THE MAINE GEOLOGIST

NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MAINE

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Volume 31
Number 2

THE PRESIDENT'S MESSAGE

I want to thank Bev Johnson and all those at Bates College for hosting an outstanding Geological Society of Maine Spring Meeting. Congratulations are in order for the recipients of the Walter Anderson Award; Scott Drew from Bowdoin College for his poster, *A geochemical analysis of the meta-volcanics of south-central Maine*, and to Evan Ackerman from Bates College for his oral presentation, *Volumetric analysis of Martian rampart craters*. Well done, gentlemen!

Our evening speaker, Mark Swanson from the University of Southern Maine, provided an overview of his work digitally mapping bedrock along the southwestern coast of Maine with students in the National Science Foundation Research Experiences for Undergraduates program. It was a technical challenge getting the Powerpoint started, but with the help of Bates faculty member Gene Clough, the evening talk eventually got underway. Thank you Mark for an informative and interesting presentation, and I hope that sometime GSM can invite you to present a summer field trip of your work; I see left-lateral shear zones and rotated clambakes down the road.

The 2005 GSM Summer Meeting will be held on July 22 – 24 at the Shin Pond Village Campground and will be in recognition of Robert B. Neuman, retired U.S. Geological Survey Research Associate, National Museum of Natural History, Smithsonian Institution, for his work in Maine. His U.S. Geological Survey Professional Paper 400-B,

Pre-Silurian stratigraphy in the Shin Pond and Stacyville quadrangles, Maine,

and U.S. Geological Survey Bulletin 1181-E,

Fossils in Ordovician tuffs, northeastern Maine

are required reading for anyone who plans to study the geology of Maine.

We will examine outcrops of the lower Paleozoic Shin Brook and Grand Pitch formations, as well as other units in the area on Saturday and Sunday. Along with the references above, a brief overview of the stratigraphy and structure of these units, as well as other references within can be found in the Geological Society of America Centennial Field Guide – Northeastern Section, 1987 paper *Type section of the Early Ordovician Shin Brook Formation and evidence of the Penobscot orogeny, northern Penobscot County, Maine*. Also, NEIGC field trips to this area examining these rocks are found in trips from the years 1966, 1980, and 1994.

Group camping has been reserved at Shin Pond Village Campground for Friday and Saturday nights. The campground does serve food, has a shower house, and our annual banquet will be held Saturday night at the campground. See more details on the second page of this newsletter.

Tom Weddle, President (2004-2006)
<Thomas.K.Weddle@maine.gov>

THE EDITOR'S MESSAGE:

Please send any items from individuals, schools or organizations for inclusion in the Newsletter to my e-mail address. Also, please note in the treasurer's report that many members are NOT paid up. Remember that **the date on your mailing address refers to when your current dues run out**. Please help the Society by paying up to date or beyond, and most especially, making good on any arrears. In a policy decided at the Spring Meeeting, if you receive a notice on goldenrod-colored paper with this newsletter, it means that you are about to be dropped from the roles of the Society if you do not pay your dues and arrears.

Thanks.

Dan Belknap, Newsletter Editor (1998 - present)
<belknap@maine.edu> (207) 581-2159, FAX: -2202

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

2005 GSM SUMMER FIELD TRIP
July 22 – 24
Shin Pond Village Campground

The annual GSM summer meeting and field trip will be held at the Shin Pond Village Campground on July 22 – 24, 2005, in Shin Pond, Maine, in recognition of Robert B. Neuman and his work in Maine.

DIRECTIONS: From north or south, take I-95 to the Sherman exit 264 (formerly exit 58) and drive north on Route 11 to Patten. In Patten take the Shin Pond Road (Route 159) to Shin Pond where you will find the campground. Register at the campground office; we have a group campsite and you can settle up with the campground owners Terry and Craig Hill when you arrive on Friday night. The campground does have a kitchen so you can get meals there unless you want to bring your own; campground also has showers. A 10-bed cabin is available; contact Tom Weddle at 207-287-2801 or thomas.k.weddle@maine.gov to reserve a bed.

SATURDAY: We will examine outcrops north and west of Shin Pond along Grand Lake Road, including the type locality of the Early Ordovician Shin Brook Formation (refer to GSA Centennial Field Guide, Northeastern Section, 1987). This stop will require 2300-foot walk to the exposure of the Cambrian Grand Pitch Formation and we will follow the exposures to the unconformable contact with the overlying Shin Brook Formation. Evidence of multiple deformation in the Grand Pitch Formation, and but one deformation in the Shin Brook Formation provided evidence for an orogenic event between Early Cambrian and Early Ordovician time, the Penobscottian orogeny.

Later in the day we will make stops at other outcrops to be determined, but most likely more exposure of the Grand Pitch Formation, a Silurian sequence along Bowlin Pond Road, and possibly a stop at Sawtelle Falls with exposures of the Seboomook Formation.

SATURDAY EVENING ANNUAL BANQUET: Dinner will be at the campground with a choice of either chicken or pork; contact Tom Weddle at the above number or email with your meal preference and so can we get a head count.

SUNDAY: We will head south back to Sherman and follow Route 11 to Stacyville, taking the Old Matagamon Tote Road there to Whetstone Falls, where outcrops of Silurian age pelite and sandstone of the Allsbury Formation will be examined. We will continue over the East Branch of the Penobscot River and turn right to access the Ordovician Wassataquoik chert exposures in Wassataquoik Stream. Time permitting, we may make other stops but will try to finish up by early afternoon.

THE STATE GEOLOGIST'S MESSAGE

A Reminder of Geologic Hazards

This spring we were again reminded that, although we live in a relatively stable geologic setting compared to many parts of the globe, Maine is not immune to a number of geologic hazards. April and May, 2005 will be remembered as very wet months with rainfall well above normal and a string of soggy weekends that frustrated outdoor enthusiasts of all types. A brief recount of significant rains in southern Maine:

March 28-29, 2.5 inches;
April 2-3, more than 2 inches;
April 23-25, 2 inches;
April 27-28, 3 inches;
May 7-8, 1 inch.

Rain contributed to significant flooding on minor streams and major rivers, but also seeped into the ground. Records for groundwater levels almost everywhere in the state exceeded seasonal highs and in some instances set all-time record high levels. While we can definitely say the drought is over by all measures, the water seeping into the ground had other less desirable consequences as well. In numerous places around the state, waterlogged glacial-marine mud gave way on steep slopes, generating small mudslides. Most of these were fairly minor, like several along I-95 in the Biddeford area. But in at least one instance the moving earth threatened a property.

On May 8 in the southern Maine town of Wells, the land gave way between a home and the Merriland River. The mudslide exposed a significant section of the home's foundation and temporarily rerouted flow in the river. No one was home at the time, so the exact time and sequence of the mudslide is uncertain, but it was likely a catastrophic event. The home was situated about 30 feet above the river at the crest of a heavily wooded slope. A few feet of fine sand overlies thick Presumpscot Formation clay at this locality. Slip probably originated in the clay and took out large blocks in retrogressive, rotational failures, leaving large trees tilted 45 degrees toward the house. The mudslide extended for several hundred meters along the river, gradually diminishing toward the north end.

