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Geological Society of Maine 2009 Summer Field Trip

JOIN US IN CAMDEN, AUGUST 8-9

Members and friends are invited for a weekend of field geology in Camden, August 8 and 9. The geology of the mid-coast area is among the most interesting and varied in the State. We will see old, beautiful, and inscrutable bedrock, complex glacial flow patterns and geomorphology, an elevated post-glacial relict shoreline, and modern eroding coastal bluffs, with occasional panoramic views. Saturday we will spend mostly in Camden Hills State Park, including some easy to moderate short hikes. Sunday we will wend our way toward the south, driving to Rockport and Warren. Trip leaders (as of this writing) are Spike Berry, Doug Reusch, Woody Thompson, and Tom Weddle. An intro to the area bedrock is the Mt. Battie MGS Site of the Month: http://www.maine.gov/doc/nrimc/mgs/explore/bedrock/sites/jul01.htm

Logistics: Meet at 9 a.m., Saturday, August 8 at Camden Hills State Park, at the picnic shelter on the ocean side (east) of Rt. 1. The group camping area at the park is reserved for us Friday and Saturday, Aug. 7-8 ($3/person/night). We will have dinner Saturday night in the group area. Please RSVP to Julia Daly (dalyj@maine.edu) by **July 24** if interested in camping or attending dinner, or contact her with questions. We hope to see you on the annual summer field trip!

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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.

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THE PRESIDENT'S MESSAGE

I'm off to Ireland/Scotland for the UMF field trip. Please read the blurb on the summer field trip that we've organized, and RSVP to Julia Daly (dalyj@maine.edu) by July 24 if interested in camping and/or attending dinner, or contact me with questions.

Julia Daly, President (2009-2010)
dalyj@maine.edu

THE EDITOR'S MESSAGE:

This is the traditional issue devoted to student abstracts from the Spring meeting. I was impressed with the quality of the presentations and written abstracts, which seem to get better every year, and are now in most cases equal to regional GSA or other professional meetings.

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 Rob Peale (see address on the last page).

Dan Belknap, Newsletter Editor (1998 – present)
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GSM WEBSITE: www.gsmmaine.org

The GSM website contains copies of present and archived Newsletters, a calendar of events, and other items of interest to the Society, including the updated Bylaws. There are many important links to geology items in Maine and elsewhere. There is a page on Maine geology and the Photo of the Month. Let us know what you think.

Webmaster, Mike Lerley mike@rentageekme.com

THE STATE GEOLOGIST'S MESSAGE

Biennial budget considerations

Everyone has heard much over the past six months about the problems with the State's 2010-2011 biennial budget and ever-dwindling revenue forecasts. With a revenue shortfall in the hundreds of millions of dollars for the biennium, all departments and agencies have felt the impact of cuts. These translate into reductions in services and benefits to all citizens of the state.

For the Maine Geological Survey, the cuts have been the most severe I have dealt with in 14 years as Director, and probably exceed the magnitude of cuts of the early 1990s. Coming after years of flat budgets and small cuts, no "easy" options remain for reductions. When faced with a request from the Governor's budget office to reduce MGS expenditures by ten percent, I was left with no option other than cutting positions. Fortunately, at the time the request came in we had two vacant positions – our receptionist/secretary and one hydrogeologist. Our receptionist left in mid-2008 for opportunities outside the state, and Marc Loiselle retired. Rather than increase the personal hardship of this economy by eliminating other occupied positions, I eliminated these vacant ones. Some members of our legislative oversight committee and the Appropriations commit-tee objected to these cuts as too severe in a time when groundwater science needed focus, and attempted to restore them. In the end, the dismal revenue forecasts prevailed and the positions were cut.

While the Survey we have now is probably not one that anyone would build from scratch, we still have viable programs that will deliver good service to our citizens. The good news is that over the past decade of state budget reductions, MGS has become very successful at pursuing outside funding opportunities. Agreements with other state agencies, the private sector, and competitive grants from the U.S. Geological Survey currently support 2.4 positions and much of our field operational expenses. We continue our major programs in basic geologic mapping, ground water investigations, and coastal geology.

But some things must change. The elimination of our receptionist means that there will be no cheery personality to greet visitors or callers. The typical receptionist/ clerical responsibilities will be distributed among the remaining staff. Although this is not the most efficient use of field staff, the volume of this work has diminished in the past five years due to posting of maps and reports on the internet, a huge manpower savings for us. Some of the work done by Marc simply will no longer be done – advanced GIS analysis, for example. But he left us in good positions on most of the systems he developed over his tenure, and the ability to use and maintain those systems has been transferred to other personnel. We have also established a cooperative program on groundwater investigations with the USGS, allowing us access to their significant analysis and modeling capabilities. With USGS contributing 50% to this effort, we are able to stretch our remaining state funds farther.

I hope that all of us in Maine's geological community weather this economic downturn well, and have an opportunity to rebuild when things improve.

Robert G. Marvinney, Maine State Geologist:
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GSM MEMBER NEWS

Please send member news to:
Carolyn Lepage, Member News Correspondent (1996-present) <calepage@adelphia.net> or
PO Box 1195, Auburn, ME 04211-1195 or
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GSM SECRETARY'S REPORT

Spring Meeting, April 3, 2009
Geology Department, Colby Bowdoin College
Waterville, Maine

The GSM Spring Meeting included a poster session and oral presentations by university and college students. It was hosted this year by the Colby College Geology Department, led by Dr. Robert Gastaldo. The setting was Colby's new comfortable, elegant, LEED-certified Diamond Building, for the poster session and talks, and the Roberts Union for Dinner and invited speaker.

The poster session began at 2 pm followed by oral presentations at 3 pm. These were followed by a business meeting, social hour, dinner and an evening speaker. The meeting adjourned at around 8:30 pm.

Student Presentations: Abstracts of the student poster presentations and talks are included in this newsletter. Winners of the Walter A. Anderson Award, recognizing outstanding student presentations were as follows:

Maura Foley, best oral presentation: Contact relationships of the Ammonoosuc Volcanics and the Jefferson Dome.

Amanda Dickey, best poster: Analysis of pottery and lithic artifacts from the Richards and Nevin sites, Blue Hill, Maine.

Congratulations to both students on fine presentations.

