystems. *Journal of Marine Systems* 79: 316-326.

Poster

LIZARDITE DISSOLUTION IN OXALIC ACID

YARDLEY, Eileen, M.S., Dept. Earth Sciences, Univ. Maine; OLSEN, Amanda, Assistant Professor, Univ. Maine; and HAUSRATH, Elisabeth, Assistant Professor, Univ. Las Vegas.

Eileen.Spinney@umit.maine.edu

Climate change due to atmospheric carbon dioxide has received growing concern as energy demands for development continues to raise anthropogenic carbon dioxide emissions. Mineral weathering is a major contributor to long-term global climate through the control of atmospheric carbon dioxide. Weathering products such as calcium and magnesium react with dissolved carbon dioxide to form carbonate minerals and form a long-term sink for carbon dioxide. Magnesium silicate minerals, such as serpentine, have been chosen for carbon sequestration because they are more concentrated and more reactive than calcium silicate minerals. Overcoming the rate-limiting step of serpentine dissolution has been the focus of researchers for improving carbon mineralization techniques. Various physical and chemical treatments including oxalic acid, a natural plant and fungal ligand, have been evaluated as possible reaction catalysts.

The objective of this research is to determine the extent to which oxalic acid contributes to chemical weathering rates of the serpentine mineral lizardite. Multiple batch reactor experiments, systematically varying pH and oxalic acid concentrations, were carried out for 48 hours and sampled at 1, 2, 3, 4, 24, and 48 hours. Samples were analyzed for magnesium, silica, and trace metals. Magnesium and silica release rates were calculated to determine a rate law for lizardite dissolution with and without oxalic acid. The rates of lizardite destruction as calculated by Si release are:

$$r = 10^{-11.2} [H^+]^{0.2} \quad ; \quad r = 10^{-10.2} [H^+]^{0.34} [Ox^{2-}]^{0.56}$$

Rate laws show that when oxalic acid is added to batch reactors, lizardite dissolution rates are an order of magnitude faster than dissolution rates when oxalic acid is absent. Trace metal concentrations decreased over time in experiments with less than 5mM oxalate, co-precipitating with iron oxide onto lizardite grains. In experiments with higher oxalate concentrations, trace metals remained more mobile in solution, increasing in concentration with lizardite dissolution.

GSM SECRETARY'S REPORT

The GSM Spring Meeting was graciously hosted by the Bates College Geology Department in the New Commons Building. Special thanks to Marita Bryant and Brenda Pelletier for the preparation and organization.

Executive Council Meeting

A meeting of the Executive Council began around 11 am. In attendance were Alice Kelley, Keith Taylor, Martha Mixon, Daniel Belknap, Cliff Lippitt, Thomas K. Weddle and Walter Anderson. Topics discussed included funding of high-school student travel to GSM meetings, the summer field trip, and potential themes for the fall meeting planned for Unity College. No motions were made or votes taken. All topics covered in the Executive Council meeting were later covered in the Business Meeting.

Poster and Oral Presentations, Undergraduate Students

The program began at 1 pm with a poster session, followed by oral presentations by undergraduate students from Maine colleges and universities. There were 14 poster presentations and 3 oral presentations. Abstracts of all presentations are included in this newsletter. The presentations were judged by volunteers from the Executive Council and awards were presented at the beginning of the business meeting (see Business Meeting notes for winners). Tough choices were made among the presenters to select winners, with very wide range of topics. All were high quality presentations. Thanks to the students who participated. In addition to the undergraduate presentations, earth science students from Blue Hill High School presented a poster on their research on aeolian deposits in New Sharon, Maine, under the direction of geologist and earth science teacher Patti Millette. They did an awesome

job presenting their original research, and revealed a sophisticated understanding of their topic.

Business Meeting

The business meeting followed the presentations. The following summarizes the announcements and discussions:

- Awards for posters and oral presentations. The award for outstanding poster presentation went to Robin F. Arnold of UMO, for her poster titled "Determining Seabed Pockmark Activity with ²¹⁰PB Dating in Belfast Bay, ME's Giant Pockmark Field". The best speaker award went to Carter A. Kindley for his talk titled "Paleostress analysis of Mesozoic rifting in fractures and basalt dikes, Great Gulf, NH". Checks for \$100 were issued by Lois Ongley, treasurer, to the two winners. The Walter Anderson Education Fund is the source of these awards. (Note to future participants: Your odds for winning the \$100 prize are much better in the oral presentation category.) Plaques listing the winners will be updated to include the names of this years award recipients, and delivered to the students' home schools for display.
- Discussion of summer field trip alternatives. Possibilities include a trip to the Deboullie Public Reserve Land, or the Stetson Mountain or Mars Hill wind farm areas. The membership will be notified via email when the location and schedule is determined.
- Funding for high school student travel to GSM meetings. A request was received a few weeks prior to the meeting from earth science teacher Patti Millette for funding in the amount of \$275 to pay for a school bus to transport her students from Mt. Blue High School to the GSM meeting. The board approved the request as a one-time emergency grant. A recommendation was made to the Education Committee that it create a procedure for handling such requests in an equitable way, and that a cap of \$1000 per year be set on such request. The procedure will include an application form submitted 6 weeks prior to the meeting. The focus of the transportation funding should be high school students, especially those who are presenting poster or oral presentations at the Spring meeting.
- Please contact Julia Daly (dalyj@maine.edu) if you are on the education committee, or would like to be.