Although the house was not damaged by the mudslide, it will likely be a total loss since the land behind it cannot be remediated to its former contours, and it would be difficult, potentially dangerous, and prohibitively expensive to move the structure. Unfortunately, the homeowner will likely bear the

burden of this loss on their own as homeowners' insurance policies do not cover landslides.

While certainly small by Caleefornia standards, this event was catastrophic for one family and drives home the message that the landscape of our planet is dynamic. While we have excellent information on the distribution of the Presumpscot Formation, our information on landslide history and hazard is incomplete. With the University of Maine, we have been working to map coastal landslide hazards, and have completed 80% of the coastline, with the remainder scheduled for the next three summers. On inland rivers, streams, and lakes, we have general information but no detailed mapping of past landslides and hazardous areas. The resources at the Maine Geological Survey are stretched very thinly, but we continue to aggressively seek funding opportunities for this important work. Please remember this if you are asked sometime soon to sign a petition to reduce the size of state government.

Robert G. Marvinney, Maine State Geologist:
<Robert.G.Marvinney@state.me.us>

Pine Hill, Little Deer Isle, ME to become a public peridotite preserve

Pine Hill, on Little Deer Isle, is underlain by peridotite. Very few ultramafic rocks are known from coastal Maine; this is a rare occurrence. The original olivine and pyroxene in this body have been replaced by magnetite and serpentine. Dave Stewart of the USGS studied the Pine Hill peridotite and inferred that it was of Jurassic age, based on its mineralogical similarity to dated dikes in the region. Recent studies, however, have concluded that another larger serpentine-rich body on Deer Isle is a block of oceanic crust or upper mantle. This raises the possibility that the Pine Hill peridotite may also be a chunk of seafloor caught up in the tectonic collision between the ancient core of North America and one of the Gondwana terranes swept against its shores 400-500 million years ago.

Extreme soil conditions may be found on serpentine, owing to its unique trace-element chemistry. Plants growing on these soils are, as a consequence, often distinct from their closest relatives on more normal soils. Serpentinite bodies thus provide an opportunity for study of the role of natural selection in the diversification of plants. The levels of plant diversity on Maine's serpentine outcrops have not yet been explored.

Both professional and amateur geologists and botanists visit Pine Hill to study its unusual mineralogy and vegetation, and both islanders and visitors enjoy the view from its top.

The Island Heritage Trust (IHT), the local land trust of Deer Isle, has an opportunity to protect this special place for present and future generations. The current owners have offered to donate the property to IHT, but transaction costs (survey and other legal work) will be close to $5000. Half of this sum has already been raised. If some of you have a special interest in preserving unique geological sites in Maine and would like to make a tax-deductible donation to help cover these costs, IHT would be most appreciative. Checks may be made out to IHT and mailed to:

IHT,
P.O. Box 42,
Deer Isle, ME 04627.

Please include a note indicating that the contribution is for the Pine Hill Fund.

n.b.: IHT permits collecting from their properties for scientific and educational purposes.

Roger LeB. Hooke, Dept. Earth Science, University of Maine. rhooke@acadia.net

ENVIRONMENTAL SCIENTIST

Acadia Environmental Technology is a growing environmental consulting company specializing in environmental management and the investigation and remediation of soil and groundwater. We have an opening for a field scientist for petroleum and hazardous waste projects. Candidates must have a BS or BA in an environmental science. An MS, 1 to 3 years of relevant experience and, 40 hour OSHA Hazardous Waste Operations training are preferred.

Send resume and salary requirements to:

ACADIA ENVIRONMENTAL TECHNOLOGY
4 Milk Street
Portland, Maine 04101

No email or telephone calls, please.
- Martha Mixon

GSM MEMBER NEWS

Mike Abbott, formerly with Sevee & Mahar, has started his own company, Abbott Engineering, in Durham. He will be providing water resources, civil engineering, and environmental consulting services.

In May, **Bill Berry** (retired from University of Maine, Farmington) and his family received the Maine Tourism Award for Recreational Suppliers at the Annual Governor's Conference on Tourism. The Berrys were honored for the improvements they have made to Saddleback Mountain since purchasing it in September 2003. According to the Maine Tourism

Office, the award honors those in the tourism industry who dedicate their work to promoting Maine as a hospitable destination.

After 7 years working as a Senior Hydrogeologist, **Jay Clausen** left the consulting firm AMEC Earth and Environmental, Inc. in January to join the Army Corps of Engineers, ERDC-CRREL facility in Hanover, NH to conduct R&D mainly focused on the environmental impacts of energetic residues. This past December he was the keynote speaker for the DoD Science and Engineering Research and Development Program Conference in Washington, DC and in October he was an invited speaker for the GeoQuebec 2004 Conference. Jay's new address is:

Jay L. Clausen
Physical Research Scientist
US Army Corps of Engineers
Engineer Research & Development Center
Cold Regions Research and Engineering Lab.
72 Lyme Road
Hanover, NH 03755-1290
tel: 603-646-4597; fax: 603-646-4785
Email: Jay.L.Clausen@erdc.usace.army.mil

Chris Evans has been hired to fill a Certified Geologist position in the DEP's Department of Defense program.

Dave Stewart reports on June 6 "I'm feeling great going in for my 4th chemotherapy tomorrow. Dr. suggests it may be the last one I need, so I'm hopeful. Positron emission test some time afterwards will tell if I have successfully got over my cancer. Have a great summer!"

Woody Thompson (Maine Geological Survey) and **Hal Borns** (University of Maine, Orono) are the principal geologists on the Ice Age Trail project. The goal is to produce a map and website for a self-guided driving tour from Acadia National Park to the New Brunswick border. The Maine DOT is collaborating on safety issues, particularly parking. The Climate Change Institute is hosting the Ice Age Trail website, as well as the Friends of the Pleistocene website that will eventually have pdf versions of field trip guides available. Woody also mentioned that the New Hampshire Geological Society's annual field trip will be August 27th and 28th in the Littleton area. **Doug Rankin** will be leading.

Andy Tolman (Dept. of Human Services) is continuing his stage career. He will be playing Mr. Twimble in the Gaslight Theater's production of "How to Succeed in Business" in late June and early July. Andy is also president of the National Association of State Boards of Geologists this year. ASBOG will have its annual meeting in Portland in November. And Andy is riding in the Trek Across Maine again this year as a member of the Bikers Against E-Coli team.

Please send member news to:

Carolyn Lepage, Member News Correspondent
(1996-present) <clepagegeo@aol.com> or
PO Box 1195, Auburn, ME 04211-1195 or
Fax: (207)-777-1370; Phone: (207)-777-1049

IN MEMORIAM

Charles V. Guidotti, Ph.D. passed away on May 19, 2005, after a courageous battle with cancer. He was surrounded by his family, and a number of his friends and colleagues were able to visit in his final few days. Charlie maintained his courage and good humor to the last. The last time we spoke, just three weeks before, he was joking and positive, but realistic as well - that was Charlie. He retired as Professor at the University of Maine in January, and was awarded Emeritus status. He is survived by his wife Barbara, son Vincent and daughters Amy and Gretchen, and two grandchildren. Charlie's many interests included birding, gardening, fighting "critters" that attacked his garden, and practical jokes.