Business Meeting: The main topic of discussion at the business meeting, raised by Julia Daly, GSM president and education committee chair, was the need to maintain critical enrollments in geology programs in colleges and universities. The education committee has identified a need to focus on introducing students to geology in high school so they come to college with geology in mind. The education committee plans to start programs in the fall, and reinvigorate other programs, that will do this. Also discussed was the need to engage more students in GSM.

Suggestions made to accomplish this included moving the invited speaker to a slot between the student poster session and oral presentations rather than after dinner; more promotion of the meetings by college and university faculties; organizing press releases and other announcements for local newspapers, especially for students from small towns who are presenting at the spring meeting; and asking students what would interest them enough to attend and stay for the full meeting. It was noted that this year's spring meeting was on the coattails of Northeast GSA, and that different schools are on different schedules for spring break. For those driving a long distance, it would help to start and end the meeting earlier.

The summer field trip was discussed, but updates to that information are elsewhere in the newsletter.

Evening Speaker: The Keynote Address was delivered by Dr. Bruce Rueger, Colby College. It was titled "Geologic Influences on Benedict Arnold's March Through Maine to Quebec, 1775". Dr. Rueger retraced Benedict Arnold's route from Newburyport to Quebec. Following is the abstract:

Regarded as one of the greatest military logistical operations in history, Benedict Arnold's March to Quebec passed through our backyards in the fall of 1775. The intent of this expedition was to secretly travel up the Kennebec, Dead and Chaudière Rivers and capture the city of Quebec from the British. If successful, expedition leaders hoped to convince the populace of Quebec to throw in with the American cause. The expedition sailed up the Kennebec to Gardiner, where sailing vessels were exchanged for bateaux. The poorly constructed, heavy bateaux were used to travel the rest of the journey. Even today, this region is recognized as a wild, untamed area, but in 1775, the natural vegetation and geology of the region significantly impeded the progress of the expedition. What was thought would take three weeks ended up taking two months and covered a distance more than twice what was anticipated. The geology and related topography of the Kennebec and the Dead Rivers played a significant role in this important event in American history. This and the changes to the river system in the Maine portion of the expedition in the last 234 years is the focus of this talk.

For those interested in doing their own field trip retracing Benedict Arnold's route, or portions of it, Dr. Rueger recommended "Following Their Footsteps, A Travel Guide and History of the 1775 Secret Expedition to Capture Quebec" by Stephen Clark. (This book has hiking and canoeing guides.)

Perhaps a publication similar to "Maine's Ice Age Trail: Map and Guide" would be of interest to high school teachers for expeditionary-type learning, combining history and science.

Secretary, Martha N. Mixon, 2006 - present
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GSM Spring Meeting - April 3, 2009 ABSTRACTS

SEDIMENTATION IN HIGH ARCTIC LAKE, LINNÉVATNET, SVALBARD: A STUDY OF MODERN PROCESSES USING SEDIMENT TRAPS

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Linnévatnet is a High Arctic glacier-fed lake in Svalbard in which past climatic characteristics are recorded in laminated lake sediments that likely span the past 9,000 years. The laminae are comprised of annual terrigenous couplets consisting of distinct coarse summer and fine winter layers. Previous studies in similar proglacial lakes throughout the Arctic and alpine regions have determined that varves of this type may record an archive of past weather and climatic influences in the catchment area.

Sedimentation in Linnévatnet has been studied since 2003 using sediment traps and instruments deployed yearly and seasonally. The traps were deployed at five locations in the lake proximal and distal to the major inlet. Depending on the water depth at each location two to five traps were attached mooring lines. In the sediment traps the summer melt season sediment is represented by distinct coarse sediment events reflecting meltwater pulses, the timing of which are constrained by time lapse photography and loggers on the moorings. The first and coarsest (26 microns) grained sediment pulse was deposited on July 4 – 5, 2008, coinciding with peak snowmelt discharge. Subsequent events appear as finer (12 – 14 microns) graded laminae in the traps and are associated with similar high discharge events in mid-July. The fine winter layer (5 – 8 microns) coarsens slightly upward and reflects quiet winter sedimentation.

Sediment stratigraphy and grain size trends in 2007 – 2008 were compiled with sediment trap analyses back to 2003 to form a composite record to compare with lake bottom deposition as reflected in sediment cores recovered adjacent to the moorings. Thin sections of laminated sediments from the cores display complex summer layer stratigraphy with multiple sedimentation units as seen in the sediment traps. Correlation between distinct units in the thin sections and sediment traps will allow evaluation of climatic and environmental conditions responsible deposition of varved sediments.

MAPPING THE CHRONOLOGY OF POST-GLACIAL SEA-LEVEL RISE IN MAINE FROM 21 KYA TO PRESENT.

ARNOLD, Megan, Geology Department, Bates College, Lewiston, ME . marnold@bates.edu

The major North American Last Glacial Maximum ice sheet, the Laurentide, extended into the Gulf of Maine

approximately 21,000 years ago and retreated to the coast at 13 kya. After the glaciers retreated sea level reached as far north as Bangor. This project uses data from the Maine Geographical Information System (ME GIS) such as 1:250,000 tiles, Gulf of Maine bathymetry, and surficial geology maps to model the post-glacial sea level rise (SLR). Elevation images will be used to "flood" the landscape at set sea-level events. A series of maps will be created to describe sea-level conditions at the major events of 21 ka, 18 ka, 13 ka, and 11 ka when Maine was ice free. The goals are to determine the furthest extent of sea level in Maine at these times and to determine what areas were submerged.

LINEAMENT ANALYSIS OF PRESIDENTIAL RANGE, NEW HAMPSHIRE

CASTRO, Carlos, Geology Department, Bates College, Lewiston, ME. ccastro@bates.edu

The purpose of this research is to measure the fractured bedrock geometry of the Presidential Range, New Hampshire, in an effort to determine the paleostress regimes in the early Jurassic during continental rifting of the supercontinent Pangea. To do this, a detailed lineament analysis was made in order to identify bedrock fractures across the landscape. The fractures identified were correlated to the known Mesozoic basalt dikes in the range. Paleostress directions were inferred from the dominant lineament trends.

The lineament analysis was performed in ArcGIS on three separate datasets: 1) 30 m resolution black and white orthophoto imagery; 2) hillshade maps derived from 10m digital elevation raster data with an illumination angle of 315 and 45; and 3) 1m resolution SPOT Earth observation satellite imagery. Two observers participated in the lineament anlaysis and only common lineaments were shown. All three lineament sets were merged and the duplicates removed. The strike of the lineaments was assumed to be the azimuth of lineaments while the dip was assumed to be 90. The data were then exported and plotted as rose diagrams. A map of known basalt dikes was georeferenced and the dikes traced as line features.