- At the invitation of Lois Ongley, the fall meeting will be hosted by Unity College in Unity, Maine. Unity College has not hosted a meeting before, and Lois requested help in organizing it. A date has not been set.
- Possible themes for the fall meeting were suggested. Suggestions included 1) a survey of geologic research that is going in the state or region, 2) science uses and misuses, tension between science and politics, 3) but other themes or topics are welcomed. In general, a mix of applied and academic topics is desired.
- The Geological Society of Vermont and the Geological Society of New Hampshire are holding a joint field trip this summer in northern New Hampshire on July 30th. GSM will continue with its own plans for a summer field trip, but individual members are invited to join NH and VT. If interested, contact Woody Thompson at the Maine Geological Survey (Woodrow.B.Thompson@maine.gov).
- The treasurer's report was presented by Lois Ongley.
- Continuing education credits form was provided for those requesting credits for attending the meeting.
- The Maine Geological Survey announces publication of its guide to the geology of Baxter State Park: Rankin, Douglas W., and Caldwell, Dabney W., 2010, A Guide to the Geology of Baxter State Park and Katahdin: Maine Geological Survey (Department of Conservation), Bulletin 43, 80 p., 2 color maps, price \$10.00
- Kevin McCartney announced that he has received a request from a colleague in Utah for specimens of Maine staurolite with 45 and 90 twinning for a museum display of Staurolites from the US. The colleague offers New Mexico specimens for trade or Kevin is willing to purchase specimens as a donation to the museum. Contact him at Kevin.mccartney@umpi.edu
- Dan Belknap announced a deadline of May 25th for the next newsletter. He specifically requests news from the campuses.
- Bates College and the Geology Department were recognized and thanked for hosting the meeting, with special thanks to Marita Bryant and Brenda Pelletier.
- No motions were made or votes taken, other than to adjourn.

Social Hour

A good time was had by all. Appetizers and an open bar were offered, compliments of Bates College.

Keynote Speaker, Beverly Johnson

Dr. Beverly Johnson of Bates College gave the keynote address. The talk was titled "Ecological Impact of Human Activities on World Oceans". An abstract is attached.

Dinner

Some stayed for dinner in the commons, enjoying Bates College's the first rate-cuisine. Others began their journeys home to distant corners of the state.

Submitted by Martha N. Mixon, Secretary.

martha.mixon@gmail.com

MID TO LATE HOLOCENE SHIFTS IN PENOBSCOT BAY COASTAL ECOSYSTEMS

Beverly J. Johnson¹, Carrie Harris², William G. Ambrose, Jr.², and Bruce J. Bourque³.

(1) Department of Geology, Bates College; (2)

Department of Biology, Bates College, (3) Department of Anthropology, Bates College.

Long-term records of coastal ecosystems are typically gleaned from commercial fisheries catch data, satellite monitoring and *in situ* observations using SCUBA. These datasets are disparate, can be biased and represent relatively short periods of time (100+ years) in ecosystems that are often already altered by human activity. Longer records of environmental change are needed to determine baseline and natural variability in ecosystems. Stable carbon and nitrogen isotope analyses of ancient fish bones provide a method for assessing trends in nearshore primary production, trophic connectivity, and food web dynamics in the Gulf of Maine for the last 4,500 years.

The stable carbon and nitrogen isotope composition of fish [Atlantic cod (*Gadus morhua*), and winter flounder (*Pseudopleuronectes americanus*)] bone collagen was analyzed from multiple mid-to late Holocene archaeological sites in Penobscot Bay. Chronologies were determined using AMS radiocarbon of associated archaeological materials and span the last 4,500 years. All bones were well preserved, as evidence by the presence of a collagen ghost after demineralization, and atomic C/N values ranging between 3 and 4.

The overall trends in $\delta^{13}\text{C}$ indicate that flounder diets have become significantly more depleted in ^{13}C over the last ~1300 years, with the highest rate of change occurring over the last 400 years. Flounder occupy a relatively shallow range of water depths (1-100m), and are often found in the vicinity of eelgrass beds, thus the enriched $\delta^{13}\text{C}$ values of the mid Holocene flounder likely reflect an abundance of ^{13}C enriched eelgrass at the base of the food web. Cod diets are more depleted in ^{13}C than flounder in

the mid Holocene, and have remained relatively constant through time. Cod occupy a wider range of water depths (10-250m water depth) than flounder, and are often found in the vicinity of kelp beds. Thus, the $\delta^{13}\text{C}$ values of ancient cod likely reflect uptake of more macroalgae and perhaps more ^{13}C depleted phytoplankton-based primary production into the present day.