Charlie was a key member of the team that developed the present bedrock map of Maine, authoring the metamorphic zones map. His specialty in mineralogy and petrology was essential to numerous students and colleagues in Maine, and his insights into orogenesis and mineral chemistry were of very broad scientific impact. He was author or co-author of 95 papers and maps, as well as 73 abstracts during his distinguished career. Charlie was recognized in 2001 by the University of Padova in Italy with the Laura Honoris Causa.

Charlie was truly one of a kind. He will be missed.

Dan Belknap, Chairman,
Dept. Earth Sciences, University of Maine

GSM SECRETARY'S REPORT

Geological Society of Maine
Spring Meeting
April 8, 2005
Carnegie Science Building and Chase Hall, Bates College
Lewiston, Maine

Tom Weddle called the Business Meeting to order at 4:35 p.m.

Walter A. Anderson Awards: As always, the quality of the posters and presentations was excellent. Well done to all!

Best Poster: Scott Drew, Bowdin
Best Oral Pres.: Evan Ackerman, Bates College

Spring Meeting Rotation: A semi-official Spring Meeting host rotation list was made, starting with Bates as the first in the rotation. The list will be: Bates (2005), UMPI (2006), UMF (2007), Bowdin (2008), Colby (2009), UMO (2010), USM (2011). If conflicts occur adjustments can be made.

Website: The events page of the GSM website has been updated for the following year. Members have been asked to submit photos, related to GSM or geology in general, to be posted on the photo page.

Guest Speaker Honorarium: It was announced that GSM will now be providing an honorarium to guest speakers. Mark Swanson was the first to receive the honorarium for speaking at the Spring 2005 meeting.

DEP Task Force: Jen Shosa, from Colby College, will be the GSM representative to the Maine Department of Environmental Protection (DEP) Task Force. Her background in geology and engineering, along with her enthusiasm, makes her an excellent choice. Liz Champeon, also a member of the DEP Task Force, provided some information on the history of the group. The DEP Task Force was set up in the late '80s-early '90s to help solve communication difficulties between the consulting community and DEP regulators. Before formation of the Task Force consultants and regulators were essentially using "two different languages" making misunderstandings frequent. The Task Force provides a forum for DEP representatives to provide information and consultant representatives to air concerns, as scientists and engineers rather than consultants and regulators. Topics are typically open and general, with no specific project discussion. Until recently, the Task Force met on a monthly basis, but now meetings are every 2 to 3 months.

Summer 2005 Field Trip: Tom announced that the 2005 Summer Field trip will be held, July 22-24, in the East Branch of the Penobscot region. Trips are planned in the Shin Pond area. At the time of the meeting details had not yet been finalized. Walter Anderson was hoping to reserve a number of camp sites at Shin Pond Village Camps.

Membership Dues: A regular topic at recent meetings has been membership dues. Approximately 33% of members are delinquent in paying their dues. If you are not current on your dues by the mailing of the next newsletter, a notice will be attached informing that future newsletters will not be received until overdue dues are paid. Membership dues may be paid up to 5 years in advance.

ASBOG Meeting: Andy Tolman announced that Maine will be hosting the 2005 ASBOG annual meeting, in November. The organization creates the examination and administers certification for geologists. A field trip will be held as part of the meeting; Andy asked that GSM help with the logistics of the field trip. Irwin Novak, of USM, offered assistance through the University. GSM members in attendance agreed that the University was better equipped to provide assistance.

Fall Meeting: Initial planning for the 2005 Fall Meeting has begun. Tom announced that there are currently several possible topics, but focus for the meeting will likely be: Practical Applications of Geology. Arrangements for the meeting have not yet been made.

Newsletter: Dan Belknap spoke briefly about the GSM newsletter. He reminded attendees that the newsletter belongs to the members. All members are encouraged to submit items for the newsletter. Dan also asked that Academic Advisors at the Colleges and Universities talk with their students about presenting at the spring meetings earlier and to please keep last-minute changes in the abstracts to a minimum.

Tom called for a motion to adjourn the Business Meeting at 5:00 p.m.

Evening Speaker: Mark Swanson
"GIS – Geological Tool for the 21st Century"

Mark Swanson, Professor of Geology at the University of Southern Maine, gave a talk on the latest, state-of–the-art, digital geologic mapping technologies. Mark, along with USM Professor Matthew Bampton, has been using high precision GPS/GIS equipment to map the structure of coastal bedrock outcrops, as part of a summer field school, for several years. The end product is a highly detailed, very accurate bedrock structure map that is extremely flexible in the ways that it can be used and viewed.

The 8-week summer coastal mapping research program, funded through the National Science Foundation, is part of the REU (Research Experience for Undergraduates) Site Program, and draws students from across the country. The program stemmed from previous summer field schools run in the Casco Bay area. The focus of the course is to study the geologic structure of the crust along the Norumbega Fault Zone, characterized by dextral transpression and various splay structures that divide up the coast. The main mode of travel through the field area is by sea kayak to the many small islands and peninsulas.

Several mapping techniques are used, including manual grid mapping, Brunton compasses and measuring tapes, plane table alidade, balloon photos, pole mounted digital cameras, total stations, and GPS systems. The three main instruments used are Handheld Trimble Geo XT GPS units, Trimble survey grade RTK GPS systems, and electronic total

station units. The Geo XT units are used to collect location information for measured points at 1-meter precision. The RTK units, in conjunction with preset base stations, are used to collect location and elevation data for features. The RTK systems correct for atmospheric variation and interference and are precise to approximately 2 cm. Even more precise, less than 1 cm, elevational data can be collected using the total station. Each mapping group uses three of each of these instruments, for a total of nine instruments and a minimum field crew of nine. A pole-mounted digital camera is also used to collect digital images of the actual outcrop surface. These images can be put together in large photo mosaics with much more detail than aerial photos. Data collected is transferred to laptop computers, in the field, for onsite digital mapping using ARC GIS software. What are created are highly detailed outcrop surface maps that can easily be manipulated, added to, and overlain onto high-resolution aerial photos.

Mark hopes that in the future this technology will be used to create a "digital geologic atlas". This atlas could contain everything from large-scale digital aerial photos to digital thin sections. Thank you Mark for an extremely interesting talk.

Respectfully submitted,
Sean R. Dougherty, Secretary (2004 -)
<sean.dougherty@maine.gov>

GSM TREASURER'S REPORT

The Society currently has 344 members, distributed as follows:

Students:	57
Associates:	25
Regular:	257
Institutional:	11
TOTAL:	350
Total Paid Up	164

Previous Balance: Funds as of January 31, 2005

Anderson Fund Savings	$ 462.83
Anderson Fund CD	$ 5,043.13
Education Fund Savings	$ 890.72
General Fund Savings	$ 7,746.15
General Fund Checking	$ 3.64
Total Funds	**$ 14,146.47**

Receipts 10/22/04-02/09/05

Dues	$ 792.00
Interest	$ 79.99
Anderson Fund Donations	$ 98.00
Misc. Contributions	$ 8.00
Receipts Subtotal	$ 977.99

Expenses 02/09/05-06/01/05

Newsletters (October and February)	$ 513.61
Anderson Awards	$ 216.38
Speaker's Honoraria	$ 150.00
Expenses Subtotal	$ 879.99

Balance on hand as of June 1, 2005

Anderson Fund Savings	$ 356.71
Anderson Fund CD	$ 5,081.81
Education Fund Savings	$ 895.01
General Fund Savings	$ 7,909.91
General Fund Checking	$ 1.03
Total Funds	**$ 14,244.47**
Net gain or loss:	$ 98.00