The orthophotos and hillshade datasets show two dominant trends going NE and NW as well as a minor trend oriented NNW. The SPOT data show a dominant NW trend and a minor NNW trend. Basalt dikes are oriented NE with a minor trend going N. Hillshade lineaments were the longest, orthophotos had a mixed range of length, and the SPOT data had the shortest lineaments.

From the basalts, the dominant NE set suggests NW to SE extension with the possibility of the minor N set showing EW extension. The orthophoto and DEM data also support the NW to SE extension. Although the SPOT data are inconsistent with other dominant trends, they suggest NE to SW extension. From this analysis, it is possible that two or more paleostress orientations existed during the Mesozoic rifting. This study will be followed by an in-depth field season at Huntington and Tuckerman ravines measuring the fractured bedrock geometry.

SEASONAL PROCESSES AFFECTING THE SEAWALL BEACH SYSTEM: AN INVESTIGATION OF THE EVOLUTION OF THE SOUTHWESTERN SPIT AND THE SPRAGUE RIVER INLET

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Sea-level rise, seasonal weather patterns and storms have dramatic effects on barrier beach systems and can cause erosion and shifts in shoreline location. Seawall Beach, in Phippsburg, Maine is an undeveloped barrier beach system, making it a premier location to study the dynamics of barrier systems. The barrier is bordered by two tidal inlets, the Morse River to the northeast and the Sprague River to the southwest. The inlets have shown significant migration over the past 60 years causing loss to recreational beaches bordering the barrier system. This study focuses on the changing morphology of western Seawall Beach and the Sprague River tidal inlet from summer 2008 to winter 2009.

Long-term observation of the western sector of the barrier system from aerial and historic photograph analysis (1950s to present) demonstrates the development of a prominent southwest barrier spit and the westward shift of the Sprague River. Seasonal changes observed in beach profiles and time-lapse photography show that wave refraction, caused by the position of offshore bedrock outcrops and the Cape Small headland, enhances longshore sediment transport southwestward forming the present-day extended barrier spit. Although the Sprague River is constrained from further westward migration by the bedrock outcrops of Cape Small, in this period of dominant southwestward longshore transport, the barrier spit obstructs eastward migration of the inlet channel. Major storm erosion of the spit platform or a shift in the westward longshore transport pattern could allow a subsequent eastward migration of the Sprague inlet.

REPRESENTING MODERN MIGRATION OF THE MORSE RIVER INLET WITH AERIAL AND SATELLITE IMAGERY

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The Morse River tidal inlet is part of the undeveloped, Seawall Beach barrier system in Phippsburg, Maine. The system is highly dynamic and changes as a result of hydrographic conditions. Throughout the past 50 years, the inlet channel has shifted dramatically. The present migration has eroded the adjacent dunes at Popham Beach State Park and the loss of sediment has caused the uprooting of trees in recent months. Using geo-referenced historic aerial and satellite imagery from 1953 to 2009,

migrations of the inlet are analyzed in ArcGIS. Analysis is done by drawing polygons to represent past inlet channel locations and creating maps displaying the extent of migrations. By comparing historic channel locations, it is possible to determine the rates of inlet migration between 1953 and 2009 and thereby better understand the nature of the Morse inlet migrations.

SPECTRAL REFLECTANCE-BASED OBSERVATION OF DIATOMS AND DINOFLAGELLATES IN HARPSWELL SOUND, MAINE

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Annual spring blooms of the phytoplankton *Alexandrium fundyense* in the Gulf of Maine are problematic for human health and the Maine economy. Neurotoxins produced by *A. fundyense* accumulate in shellfish, leading to the potential for Paralytic Shellfish Poisoning (PSP) in humans who consume the shellfish. One proposed method for the observation of *A. fundyense* is the use of satellite remote sensing. However, *A. fundyense* is difficult to monitor directly since it is usually not a major component of the total phytoplankton population. To account for this, the presence of dinoflagellates is used as a proxy for *A. fundyense*, since microscopic cell count data has shown a correlation between the presence of dinoflagellates and *A. fundyense*. Water samples for cell counts, pigment, and absorption analysis were collected in Harpswell Sound two times per week from March to August 2008, and once per week in September and October 2008. Microscopic cell counts were used to determine dates when dinoflagellates or diatoms were present as the majority of the phytoplankton population. HPLC pigment analysis from the same dates and times shows that the presence of differently absorbing carotenoid pigments is well correlated with the two phytoplankton groups. Measured absorption values were then analyzed, and differences in absorption spectra were observed on days when dinoflagellates or diatoms were the majority of the phytoplankton population. Finally, dates with known differences in absorption will be used to look for differences in spectral reflectance, measured with a Satlantic TSRB buoy deployed in Harpswell Sound from May 14 to October 10 2008. It is expected that differences in absorption will indicate differences in spectral reflectance, since reflectance varies inversely with changes in absorption spectra. Modeled spectral reflectance of different absorption components show that the presence of the two phytoplankton groups can be discerned based on measured reflectance. After the reflectance model has been validated, an inverse reflectance model will be applied to reflectance data from May through October 2008. These data, combined with other hydrological data, will allow some insight into the dynamics of *A. fundyense* in Harpswell Sound and the abilities of satellite remote sensing to detect its presence.

ANALYSIS OF POTTERY AND LITHIC ARTIFACTS FROM THE RICHARDS AND NEVIN SITES, BLUE HILL BAY MAINE

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The Richards and Nevin sites are two contemporaneous sites, located in the town of Blue Hill, Maine. Excavated in the 1930s, these are two of the largest archaeological sites in the region. These sites contain over ten thousand individual pottery artifacts, which represent several hundred pots. Several hundred lithic artifacts together with a small assortment of copper implements are also present from the sites. Pottery shards recovered from both sites exhibit two decoration styles. The older dentate pottery ranges from 2300 to 1500 B.P. while the younger cord wrapped stick pottery ranges from 1500 to 450 years B.P. Open pit firing during manufacture indurated the pots. Pottery shards were ultrasonically disaggregated into their constituent clay – and silt - sized grains. The clay fraction contains an assemblage of quartz, muscovite, illite, and chlorite +/- plagioclase. The silt fraction consists of quartz, illite, muscovite, chlorite, orthoclase, and plagioclase. Several pots are clay-poor and consist almost entirely of silt-sized and larger grains. Pottery materials are consistent with that of local glacial marine clay and silt of the Presumpscot Formation. Mineralogy of the clay and silt sized portions of the pots suggests that the Presumpscot is a likely source.