Recent changes in flounder diets have been rapid and indicate that there is ~50% less eelgrass present in Penobscot Bay today than through much of the Holocene. Loss of eelgrass may have resulted from a “shading out” effect (i.e., too much turbidity), dredging, and/or disease. The timing and spatial extent of this eelgrass loss is not known and continues to be investigated.

GSM TREASURER’S REPORT

The Society currently has 239 members, of whom 60% are up to date with their dues. In keeping with policy, we will drop any members more than two years in arrears at the end of this calendar year. The present membership is distributed as follows:

Students:	22	
Associates:	17	
Regular:	194	
Institutional:	6	
TOTAL:	229	Total Paid Up: 103

Balance On Hand: December 31, 2010

Anderson Fund Savings	\$ 5,199.21
Anderson Fund CD	\$ 6,003.30
Subtotal	\$ 11,202.51

General Fund Savings	\$ 25.02
General Fund CD	\$ 5,751.30
General Fund Money Market	\$ 3,499.93
General Fund Checking	\$ 102.47
Subtotal	\$ 9,378.22

Total	\$ 20,581.23
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Balance On Hand May 20, 2011

Anderson Fund Savings	\$ 5,583.53
Anderson Fund CD	\$ 6,016.10
Subtotal	\$ 11,559.63

General Fund Savings	\$ 2,025.29
General Fund CD	\$ 3,794.26
General Fund Money Market	\$ 2,503.46
General Fund Checking	\$ 1,375.45
Subtotal	\$ 9,668.46

Total	\$ 21,268.09
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Net gain [or loss]	\$ 686.86
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Respectfully submitted,

Lois K. Ongley, Treasurer (2010 -present)

longley@unity.edu

Editors Note: The Executive Committee and the Treasurer are discussing the layout of the reporting of income and expenses (annual cumulative versus between Newsletter dates; the later has been our standard). We will give a more complete report of the Income versus Expense in the next newsletter.

NEWS FROM THE CAMPUSES

The University Of Maine, Orono

On July 1, Scott Johnson will take over as Chair of the Department of Earth Sciences at the University of Maine. Joe Kelley will be stepping down after five years, and taking a well-deserved sabbatical.

University of Maine Farmington

Dave Gibson and Doug Reusch traveled with students to Fredericton, N.B. for the Atlantic Geoscience Society Colloquium, where UMF senior Jacob Hansen received the Graham Williams best poster award for his structural mapping research on Bald Mountain, near Wilton. Julia Daly and students Rob Abrams, Sara Adams, Sarah Lavorgna, and Amy Daniels, supported by Quimby Foundation funds, will continue their research on mountain ponds. Dr. Gibson and students Myles Fetch and Megan Whitman are funded to collect and analyze samples from the Augusta 1:100,000 sheet. Tom Eastler remains active in the Sandy River Watershed Association.

University of Maine Presque Isle

Kevin McCartney’s research sabbatical at the University of Nebraska a year ago has resulted in five articles to international micropaleontology journals. This work was on Cretaceous materials from several islands of the Canadian Archipelago and found two new genera and eighteen new species of silicoflagellates, including the new genus and species *Umpiocha umpiana*, named after his school. Kevin reports that he has considerably furthered the understanding of early silicoflagellate evolution.

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

\$20.00	REGULAR MEMBER	Graduate geologists, or equivalent, with one year of practice in geology, or with an advanced degree.	FEE SCHEDULE
\$20.00	INSTITUTIONAL MEMBER	Libraries, societies, agencies, businesses with interests in or practicing geology and related disciplines.	AS OF
\$10.00	ASSOCIATE MEMBER	Any person or organization desirous of association with the Society.	February, 2008
\$ 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 _____	Lois K. Ongley, Treasurer
Student Member	\$ 5.00	\$ _____		Unity College
Contributions to GSM		\$ _____		90 Quaker Hill Road
(please write gift or fund on check)				Unity, ME 04988
TOTAL ENCLOSED		\$ _____		

Email Address _____

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

2010/2011 SOCIETY YEAR BEGAN SEPTEMBER 1 - PLEASE SEND DUES TO TREASURER.

The DATE on your mailing address refers to PAID UP DUES DATE

THE GEOLOGICAL SOCIETY OF MAINE

c/o Daniel F. Belknap, Newsletter Editor
Department of Earth Sciences
111 Bryand Global Sciences Center
University of Maine
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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.

Return Service Requested

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

Lois K. Ongley, Professor of Geochemistry, Unity College,
90 Quaker Hill Rd., Unity, ME 04988 <longley@unity.edu>

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

Daniel F. Belknap, Dept. Earth Sciences, University of Maine,
Orono, ME 04469-5790 <belknap@maine.edu>

President	Alice Kelley	University of Maine
Vice President	Keith Taylor	St. Germain-Collins Consulting
Secretary	Martha Mixon	Consulting geologist
Treasurer	Lois Ongley	Unity College
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	Tom Weddle (09-12)	Maine Geological Survey
	Rudy Rawcliffe (10-13)	Northeast Geophysical Services