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

GSM SPRING MEETING STUDENT ABSTRACTS

VOLUMETRIC ANALYSIS OF MARTIAN RAMPART CRATERS

ACKERMAN, Evan S., Geology Department, Bates College, Box 2 Bates College, Lewiston ME 04240, <eackerma@bates.edu>

The morphology of ejecta blankets surrounding many Martian impact craters exhibits a lobate structure, with pronounced distal ridges bordering the ejecta facies. These craters have been termed rampart craters. The specific process that emplaces this type of ejecta is uncertain, but may be some combination of a subsurface volatile component (liquid water) and the low atmospheric pressure on Mars. Craters can provide a valuable tool to determine surface and subsurface properties, but the mechanics of their formation must first be understood. The purpose of this project was to develop a method for volumetric measurement of Martian rampart craters, and to analyze the data in terms of individual craters and potential regional trends, in the context of the underlying geology. Approximately 120 craters on the Lunae Planum geologic region of Mars were measured using a combination of digital image mosaics and laser altimetry data from various remote-sensing instruments aboard Mars orbiting spacecraft. The measured ejecta and cavity volumes were corrected to account for ejecta bulking, structural rim uplift, and down driven cavity material. The average corrected ejecta volume to excavation cavity volume ratio was 1.03, with a standard deviation of 0.44. These data suggest that despite a range of specific morphological differences between craters, the methodology and corrections are valid. Craters with especially high or low volume ratios were examined visually to determine the cause of the volume difference. In many instances, these differences could be attributed to the surficial geology of the impact area, in terms

of target composition or grain size, based on the cratering process. Continuing research will examine such trends and differences over specific areas to better understand crater morphology and surface characteristics, and may provide a basis for improved geologic maps of the Martian surface.

HOW BEDROCK AND FRACTURE ORIENTATION OF THE QUIMBY FORMATION ARE RELATED TO ARSENIC CONCENTRATIONS IN BEDROCK WELLS IN RANGELEY, ME

AMAYA, Vanessa, Bates College, Geology Department, Bates College, Box 2 Bates College, Lewiston ME, 04240, <jamayaro@bates.edu>

Some domestic wells around Dodge Pond, Rangeley, Maine, have arsenic levels well above the maximum contaminant level 0.01 mg/L; (US EPA, WHO). Although, extensive research on geochemical processes that release arsenic has been done, bedrock properties such as structural features and metamorphic history may have a role in arsenic mobility. The southern two thirds of Dodge Pond lies within the late Ordovician (?) Quimby Formation. The Quimby Formation is about 3,000 feet thick and consists of sulfidic metashale, metagraywacke, felsic metavolcanic rocks and thin beds of black calc-silicate rock. The northern third of Dodge Pond lies within a Devonian gabbro from the Flagstaff Lake Pluton, which produced a narrow metamorphic aureole. Water and rock samples were collected at 10 sites located within shale and metagraywacke members of the Quimby Formation. All water samples contain high concentrations of arsenic ranging from 0.016 mg/L to 0.42mg/L, but samples from wells near the gabbro contact have lower concentrations. From SEM-EDS analysis and whole rock geochemistry arsenic concentrations are negligible in both the Quimby Formation and the gabbro. Al_2O_3, Fe_2O_3, SiO_2 are found in high concentrations at the Quimby and at higher concentrations at the gabbro, suggesting precipitation of arsenic from a secondary source. There are two prominent joint sets one striking NW-SE and the other NE-SW which do not appear to have any correlation with arsenic concentrations in groundwater. The metamorphic aureole is hypothesized as a possible mechanism for arsenic release as well as close anthropogenic sources such as sanitary landfill located in the metagraywacke member, and a sulfide rich prospect pit located within the gabbro.

GEOCHEMICAL ANALYSIS OF CHANGES IN SALT-MARSH STRUCTURE OVER THE PAST 4000 YEARS AT SPRAGUE MARSH, PHIPPSBURG, ME

BEIRNE, Erin, Department of Geology, Bates College, <ebeirne@bates.edu>

This project focuses on the changes observed in salt marsh structure through bulk sediment samples of a 3-meter vibracore from Sprague Marsh in Phippsburg, ME. C/N ratios, %OC and $\delta^{13}C$ of the samples were mea-sured on the Isotope Ratio Mass Spectrometer (IRMS) at Bates College and correlated with core stratigraphy. Shifts in these geochemical parameters were consistent with changes in stratigraphy and marked significant differences in salt marsh structure. From these data, conclusions were drawn as to the extent of colonization, types of vegetation and depositional environment at different periods throughout the late Holocene.

THERMAL MODELING OF PLUTONS IN SOUTH-CENTRAL MAINE

BROWN, Lucy, Department of Earth Sciences, University of Maine, Bryand Global Sciences Center, Orono, Maine 04469, <lucy.brown@umit.maine.edu>

Numerical thermal modeling of South Central Maine is used to investigate the possibility that local plutons provided the source of heat for a nearby metamorphic gradient. The results suggest that a regional heat source, rather than a local source, is necessary to have caused the observed metamorphism. The resultant distribution of heat has implications for rheology during the Acadian mountain building event.

SEASONAL MORPHOLOGY AND SEDIMENTATION TRENDS ON SEAWALL BEACH, IN PHIPPSBURG MAINE

CARY, Chris, Department of Geology, Bates College, Box 671, Lewiston, ME 04240 ccary@bates.edu

Coastal processes that occurred on Seawall Beach, a barrier system in Phippsburg, Maine, were monitored from May 2004 until February 2005 to determine the patterns of erosion and accretion of sediments. Topographic profiling, activation rod analysis and grain size examination were conducted over 7 transects that span 2.2km beach. A photo-journal comprised of digital images, taken monthly, visually represents the morphological changes that the beach went through. The NOAA Portland weather buoy #44007 collected weather data consisting of wave heights, wind speeds, wind direction, barometric pressure and dominant wave periods. Storms were then classified using the Dolan and Davis (1992) intensity scale for storms in the northeast. Responses of the beach to the changing seasonal conditions were studied and models were developed to explain the observed dynamics.

Profiling results were typical of barrier beach systems, with accretion taking place in the tranquil summer months and erosion dominating during the winter months. Transects W5 and W12, which receive the most direct swell exposure, displayed the highest amount of erosion. Sediments on these transects were transported towards the Sprague River via the longshore currents, a process that over the course of several years, has led to the present day cuspate shape of the beach. By February, a mature winter profile had developed with localized regions of scarping, but the beach became more dissipative as the winter progressed, preventing extensive erosion.

The deposition of sand in offshore bars was modeled using the physical relationship between seasonal wave base, grain size, and the local bathymetry. By analyzing their interaction, three subtidal zones that have specific sediment dynamics were constrained and locations of the bars were inferred.