Five principal varieties of stone implements are recognized from the two sites. Two varieties suggest sources from western and northern Maine and three varieties suggest origins from eastern Pennsylvania, Vermont and Nova Scotia. The two varieties interpreted to have origins from Maine are chert from the Munsungan Lake area west of Ashland, Kineo Rhyolite interpreted to have originated from the Moosehead Lake area. A red and yellow ochre colored jasper is interpreted to have originated in eastern Pennsylvania, while a fine – grained very well sorted quartzite is attributed to the Cheshire Quartzite from Vermont; and a mottled brownish brecciated jasper is interpreted to have originated from Nova Scotia. The copper for this group of artifacts is interpreted to have been derived from the Cap d'Or region of Nova Scotia.

CONTACT RELATIONSHIPS OF THE AMMONOOSUC VOLCANICS AND THE JEFFERSON DOME

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This study examines the contact relationship of the Ordovician Ammonoosuc Volcanics (Oam) and Oliverian Jefferson Dome (Obqm) along the southeast flank of the Bronson Hill Anticlinorium, northern NH. The purpose of the study is to evaluate the kinematics and timing of the contact to determine the pre- and syn-doming relationships. Previous work in the study area found mylonites in the Ammonoosuc that were interpreted to be normal faults that were later domed, switching dip sense. Moench and Aleinkoff (2003) interpret the contact to have been intrusive then domed. Tucker and Robinson (1990) propose a faulted relationship between the geochemically contrasting units that was later domed. Three detailed strip maps across the contact were made and oriented samples were collected for microstructral and geochronologic study. Detailed mapping shows that the Jefferson Dome is intercalated with a heterogeneous assemblage of Ammonoosuc lithologies with pervasive shear fabrics along the boundary decreasing in intensity away from the contact. The average strike and dip of mylonitic foliation is 58, 44 SE, which is accompanied by a variably strong lineation with an average trend and plunge of 110, 41. Microstructural shear sense indicators of 6 oriented samples distributed across the study show oblique normal slip along the foliation in its present domed orientation in the Oam and reverse motion in the Obqm. This is consistent with fabrics in the Oam being produced by diapiric doming but does not preclude the interpretation that these fabrics are domed earlier thrust faults. Indicators in the Obqm have been interpreted as earlier normal faulting domed to appear reverse. Monazite dating of Oam and Obqm constrains the timing of the contact to Silurian (415 +/- 7 ma) ages of normal faulting, Devonian (370 - 390 ma +/- 5 ma) doming ages, and Carboniferous (357 - 367 +/- 5 ma) Bickford plutonism ages.

TEMPERATURE VARIATION IN WESTERN MAINE PONDS

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Horns, Cranberry, and Tumbledown Ponds are located on Bigelow and Tumbledown Mountains in western Maine along the Appalachian Trail. They range in elevation from 2,437 to 3,130 feet and in size from 3 to 8 acres. These ponds are of significant ecological and recreational value; some are stocked with fish or are used as a water source for hikers. At present, historic records of seasonal markers such as ice-out dates are only available for larger, lower elevation lakes to assess response of these lakes to changing climate. By analyzing high-resolution water temperature data of these small, high elevation ponds, we hope to better understand their relationship to similar climate forcings. At each pond, loggers are placed at three depths: surface, 2 meters down, and at the bottom. Water temperature is logged every 20 minutes, resulting in high-resolution data sets. There are summer temperatures for all three ponds and a year-round record at Tumbledown. Loggers at Tumbledown show seasonal markers including fall turnovers, winter stratification, and ice-out. Surface temperatures at all three locations have similar daily trends, although the lowest elevation pond is slightly warmer. The timing of turnover events is similar at all three locations. Bottom temperature changes at Tumbledown and Horns Pond are similar, including a rapid mid-summer temperature increase attributed to a turnover event. Comparison to meteorological records in the future will determine what relationship wind speed and direction, air temperature, insolation, and precipitation have on water temperature and the timing turnover events. By monitoring these three ponds along with others long term, we will have records of seasonal markers and be able to determine how sensitive these small ponds are to climate change.

GIS MAPPING OF TRIBAL LAND ENVIRONMENTAL CONSTRAINTS FOR HOULTON BAND OF MALISEET INDIANS OF MAINE

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GIS is a powerful tool used to map environmental constraints. Environmental constraints are limits to development of lands. They may include poorly-drained soil, highly erodible soil, large slope gradient, wetlands, etc. In partnering with the Houlton Band of Maliseet Indians Natural Resources Department, we use ArcGIS to create environmental constraints datasets and maps. The datasets can be used for agricultural purposes, economic development, and planning for future residential lots while sustaining and managing the natural resources for the continuing benefit of the Maliseet people, its cultural and ecosystem health. The original data were collected by USDA and downloaded from Maine Office of GIS website. New data layers such as poorly drained soils, highly erodible soils, and shallow soils were derived with ArcGIS selection and spatial analyst tools. A new dataset of highly drained soil that may be not suitable for conventional septic systems in terms of housing development was also generated. Lands with slope gradient greater than 15% were derived from DEM data. Those lands with higher slope gradient are not recommended for agricultural, building, and other construction. The project assists the Native American

community well with the badly needed environmental constraints GIS datasets for its land planning, development, and conservation.

TEXTURAL ANALYSIS OF SELECTED ENCLAVES WITHIN THE SOUTH POND PHASE OF THE WALDOBORO PLUTON, FRIENDSHIP, MAINE

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Field evidence suggests that the unusual texture of some of the enclaves within the South Pond Phase of the Waldoboro Pluton Complex may be due to magma mixing processes. The granitic complex that intruded mid-coastal Maine during the Devonian consists of seven granitoid units. Evidence for anatexis of the Benner Hill and Bucksport Formations followed by restite-melt unmixing processes have been suggested for the origin of the enclaves present within the major phase of gneissic granites. The granite-country rock relationships along the eastern margin of the complex within the South Pond Phase however, are poorly understood due to intense deformation and recrystallization. Three different enclaves were sampled from the restite-rich granite porphyry of the South Pond Phase and were found to be texturally and mineralogically different from one another. Whereas two of the enclaves appear to represent restites of partial melting, the third, coarse grained, enclave may represent an autolith/zenolith source. The sample consists of primarily plagioclase and biotite, as well as anhedral amphibole and epidote. The enclave has experienced intense alternation as evidenced by deformation twins, kink folds, and alteration to chlorite and sericite. The enclaves do not show quench textures that would imply magma mixing, yet they are texturally distinct; while some appear restitic, others are proposed to be inclusions of an alternate member of the Waldoboro Pluton or owe their origin to a foreign source.