A GEOCHEMICAL ANALYSIS OF THE METAVOLCANICS OF SOUTH-CENTRAL MAINE

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In south-central Maine, the Cushing (471-473±3 Ma) and Spring Point (469±3 Ma) Formations of the Casco Bay Group; the Nehumkeag Pond (472±7 Ma) and Mount Ararat (471±6 Ma) Formations of the Falmouth-Brunswick sequence; and the Yarmouth Island (443-445±3 Ma) and Sebascodegan (undated) Formations of the East Harpswell Group are all metavolcanics deposited during the Ordovician (ages compiled from previous reports). Thirty-four samples were collected at coastal outcrops, river outcrops, quarries and road cuts from Portland to Bath and analyzed for bulk-rock geochemistry (major and trace elements) in order to define more precisely the relationship between these metavolcanic rocks and to construct a geologic model outlining their formation. The Cushing Formation consists of compositionally similar meta-dacites, some containing pyroclastic material. The Spring Point Formation exhibits broad variation including basalt, andesitic-basalt, andesite, and dacite compositions, complicating the bimodal model previously proposed for this formation. The Mount Ararat Formation analyzes as an andesite, although field observations reveal alternating mafic and felsic layers (1-10cm). The Nehumkeag Pond Formation is rhyolite in composition. The Sebascodegan Formation consists of andesitic-basalt, andesite, and dacite compositions. No geochemical analyses have yet been obtained for the Yarmouth Island Formation. Mafic samples of the Spring Point, Mount Ararat, and Sebascodegan Formations plot near EMORB and exhibit a negative Nb anomaly, suggesting a crustal influence and a subduction component. The felsic Spring Point and Cushing Formation samples exhibit a steep REE pattern, characteristic of arc magmatism. To date, the trace and rare earth element analyses suggest that the metavolcanic members of the Casco Bay Group, the Falmouth-Brunswick sequence, and the East Harpswell Group constituted an evolving progression of arc volcanism throughout the Ordovician.

PALEOCLIMATE RECONSTRUCTION USING PHYSICAL SEDIMENTOLOGY AND ORGANIC MATTER BIOGEOCHEMISTRY OF VARVED SEDIMENTS, BASIN POND, FAYETTE, MAINE

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Basin Pond is a small (34-acre) and deep (32 meter) meromictic pond in Fayette, Maine. The pond's anoxic bottom-waters preclude the presence of aerobic benthic organisms, thereby minimizing bioturbation of the sediments. Consequently, laminated sediments and sedimentary organic matter are well preserved. The regular deposition of simple light-dark biogenic couplets suggests that the laminae are formed annually, or varved, from the seasonal succession of phytoplankton blooms and winter settling. In this study, proxy data based on physical sedimentology (lithology, varve thickness) and organic matter biogeochemistry (organic matter C/N, $\delta^{13}C$) were used to reconstruct a high-resolution paleoenvironmental record, based upon the varve chronometer and radiocarbon dating, on sediment cores spanning the late glacial (12k ^{14}C years bp) to present. Low organic matter C/N ratios, between 7 and 14, and $\delta^{13}C$ values ranging from –34 to –28 per mil suggest organic matter production is dominated by C_3 algae with some input from terrestrial C_3 vegetation. Significant alterations of the paleo-environment suggest both anthropogenic and climate induced forcings. Sedimentological and biogeochemical evidence exists for three major sedimentary regimes in the Basin Pond paleo-environment: Historic Watershed Deforestation, Holocene lake-level fluctuations, and the Late Glacial and Younger Dryas Climate Reversal. It appears that the presence of perennial anoxia in Basin Pond bottom waters has a distinct control on the stable carbon isotope record and nutrient recycling within the water column. Autochthonous organic matter production in the meromictic setting results in depleted organic matter $\delta^{13}C$ values while oxygenation of the water column or increases in the amount of terrestrial vegetation have the tendency to enrich. The breakdown of meromixis and loss of a significant terrestrial source of organic matter at Basin Pond is evident with the onset of the Younger Dryas. Watershed deforestation may be evident in a modern flux of terrestrial organic matter.

DYNAMICS OF ALUMINUM AND PHOSPHORUS DURING A HIGH DISCHARGE EVENT AT HADLOCK BROOK, ACADIA NATIONAL PARK, MAINE, USA

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Aluminum (Al) speciation in water is a valuable indicator of the health and trophic status of stream and lake ecosystems. The solubility of Al depends substantially on pH, with lowest Al solubility in the 6-7 pH range. Degassing of CO_2 from groundwater emerging into streams or lakes causes an increase in pH, thereby potentially affecting Al solubility. Collection methods clearly impact concentrations of dissolved Al. However, degassing has not been directly empirically linked to precipitation of Al.

We obtained water samples from Hadlock Brook (Maine, USA) at four elevations with pH ranging from 4.36 (highest elevation) to 6.12 (lowest) during a high discharge episode in October, 2004. All samples were initially oversaturated with CO_2 with respect to the atmosphere. As samples degassed at room temperature for eight days, pH increased in three of four samples. However, Al did not precipitate. Samples initially contained from 194 (highest pH) to 451 (lowest pH) g/L dissolved Al, and after eight days, no significant loss had occurred. Most of the dissolved Al was bound with dissolved organic carbon (DOC). Because such a large portion of the Al was bound with DOC, dissolved ionic Al was undersaturated in all samples with respect to amorphous $Al(OH)_3$.

The increase in pH resulting from CO_2 degassing as groundwater discharges into streams will cause $Al(OH)_3$ to precipitate if certain conditions are met: (1) enough CO_2 degasses to measurably raise pH, (2) initial pH is below the solubility minimum for $Al(OH)_3$ and (3) concentrations of inorganic ionic Al are close to saturation. This degassing process can occur during sampling, within sample containers,

or during filtration (field or laboratory) thereby causing erroneous Al speciation and concentration measurements.

RE-EVALUATION OF TAXODIACEOUS TAXA PRESENT IN UPPER PALEOCENE SENTINEL BUTTE FORMATION OF NORTH DAKOTA: A SCANNING ELECTRON MICROSCOPE ANALYSIS OF PLANT MICROSTRUCTURE

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The Sentinel Butte Formation near Almont, North Dakota contains a rich and diverse fossil flora assemblage of the Late Paleocene. Exceptionally well-preserved plant material from this location provides a great opportunity to study the time interval between the Cretaceous-Tertiary extinctions and the Paleocene-Eocene climatic transitions. The fossils are found in a hard, brown, fine-grained siliceous shale exposed only in excavation pits in mounds on agricultural land. Although the flora has been well documented for its angiosperm content, the specific composition of gymnosperms, particularly conifer taxa, is ambiguous and warrants review. Previous studies have noted the presence of Taxodiaceous needles but workers disagree over which genus is represented or whether more than one may be present.

During the summer of 2004, new specimens of conifer remains were collected at the Almont fossil locality. Hand samples were removed from the bedrock using a pry bar and pick axe. At least six morphologically distinct shoot types were identified in a collection of 48 specimens, recovered over the course of three days. The fossils and reference specimens of modern Metasequoia and Taxodium were studied under a scanning electron microscope to note similarities and differences between morphotaxa. Needle shape, cell structure and stomatal patterns were used as distinguishing characteristics.

Results indicate the presence of more than one conifer taxon present in the Almont fossil flora based on dissimilar morphological and anatomical features of the analyzed needles. At least one fossil specimen has ribbon-like midrib cell alignment similar to modern Taxodium, though elongate ripple-margined epidermal cell structure and parallel lengthwise orientation of oval stomata are like that of modern Metasequoia, implying a closer affinity to this genus. Such evidence suggests that the recent assignment of the needles to the genus Parataxodium may not be valid for all taxa represented at this site. These findings could have implications towards the current understanding of the paleoenvironment of the area, as well as, the relationships between restricted floras of the Great Plains of the United States during the Late Paleocene.

THE PALEOECOLOGY AND DEPOSITIONAL SETTING OF A SILURIAN MIXED SILICICLASTIC SYSTEM: RIPOGENUS DAM, MAINE

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The Silurian Ripogenus Formation consists of shallow marine siliciclastics and fossiliferous carbonates. It is located on the Caribou Lake Anticline in north-central Maine, and is truncated to the east by the Katahdin Pluton. It is in contact with Dry Way Volcanics. The best exposure of the Ripogenus Formation lies at the southeastern end of Ripogenus Lake, in a gorge at the base of Ripogenus Dam, 28 miles northwest of Millinocket. Although the formation has been noted previously to contain abundant shallow marine invertebrates, few paleontological studies have been conducted. This project evaluated the fossil assemblage and unique lithology of the Ripogenus Formation.

The most distinctive lithostratigraphic interval is a ~15 m section of alternating sandstone and limestone beds, typically 10 to 40 cm and 5 to 20 cm in thickness, respectively. The limestones have been weathered heavily, and exhibit a conspicuous pitted appearance. The fauna is restricted to these limestones and consists of benthic invertebrates associated with reef environments. These include framework builders such as stromotoporoids and Halysites, as well as, reef dwellers such as bryozoans, pentamerid brachiopods, and Archaegastropods. The fossils are found both in situ and organically bound as allochthonous elements within the carbonate unit.

The relative abundance and specific composition of the assemblage strongly resembles a Silurian reef community. A paleoecological analysis of the assemblage confirms the presence of a protected reef-flank or proximal-reef community subject to cyclical sea-level fluctuations with changes in sedimentation processes.

SEA-LEVEL LOWSTAND AND TRANSGRESSIVE EVOLUTION OF OUTER SACO BAY, MAINE

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Bedrock geology, glacial deposits, postglacial sediments, and both glacial and littoral processes constrain the morphology and sedimentology of Saco Bay, Maine. Rapid relative sea-level change was the primary process forcing migration of littoral environments in Saco Bay since 14 ka. Earlier work suggested a lowstand at about 60 m below present sea level ca. 10.5 ka, followed by the on-going transgression. To better understand coastal responses to changing sea level, we created a base map of the outer bay with a 45 km^2 mosaic of narrow-swath multibeam bathymetry and backscatter coupled, with side-scan sonar in the 40 to 80 m depth range. Based on this we gathered 120 km of seismic reflection profiles to link the subsurface stratigraphy with bathymetric landforms. We used these data to take 20 vibracores of potential lowstand deposits and for stratigraphic verification. Sand and gravel have been identified in several cores, indicating remnants of beach environments. Some identified lowstand terraces are erosional in nature, with a thin veneer of sand. Others might be depositional, and thus may contain a thicker sand unit. Complete analysis of the cores is underway at this time. This pairing of bathymetric and surficial geology with stratigraphy allowed the interpretation of the study area, including beach,

river and tidal environments, which have continued to be modified by modern processes. Placing these environments into a sequence-stratigraphic framework and series of paleogeographic reconstructions have aided in our knowledge of the evolution of the bay. This understanding of past continental shelf submergence will also provide insight to the modern environment's response to a changing sea level and consequent environmental stress.

COMPLEX FLOW DYNAMICS WITHIN A FRESH-WATER TIDAL ECOSYSTEM: THE LOWER ANDROSCOGGIN PORTION OF MERRYMEETING BAY, MID-COAST MAINE

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Merrymeeting Bay is a shallow freshwater tidal ecosystem formed at the confluence of the Kennebec and Androscoggin Rivers in mid-coast Maine. The bed topography of the bay is complex, reflecting the arrangement of glacially scoured bedrock and the tidal/riverine redistribution of glacial sand. During summer 2004, boat traverses were conducted during semidiurnal neap and spring tidal cycles (ranges of 1.2 and 1.7 m, respectively) utilizing an Acoustic Doppler Current Profiler to investigate current flow within the lower Androscoggin portion of the bay. Overall, tidal fluxes average an order of magnitude higher than river discharge, but flow is spatially non-uniform. During rising tides, high-velocity currents move up bay through a channel that wraps around the bay's northwestern edge. In this channel, velocity magnitudes are a factor of two greater during flood than during ebb tide. Ebb flow, in contrast, is concentrated in shallow channels along the southwestern margin of the bay, at velocities some 30% higher than during the flood tide. Surface measurements reveal higher salinity, colder temperatures, and less turbidity in the flood-dominated channel over the course of the flood tide, versus lower salinity but higher temperature and turbidity in the ebb-dominated channels over the course of the ebb tide. Convergence fronts are common in the flood-dominated channel throughout the tidal cycle, reflecting density gradients and/or convergence of water moving via different paths through the complex topography. The distribution of sand bodies within the bay follows the major flow patterns. The flood-dominated channel is flanked to the north by a large flood-tidal delta, whereas ebb-oriented linguoid bars occupy the ebb-dominated channels to the southwest. These large bedforms, as well as channel floors, are mantled by dunes, some of which reverse direction with tidal flow. The complexity of flow presents challenges to sampling and modeling biogeochemical and sediment fluxes in this unique coastal environment.

DETERMINATION OF MARTIAN CLIMATE HISTORY USING POLAR LAYERED DEPOSIT IMPACT CRATERS

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The Thermal Emission Imaging System (THEMIS) aboard the 2001 Mars Odyssey orbiter provides an unprecedented resolution capability for Martian surface features including impact craters. A population study of these craters, in turn, provides a basis for estimating the age of the South Polar Layered Deposit (SPLD) using theoretical modeling for impact rates. Interpretation of the PLD may be the key in determining recent Martian climate history. In this study, the portion of the SPLD roughly between 270° and 330° east longitude and 80° and 87° south latitude was examined using 36 meter/pixel images obtained from THEMIS, allowing for determination of craters greater than ~150 meters in diameter. For craters found on the images, a number of variables including diameter and location, among others, were collected and compiled into a database. Using the diameter variable, it was possible to do a size distribution study of the craters. Early indications are that there are a disproportionately low number of small craters, which is likely due to some sort of small crater removal process.

The rate of removal varies between the SPLD and its counterpart in the Northern Hemisphere. The NPLD appear to be made of the same material as the SPLD, yet the calculated age of the NPLD is only a fraction of that of the SPLD. This variation is likely the result of variations in the climate of the two polar regions caused by orbital forcings. The outcomes of these Martian orbital forcings are opposite those of the Earth in terms of the occurrence of glacial periods.