TESTING THE TRANSPRESSION HYPOTHESIS USING QUALITATIVE PORPHYROCLAST ANALYSES: AN EXAMPLE FROM THE SOUTHERN MYLONITE ZONE OF THE CHEYENNE BELT SHEAR-ZONE SYSTEM, WYOMING

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The Cheyenne belt of southeastern Wyoming is a system of subvertical plastic shear zones with down-dip elongation lineations forming the boundary between the Archean Wyoming craton and the Paleoproterozoic Colorado province. Previously it was interpreted as a series of dip-slip shear zones. However, numerical simulations of deformation indicate that this fabric geometry may record transpressional deformation with a large strike-slip component coupled with vertical extrusion out of the zone in response to a pure-shear component of deformation that controls elongation lineation orientation. Using samples from the southern mylonite zone of the Cheyenne Belt, this study is designed to test the transpression hypothesis.

Two mylonite samples with a granitic protolith were analyzed. Because feldspar porphyroclasts deformed plastically in these rocks, a semi-quantitative porphyroclast character-ization method was developed to classify the relative amounts and direction of asymmetry in the mylonite samples. Porphyroclasts were evaluated for shear sense while making transects across thin sections cut parallel with the lineation and perpendicular to the foliation, and parallel with strike and perpendicular to foliation. For one sample, a vertical, foliation-perpendicular face was also analyzed. The percentage of asymmetric versus ambiguous clasts was calculated and the dominant shear-sense direction was determined for each face. This method was tested for repeatability and precision by five individuals. The number of evaluated porphyroclasts varied between individuals; however the overall shear sense and percentage of asymmetric porphyroclasts versus ambiguous porphyroclasts remained nearly constant. Thus, a repeatable, semi-quantitative method for qualitative porphyroclast analyses was created.

In both samples, lineation-parallel, foliation-perpend-icular faces yield the largest percentage of asymmetric porphyroclasts indicating monoclinic flow with the vorticity vector sub-perpendicular to the lineation-parallel face. Both samples show dextral-reverse-oblique motion in geographic coordinates. These results do not indicate a transpressional geometry of the fault zone where elongation lineations track the pure-shear component of deformation.

CONTIBUTIONS TO THE UNDERSTANDING OF GLACIAL LAKE BIGELOW BETWEEN EUSTIS AND COBURN GORE, NORTHWESTERN MAINE

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A newly found Gilbert-style delta indicates a Pleistocene shoreline of Glacial Lake Bigelow in the Flagstaff Lake (Bigelow) Basin of 1280 ft above sea level. A contact of foreset and topset beds at this elevation was located in a sand and gravel pit north of Eustis, Maine and appears to correspond to the 1280-ft lake level suggested by Thompson et al. (2006), nearly 100 feet higher than estimated by 20th-century workers. This shoreline and the extensive local esker system within the Flagstaff Lake (Bigelow) Basin and adjacent North Branch Dead River Valley were mapped on USGS 7-1/2–minute quadrangles. Although neither lacustrine beds overlying esker deposits nor shoreline features have thus far been found in the uppermost part of the river valley, the 1280-ft contour should approximate the Glacial Lake Bigelow shoreline

and has been tentatively mapped all the way to and around the Chain of Ponds. Dip directions in sand and gravels from multiple sites are consistent with a meltwater source stream to the north-northwest. Thompson et al. (2006) stated that Glacial Lake Bigelow at the 1280-ft stage was merged with Glacial Lake Langtown to the southwest, making the present study area the extreme upvalley end of a very large proglacial lake system. This conjoined body of water was apparently dammed by an active ice margin to the east. As this margin retreated, the ice dams were breached, spillways were opened, and Glacial Lake Bigelow stabilized at a lower level. Patchy diamict atop deltaic sands and gravels at one site may be till from a minor re-advance following the drop in level or, more likely, ice-rafted debris deposited *en masse* in shallow waters during the 1280-ft lake stand.

MAPPING PRESQUE ISLE DOWNTOWN PEDESTRIAN NETWORK INFRASTRUCTURES AND HELPING ITS DOWNTOWN REVITALIZATION EFFORTS

MONAHAN, Jared, PROKEY, Jennifer and WANG, Chunzeng. College of Arts and Sciences, Univ. Maine at Presque Isle. <chunzeng.wang@umpi.edu>

The GIS Laboratory at the University of Maine at Presque Isle and the Presque Isle Department of Planning and Development are partnered to develop GIS databases to help city planning and development. One of the projects is to develop a downtown pedestrian network infrastructure GIS database that includes sidewalks, curbs, buffers between sidewalks and curbs, walkways, crosswalks, parking, utility and light poles, etc. In the fall of 2008, following determination of attributes for each type of infrastructure, we conducted field data collection of the infrastructures with a Trimble GeoXh unit and processed the data collected. One of the attributes for each infrastructure is the current condition, which could be good, fair, or poor. The data on condition help evaluation of the current infrastructures and estimation of the cost for replacement and improvement. The maps made through the project have helped the city to write a grant proposal for funding its effort toward downtown infrastructure improvement and revitalization.

MAPPING STORM WATER INFRASTRUCTURES AND DEVELOPING A GIS DATABASE FOR CITY PRESQUE ISLE

MONAHAN, Jared and WANG, Chunzeng, College of Arts and Sciences, University of Maine at Presque Isle. <chunzeng.wang@umpi.edu>

The GIS Laboratory at the University of Maine at Presque Isle and the Presque Isle Public Works Department (PIPW) are partnered to develop GIS databases of municipal infrastructures. One of the projects is to develop a storm water GIS database. In the summer of 2008, we conducted field data collection of 939 culverts as part of the project. A Trimble GeoXh GPS receiver with sub-foot accuracy was used to collect field geographic and non-geographic, attribute data. The non-geographic, attribute data collected include material type (CMP, HDPE, RCP, and AC), diameter, single culvert or twin culverts, class (driveway, sidewalk, cross street, and railroad), function (cross drain and stream crossing), condition (good, rusted, clogged, and collapsed), street, house (address), etc. The project has not only made the first-of-its-kind inventory of storm water infrastructures, but also developed a dynamic GIS database system for effective management of the municipal properties for the wellbeing of its citizens for the city of Presque Isle.

MAPPING SHORT-TERM BARRIER BEACH PROCESSES AT SEAWALL BEACH, PHIPPSBURG, MAINE, TO MODEL THE TRANSGRESSIVE SHORELINE IN 2100 FROM SEA-LEVEL RISE

OSTER, Dana, Bates College, Lewiston, Maine and DUVALL, Matt, Bates College Imaging and Computing Center. <doster@bates.edu>

The Maine coast is directly threatened by sea-level rise from projected climatic warming in the coming century. The barrier beach system migrates congruent to the changing ocean level. Understanding the seasonal and long-term system fluctuations is essential to predicting their response to accelerated sea level rise. The natural processes that dominate the structure of tidal inlets are the migration of sand from the swash-aligned beach ridge, bedrock morphology and sediment input from rivers. Seawall Beach, in Phippsburg, Maine, is between the Sprague River and the Morse River. It is part of the Bates-Morse Mountain Conservation Area (BMMCA) which is the largest undeveloped barrier beach complex in the state of Maine.

The purpose of this study was to create a computer model in ArcGIS to project a wide range of scenarios of changes in the shoreline at Seawall Beach caused by SLR in 2100. This project investigated the barrier beach system at Seawall Beach in a short term and long term time period, from May 2008 – May 2009. The seasonal changes of the beach were monitored using five selected transects across the beach to capture changes from the summer to winter profiles and calculate average beach slope. The slope was used in conjunction with four SLR scenarios and the Bruun Rule to find the horizontal transgression of the beach. All the beach features were mapped using a high-resolution GPS unit and the 2008 dune line was used to re-calculate the Bruun Rule values because the profiles could not extend out to closure depth. With the vertical and horizontal parameters set, the projected shoreline for 2100 revealed the vulnerabilities of the western segment of the beach and the Sprague Salt Marsh.

MICROSTRUCTURES OF THE WHITESTONE ANORTHOSITE: IMPLICATIONS FOR STRAIN LOCALIZATION AND THE INFLUENCE OF FLUIDS

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Insight into mechanisms that lead to the localization of strain in the deep orogenic crust is provided by microstructural and geochemical data from an anorthositic mass that was deformed at upper amphibolite facies within a shear zone in the Grenville Province of southern Ontario. The Whitestone Anorthosite is an anorthositic and leucogabbroic sill that was metamorphosed to granulite facies during the Grenville orogeny ca. 1.2 billion years ago. Following peak metamorphism, the Whitestone Anorthosite was deformed along its margins due to shearing. This area, known at the Parry Sound Shear Zone, is a 1 to 3 km wide ductile shear zone that separates large amphibolite and granulite facies lithotectonic domains. The undeformed core of the Whitestone Anorthosite preserves igneous textures and the granulite facies assemblage. Deformed rocks exhibit a planar fabric dominated by centimeter- to meter-scale shear zones that anastomose around lozenges of less deformed rock similar in texture to the undeformed core. Strain gradients at shear zone margins are moderate to high. Within low-strain rocks, two morphologies of hornblende replaced clinopyroxene under amphibolite facies conditions: a monophase hornblende rim surrounds a core composed of intergrown hornblende and quartz. The hornblende grains along the rims are enriched in Fe and Al relative to the hornblende in the core. In the moderately- to highly-strained rocks, all hornblende chemistries are identical and plagioclase feldspar shows a correlation between recrystallization and Na content. In places, the volatile-rich mineral scapolite replaces the recrystallized plagioclase feldspar grains. These observations show a correlation between fluids and strain within the Whitestone Anorthosite.

MULTI-PROXY ORGANIC GEOCHEMICAL ANALYSIS OF THE LATE-HOLOCENE SEDIMENT RECORD FROM MEETINGHOUSE POND, PHIPPSBURG, ME

PICKOFF, Mike, Environmental Studies Program, Bates College, Lewiston, ME. <mpickoff@bates.edu>

This study is a paleo-environmental reconstruction based on the late Holocene sediment record from Meetinghouse Pond in Phippsburg, Maine (43°76' N, 69°83'W). The pond has a surface area of approximately 0.03 km^2 with a mean depth of 2.7 m and maximum depth of 6.5 m. The basin has no continuous fluvial inlet, and therefore input is primarily a combination of precipitation and groundwater sources. Four surface cores, each approximately 50 cm in length and a 3.58 m percussion core were recovered from the study area. Together, these cores archive sedimentation from the late Holocene period (~ 0 – 1300 yr bp) which spans the Medieval Warm Period, Little Ice Age, and 20th Century warming as well as regional anthropogenic inhabitation. A range of analyses including %LOI, bulk magnetic susceptibility, C/N ratios, and stable isotope analysis of $d^{13}C$ and $d^{15}N$, are employed to detail and decipher the archive of environmental change available in the sedimentary record. An age model is generated based on $^{239+240}Pu$ isotope analysis. Five zones of temporal variability indicated by the resulting geochemical proxy suite are discussed and interpreted. Zone 5 (~726 – 1302 AD) is marked by relative stability with no apparent environmental or climatic changes. Zone 4 (~1302 – 1483 AD) exhibits trends that suggest bolstered paleo-productivity possibly in response to warmer temperatures. Zone 3 (~1552 – 1664 AD) exhibits synchronous depletions across the proxy suite, a response to a proposed Little Ice Age cooling episode. Zone 2 (~1707 – 1827 AD) exhibits a response to a watershed disturbance interpreted as regional deforestation following European settlement. Finally, Zone 1 (~1827 – present) shows a recovery of the watershed, with values returning to pre-deforestation levels as a comprehensive vegetation cover is established. Recent anthropogenic impact may be indicated by marked depletions in $d^{13}C$ and $d^{15}N$ in the uppermost sediments.