SEASONAL LOW DISSOLVED OXYGEN INTERACTION BETWEEN QUAHOG BAY AND CASCO BAY

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Local environmental and oceanographic groups, such of the Friends of Casco Bay (FOCB) have monitored seasonal fluctuations in dissolved oxygen in Quahog Bay for the past several years. Attention has also been paid to low oxygen levels in Casco Bay by the Gulf of Maine Ocean Observing System (GOMOOS). Previous measurements in Quahog Bay have shown percent saturation values approaching an anoxic state during the months of August to September. The values range as low as 60% during the early to mid fall. This study examines the seasonal approach to anoxic conditions in Quahog Bay and Casco Bay. Using Quahog Bay as proxy for many of the smaller bays in Casco Bay, this study then attempts to determine whether localized low D.O. processes drive the larger scale process in Casco Bay, or vice versa. Data were collected by: Bowdoin Geology Class Geo 103, FOCB, GOMOSS, and by David Mortimer and Ed Laine Current data analysis indicates that in 2004 and 2003, localized processes drove the larger scale process in Casco Bay. It also indicates that D.O. levels in Quahog Bay were substantially lower during the fall of 2004 than in previous years.

DETAILED BEDROCK MAPPING OF THE DEVONIAN LITTLETON FORMATION, MT. MADISON, PRESIDENTIAL RANGE, NEW HAMPSHIRE

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To better understand the complex tectonic history of the Acadian orogeny in the Presidential Range, New Hampshire, the bedrock geology of the alpine zone surrounding Mt. Madison was mapped at a scale of circa 1:3,000. The Presidential Range lies within the belt of Silurian and Devonian metasedimentary rocks that compose the Central Maine Terrane. The well-exposed, higher elevations of the Presidential Range are dominated by the Littleton Formation, which has been complexly deformed and metamorphosed. A new bedrock geologic map and cross-section along a transect from Madison Springs Hut to treeline on Osgood Ridge was constructed to redefine the lithologies and geologic contacts. Three new and six total members of the Devonian Littleton Formation have been defined by variations in bedding style and the ratio of schist to quartzite. A prominent sedimentary facies change has been mapped between two of these members. D1 deformation is characterized by an overall inverted limb with two meso-scale, east-facing, north-plunging F1 folds with hinge-parallel L1 pseudoandalusite lineations. A total of six gently plunging, D4 antiformal synclines and synformal anticlines with west-dipping S4 axial surfaces have been identified in the study area. Stereo- and orthographic projections were used to construct the revised map, which will be incorporated into an updated version of the bedrock geologic map of the entire Presidential Range.

EARLY AND LATE ACADIAN STRAIN PARTITIONING: D1 LINEATION AND D4 FOLDING; MOUNT MADISON, NEW HAMPSHIRE

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The alpine zone of the Presidential Range in New Hampshire affords excellent exposure of Silurian and Devonian metasedimentary rocks from the Acadian hinterland. Of the many phases of deformation recognized in the region, D1, characterized by isoclinal, east vergent nappes with a hinge-parallel pseudoandaulsite mineral lineation (L1) and D4, defined by moderately inclined to overturned, gently to moderately plunging, asymmetric folds, are the most ubiquitous deformations seen. Rapid transitions in the intensity of L1 development have been quantified by measuring trend/plunge at forty-two localities along a 2.1 km long transect. The data were plotted on rose plots to determine the longest petal using a running bin average method and then contoured to produce an L1 strain map. Maximum petal lengths measured by this technique range from 8% - 26%. In conjunction with schist/quartzite ratios reflecting bulk rock rheology it appears that L1 strain is highest along rheologic boundaries. D4 shortening calculations were done by comparing folded line lengths to straight line lengths through the folds trains. Fold trains for thirty-one 2 –10 m long outcrops, one 2.1 km long cross section, and thirteen thin sections at the microscale were measured. Outcrop scale shortening is calculated to be 16.2% of original layer length, microscale shortening is calculated to be 12.2% and macroscale shortening is calculated to be 10.2%. This study represents an ongoing effort to quantify early and late Acadian strain in the Presidential Mountain Range.

HIGH-RESOLUTION TOPOGRAPHIC CHANGES AT THE VOTER BAR, SANDY RIVER, NORTHWESTERN MAINE, 2002-2004

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The Sandy River, a tributary of the Kennebec River, traverses a narrow, sediment-filled valley through the Longfellow Mountains of northwestern Maine. Renewed controversy has arisen over the environmental impact of gravel removal from active sediment bars. In response, the Maine Geologic Survey and the University of Maine at Farmington initiated a project in 2002 with the objective of documenting the sedimentary dynamics at five sites along the river. We focus on the Voter site, which includes three point bars, the central one transected by an avulsion channel. This site extends 700 m along the river and encompasses a width of 150 m and relief of less than 10 m. High-resolution topographic data was collected with a total station during the summers of 2002, 2003, and 2004. These data were used to assess patterns of erosion and deposition and their relationship to climate variables, particularly flood vs. low-flow. Whereas discharge varied only moderately during the first year, a 20-year flood occurred during December 2003. The year of low-flow resulted in cut bank erosion, sparse deposition and a general lowering of the site on the order of 5 cm, possibly due to compaction. Net volumetric loss was significant. Cut bank erosion continued through 2004 but spatially extensive deposition, including considerable foreset progradation, countered much of the volumetric loss. Over the two-year interval, the single flood event of December 2003 seems to have dominated the pattern of deposition.

APPLICATIONS OF GEOREFERENCED PRECISION PHOTOGRAPHY TO DIGITAL MAPPING

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The addition of low-altitude aerial georeferenced photography using a unique assemblage of equipment, techniques, and software creates new opportunities for geologic mapping. Georeferenced photo mosaics form a virtual world in which it is possible to view an outcrop at scales ranging from a low altitude “birds-eye view” to close-ups of features too small for the most precise survey equipment. This technique can be enhanced by the addition of on-screen digitizing: features may be

mapped as shape files directly from the georeferenced photographs creating a greater density and complexity of features than is possible to map in the field. This process thereby allows mapping at a previously unattainable range of scales.

A variety of techniques were used to determine the most effective method for building photo mosaics. Photographs were taken with at least two reference points per frame whose positions were established using a Trimble 5700 RTK GPS. Three methods of photography were employed: fine structures were photographed using a Hasselblad 500c/m 6x6cm camera with a 50mm planar lens, mounted on a 1-meter tripod. Larger structures were shot by hand using an Olympus 4.1 megapixel digital camera. Entire outcrops were shot using the same digital camera mounted on a 6m pole extended above the outcrop. Photographs were loaded into Adobe Photoshop in order to build photomosaics with the assistance of the Photomerge function. This function assists in combining frames by using calculated histograms and matching points within each frame.

Different photographic methods resulted in varying degrees of success for the photo-georeferencing processes. Scanned film showed more detail than the digital frames, although both clearly show all major features. Mosaics shot using the camera pole resulted in less distortion than mosaics created from frames taken at lower heights. Increasing the camera height over the outcrop diminishes the distortion resulting from varying surface elevation across the outcrop.

The photo mosaic and reference point files were loaded into ArcMap where the mosaic was positioned and oriented using the georeference tool: points within the photo were aligned with their corresponding geographic reference points.

NUMERICAL MODELING OF FLUID PRESSURE GRADIENTS IN ANISOTROPIC ROCKS UNDERGOING HETEROGENEOUS DEFORMATION

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Migmatites represent zones in the crust where transport and accumulation of partial melts occurred in structurally controlled sites. Because migmatites localize strain at the orogen scale, it is critical to understand the development and propagation of melt flow pathways through the system in three dimensions, as this will affect the rheology of anatectic zones.