METHODS FOR LAND-COVER CLASSIFICATION IN ARCGIS

PICKOFF, Mike, Environmental Studies Program, Bates College, Lewiston, ME. <mpickoff@bates.edu>

A statewide land cover map of Maine is available for download from the MGIS. This map (melcd) uses a supervised classification, which includes regression tree modeling algorithms and spatial modeling to extrapolate land-cover over the entire state based on "assigned signatures." It appears to accurately represent the general land-cover on a broad scale, but at smaller scales, the accuracy of this map diminishes. This study explores the methods for generating accurate land-cover maps of small regions in ArcGIS. Two 1-foot orthoquad images, which encompass the Bates Morse Mountain Conservation Area and the Shortridge Coastal Environmental Research Center, are utilized. First, a land-cover map is manually drawn, taking advantage of the high-resolution aerial photos. Polygons are drawn for Buildings, Roads, Open Water, Wetlands/Marsh, Mixed Forest (dense), Mixed Forest (medium), Unconsolidated Shore, and Cleared Land. This feature class is dissolved based on a "classID" field, and the area for each land-cover classification is calculated. This new land-cover map can be used for students pursuing environmental research at one or both of the Bates facilities. Supervised and unsupervised classifications are run for the same study area using the

spatial analyst tools, and compared to the manually drawn map. Parameters are adjusted to improve accuracy and efficiency. A discussion of the advantages of each method is included.

RECONNAISSANCE FABRIC ANALYSES OF QUARTZITE MYLONITES, MEDICINE BOW MOUNTAINS, CHEYENNE BELT, SOUTHEASTERN WYOMING

SCHWARZ, Jacob J. and SULLIVAN, Walter A., Dept. Geology, Colby College, 5800 Mayflower Hill, Waterville, ME, 04901. <jschwarz@colby.edu>

This study reports reconnaissance quartz *c*-axis-fabric and microstructural analyses of part of the northern mylonite zone, Cheyenne Belt, Medicine Bow Mountains, southeastern Wyoming. Quartz *c*-axis and oblique-grain-shape fabrics were measured in three epidote-amphibolite-facies mylonitic quartzites to determine the nature and slip direction of the fault system. Strike-and-dip of foliations for the three samples range from 037° to 072° and 69° to 76° NW, and trend-and-plunge of elongation lineations range from 353° to 012° and 56° to 67°. Samples collected at the outer edge of the shear zone exhibit single-girdle quartz *c*-axis fabrics with only faint outlines of a second girdle, indicating simple-shear-dominated flow. A third sample from the interior of the shear zone yields an asymmetric cross-girdle *c*-axis fabric, indicating a large component of pure-shear. No previous studies report significant pure-shear flow in this shear zone system. The oblique-grain-shape fabrics indicate the same sense of shear as the asymmetric quartz *c*-axis fabrics. However, pervasive grain-boundary-migration dynamic recrystallization resulted in large variability in the long-axis orientation of recrystallized grains, making the oblique-grain-shape fabrics unsuitable for quantitative kinematic vorticity analyses. All samples from this study show S-side-up motion verging to the NNW. In present-day coordinates, this indicates an apparent normal sense of shear. There are two possible deformational scenarios that fit these data: (1) this shear zone may represent a reverse fault, later rotated through vertical (Duebendorfer, 1986), and (2) this shear zone may record subvertical extrusion with the simple-shear-dominated samples representing a stretching fault at the zone margins.

CRYSTALLIZATION OF BOROSILICATES IN A LATE STAGE PEGMATITE FROM THE LARSEMANN HILLS, PRYDZ BAY, EAST ANTARCTICA

WADOSKI, Eva, Dept. Earth Sciences, Univ. Maine, Orono, ME. Eva_Wadoski@umit.maine.edu
*graduate student

The Larsemann Hills are underlain by medium-pressure granulite-facies rocks cut by several generations of anatectic pegmatites where the later generation differs from earlier generations in being planar and only tens of centimeters thick. Using both electron microprobe analysis and optical petrography, we determined a sequence of crystallization of one pegmatite. The borosilicate minerals that are key to this investigation are tourmaline, boralsilite ($Al_{16}B_6Si_2O_{37}$), and dumortierite ($(Al,\square,Ti)Al_6(BO_3)Si_3O_{13}(O,OH)_2$). Preliminary results show a wide range in composition in both tourmaline and dumortierite, for example, tourmaline ranges in composition from schorl-dravite, $(Na_{0.54},K_{0.01},Ca_{0.06},\square_{0.39})(Fe_{1.98},Mg_{0.22},Al_{0.66}Ti_{0.03},\square_{0.10})Al_6(Si_{5.82},Al_{0.18})O_{18}(BO_3)_3(OH_{3.86},F_{0.09},Cl_{0.05})$, to foitite – olenite $(Na_{0.37},Ca_{0.03},\square_{0.59})(Fe_{2.16},Mg_{0.03},Al_{0.72},\square_{0.08})Al_6(Si_{5.99},Al_{0.01})O_{18}(BO_3)_3(OH_{3.9},F_{0.05},Cl_{0.05})$. Primary dumortierite forms prisms and contains low amount of As + Sb + Nb (0.13 wt% average as oxide) whereas secondary dumortierite, commonly found in fractures or as overgrowths of primary dumortierite, is more massive or fibrous, and contains higher concentrations of As + Sb + Nb (0.48 wt% average as oxide). Compositions of dumortierite and tourmaline vary with texture and distance from other minerals, notably K-feldspar. Dumortierite in close proximity to K-feldspar contains less TiO_2 (0.00 – 0.84 wt%) than dumortierite isolated from K-feldspar (2.45 – 5.45 wt%). Tourmaline is found with three distinct textures: large crystals with primary oscillatory zoning, in a graphic intergrowth with primary quartz and as a distinctly secondary phase replacing boralsilite. Both the primary and secondary tourmaline show a trend of increasing Al content with increasing proximity to K-feldspar. Boralsilite in splays, bundles or individual prisms surrounded by quartz is fractured and partially replaced by tourmaline, whereas boralsilite found in K-feldspar is mostly replaced by diaspore. On the basis of microstructural and chemical analysis, we conclude that after primary mineral growth the pegmatite was altered by fracturing and fluids, resulting in a later growth of tourmaline and dumortierite, together with replacement of boralsilite.

LATE ACADIAN FOLD TRAIN SHORTENING, MT ADAMS, PRESIDENTIAL RANGE, NH

WILLBANKS, Simon A. and EUSDEN, J. Dykstra Jr., Geology, Bates College, Lewiston, ME 04240, swillban@bates.edu

Shortening calculations were performed on D4 fold trains from the Devonian Littleton Formation in the Mt. Adams alpine region, Presidential Range, NH. The purpose was to evaluate the spatial variation of late stage Acadian linear strain and how that relates to major D4 fold traces, the bedrock rheology, and Acadian tectonic models. The Littleton Formation contains variably bedded schist/quartzite couplets, ranging to massive schists, that were multiply deformed in the Acadian. The D4 folds are east vergent with west dipping axial planes and shallow, variably plunging axes. Linear strain shortening

calculations were performed with *ImageJ* software at the meso-, macro- and microscales using the equation, e = ((lf-lo)/lo)*100. Fold train shortening was determined for 48 meso-scale outcrops, six micro-scale thin sections, and one macro-scale cross section. For each mesoscopic fold, the limbs (S0), axial plane (S4), hinge line (F4), wavelength, and double amplitude were measured. Mesoscopic folds have wavelengths that range from 5.5 cm to 7.82 m with a mean value of 98.6 cm, and double amplitude range from 210 cm to 1cm. The range of mesoscale shortening is 65% to .75% with a mean value 14.2%, consistent with previous studies of shortening in the Presidential Range. Mesoscale shortening varies spatially with the lowest values in King Ravine area (0.75%-8.2%), slightly increasing along Sam Adams Ridge (1.4%-8.9%), increasing to the Mt. Adams summit (65.7%-2.3%) and John Quincy Adams (60.7%-1.7%). Macro- and micro-scale shortening calculations will be compared with the mesoscale to evaluate the scale dependence of the strain.

DENSITY-DRIVEN CIRCULATION IN EASTERN CASCO BAY AND ITS EFFECTS ON *ALEXANDRIUM* BLOOMS

WOLOVICK, M., LAINE, E., Bowdoin College Geology Dept., ROESLER, C., Univ. Maine Darling Marine Center, and TEEGARDEN, G., Saint Joseph's Coll. Maine Marine Sci. <mwolovic@bowdoin.edu>

Eastern Casco Bay, in the Gulf of Maine, contains three sublinear inlets which been observed to alternate between estuarine and reverse estuarine subtidal circulation regimes. The physical oceanographic characteristics, including temperature, salinity, and ADCP current profiles, of these inlets were monitored during the spring and summer of 2007 and 2008 by a buoy in Harpswell Sound and in New Meadows River. It was found that the strength of subtidal circulation is controlled by the discharge of the Kennebec River, roughly 10 km from eastern Casco Bay. During periods of high discharge the inlets experience strong subtidal circulation and change from estuarine to reverse estuarine regimes approximately simultaneously, while during periods of low discharge they exhibit weak subtidal circulation and little to no coherence between inlets. We hypothesize that this is caused by the interaction of lens of Kennebec discharge with local topography. The discharge lenses, being of lower density than surrounding seawater, ride high on the water column and are a sea surface maximum; water flows outward from this maximum but is deflected by the Coriolis force to move clockwise around Small Point and into eastern Casco Bay, where it enters the inlets at the surface and forces a compensating outflow at depth. As the lens dissipates fresh water remains behind in the inlets, reversing sea surface slope and inducing estuarine circulation.

GSM TREASURER'S REPORT

The Society currently has 246 members; of which 69.11% are up to date with their dues. In keeping with previously decided 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:	18	Associates:	17
Regular:	205	Institutional:	6
TOTAL:	246	Total Paid Up:	170

Balance on Hand January 31, 2009	
Anderson Fund Savings	$ 2,658.90
Anderson Fund CD	$ 5,845.83
General Fund Money Market	$ 3,491.13
General Fund Savings	$ 40.55
General Fund CD	$ 5,589.06
General Fund Checking	$ 0.00
Total	$ 17,625.47

Income	
Dues	$ 910.00
Interest	$ 118.01
Anderson Fund Donations	$ 32.00
Other Donations	$ 0.00
Publication Sales	$ 0.00
Subtotal	$ 1,060.01

Expenses	
Newsletters	$ 230.04
Honoraria	$ 0.00
Anderson Awards	$ 200.00
Other Awards	$ 0.00
Meeting Expenses	-
Donations	$ 0.00
Postage	$ 0.00
Web Site	$ 59.90
Subtotal	$ 489.94

Balance On Hand May 31, 2009	
Anderson Fund Savings	$ 2,985.11
Anderson Fund CD	$ 5,898.95
General Fund Money Market	$ 3,625.44
General Fund Savings	$ 40.65
General Fund CD	$ 5,635.33
General Fund Checking	$ 10.06
Total	$ 18,195.54
Net gain [or loss]	$ 570.07

Respectfully submitted,
Rob N. Peale, Treasurer (2004 -present)
<Rob.N.Peale@maine.gov>

MEMBERSHIP DUES STATEMENT

The GEOLOGICAL SOCIETY OF MAINE, INC. (often referred to as **GSM**) is a non-profit corporation established as an educational Society to advance the professional improvement of its members; to inform its members and others of current and planned geological programs in Maine; to encourage continuing social contact and dialog among geologists working in Maine; and to further public awareness and understanding of the geology of the State of Maine; and of the 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 field trips). A newsletter, ***The Maine Geologist***, is published for all members three times a year. The Society year runs from August 1 to July 31. Annual dues and gift or fund contributions to the Society are tax deductible. There are three classes of memberships:

$20.00	REGULAR MEMBER	Graduate geologists, or equivalent, with one year of practice in geology, or with an advanced degree.	***PLEASE NOTE NEW***
$20.00	INSTITUTIONAL MEMBER	Libraries, societies, agencies, businesses with interests in or practicing geology and related disciplines.	***FEE SCHEDULE 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.	

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Regular Member	$20.00	$__________	Name ____________________________________	**Make checks payable to:**
Institutional Members	$20.00	$__________		Geological Society of Maine
Associate Member	$10.00	$__________	Address ____________________________________	Rob Peale, Treasurer
Student Member	$ 5.00	$__________		Maine Dept. Enviromental
Contributions to GSM		$__________	____________________________________	Protection,
(please write gift or fund on check)				State House Station 17
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2009/2010 SOCIETY YEAR BEGINS AUGUST 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
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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.

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Orono, ME 04469-5790 <belknap@maine.edu>

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