Three-dimensional numerical modeling was undertaken to investigate the role of host rock mechanical heterogeneity in the development of locally dilatant sites, which influence the distribution of fluids in a melt-bearing system during deformation. At the onset of melting, the mechanical heterogeneity of the host rock leads to strain localization and the establishment of local fluid pressure gradients, which allows for the development of interconnected fluid networks. Once an interconnected fluid network has been established, zones of local extension serve as melt sinks, which may enhance further strain localization and allow for effective drainage of partial melts.

The occurrence of similar processes in rocks undergoing anatexis may control the flow of partial melts through the middle and lower crust, and thereby affect the distribution of relatively weak melt-bearing zones on a variety of scales. Further constraints of the fundamental processes of melt migration may also help to explain the apparent structural and geochemical relationships between migmatites, diatexites, and granites in transpressional orogenic settings.

DYNAMICS OF CO_2 DURING A HIGH DISCHARGE EVENT AT HADLOCK BROOK, ACADIA NATIONAL PARK, MAINE

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Hadlock Brook, a first order stream in Acadia National Park, Maine, lies in a watershed which is sensitive to acidification from precipitation events. This geochemical sensitivity is indicated by low alkalinity of several stream samples from a single rain storm event. Several pH-controlling mechanisms in the stream, one of which is the carbonate system, respond rapidly to a high volume input of precipitation. Water which is initially oversaturated with CO_2 with respect to the atmosphere may equilibrate with the atmosphere by degassing. This causes an increase in stream pH if initial pH is above ~5. Microbial and root respiration are sources of most excess CO_2 in streams.

Stream samples were obtained from multiple sites along Hadlock Brook during a high discharge event in October 2004. At all sites CO_2 pressure (PCO_2) was in excess of atmospheric CO_2 pressure ($10^{-3.5}$ atmospheres), and ranged from $10^{-3.02}$ to $10^{-2.38}$ atmospheres. There was no relationship between PCO_2 and location along the stream. Sections of Hadlock Brook with the highest PCO_2 tended to have higher pH (with the exception of one site), indicating that excess CO_2 was not controlling pH at the time of sampling during this event.

The relative effect of PCO_2 degassing on stream pH is related to the amount of groundwater influence at specific stream sites, at specific times during a high flow event. The $\delta^{18}O$ of the Hadlock Brook samples showed spatial and temporal variations, likely from varying influence of groundwater at the different stream sites. The stream samples were taken during a four-hour period, during which the discharge of the stream declined from 5.5 cfs to 3.0 cfs. The degree of groundwater influence along the stream could not be determined from the samples because of rapidly changing discharge and the time required for sampling. To understand CO_2 response better, samples should be acquired simultaneously and repeatedly at several sites along the stream.

GEOLOGICAL AND HISTORICAL INVESTIGATION OF THE BELGRADE LAKES WATERSHED

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The Belgrade Lakes watershed includes six interconnected lakes and represents an important water and recreational resource in

central Maine. The present geographic configuration of this watershed has been significantly modified by the construction of seven dams for water control and the generation of hydroelectric power over the past 100 years. The purpose of this investigation was to understand and document the impacts of these dams on the evolution of this lake system. Preliminary data on each dam was obtained from the Maine Emergency Management Agency and included date of construction (1896 to 1989), length (6.7-76.1 m), structural height (0-7 m), and hydraulic height (0.3-5.5 m). Longitude and latitude of each dam was obtained in the field using GPS. These data were integrated into a GIS mapping program and depth maps for each of the six lakes were constructed. Using hydraulic height values to the closest meter for the dams the original geographic extent, volumetric changes ranging from 1.0 x 106 to 14.0 x 106 m3 and changes in surface area percent ranging from 12 to 43 % for each lake were determined. Adding dates of dam construction, changes to aerial extent of the lakes in the watershed were mapped in a historical context. It is clear that this region would have looked significantly different had the dams, beginning in 1896, not been constructed. Results of this investigation provide a historical context and an important foundation for long-term hydrogeochemical and geochemical investigations of this watershed.

COMPARING INTRA-PLATE (MAINE-CANADA) AND ACTIVE PLATE (AEGEAN) REGIONS USING REMOTELY SENSED GEOPHYSICAL AND LANDSAT-5/TM DIGITAL DATA

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A comprehensive picture of intra-plate (the area straddling the St. Lawrence River valley for Maine and adjacent Quebec and Ottawa in Canada) and active plate (Greece, the Aegean Sea and adjacent western Turkey) regions has been assembled in a Geographic Information System (GIS) in order to compare the two and to assess the geophysical factors at work. Remotely sensed and other digital information assembled included heat flow, Digital Elevation Models, digital geologic maps, seismicity, World Stress Map (WSM) stress vectors, and Global Positioning System (GPS) data. Landsat 5-TM and MODIS satellite imagery were also employed. In addition, for the intra-plate region digital, magnetic field and gravity field data sets were integrated into the GIS.

Earth surface and geophysical features are clearly shown to relate to regional crustal patterns and tectonic elements. As expected, earthquakes are highly correlated with fault patterns in the both areas. For the geophysical data analyzed in the intra-plate locale we found that earthquake epicenters are generally correlated with values of low to intermediate heat flow. For the active plate locale there does not appear to be a correlation between heat flow and earthquake epicenters. Earthquake epicenters in the Maine-Canada region were found to be correlated with zones of high aeromagnetic anomalies and zones of low Bouguer gravity anomalies. No comparable aeromagnetic or Bouguer gravity data were available for the Aegean study area. In the Maine-Canada area magnetic values showed the highest correlation with bedrock geology. The influence of recent regional de-glaciation complicates the interpretation of crustal dynamics in the intra-plate region.

This approach confirms, in one synoptic view, the greater earthquake activity, higher heat flow, faster plate motion, and the "newness" of the Aegean region relative to the Maine and adjacent Canada area.

SOME USEFUL WEBSITES:

GSM Geological Society of Maine:
http://www.gsmmaine.org/

BATES COLEGE:
http://www.bates.edu/GEO.xml?dept=GEO

BOWDOIN COLLEGE:
http://academic.bowdoin.edu/geology/

COLBY COLLEGE:
http://www.colby.edu/geology/

UNIVERSITY OF MAINE:
http://www.geology.um.maine.edu/

UNIV. MAINE FARMINGTON:
http://www.umf.maine.edu/academics/dept_natural.php?location=academics

UNIV. MAINE PRESQUE ISLE:
http://www.umpi.maine.edu/programs/Scimat/

UNIV. SOUTHERN MAINE:
http://www.usm.maine.edu/~geos/

MGS: Maine Geological Survey:
http://www.state.me.us/doc/nrimc/mgs/mgs.htm

MEDEP: Maine Dept. Environmental Protection
http://www.maine.gov/dep/index.shtml.

Monument Cove boulder beach, Acadia National Park – D.F. Belknap photo, 11/03/2001

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:

$12.00 REGULAR MEMBER	Graduate geologists, or equivalent, with one year of practice in geology, or with an advanced degree.	***PLEASE NOTE NEW FEE SCHEDULE AS OF August 1, 2003***
$12.00 INSTITUTIONAL MEMBER	Libraries, societies, agencies, businesses with interests in or practicing geology and related disciplines.	
$10.00 ASSOCIATE MEMBER	Any person or organization desirous of association with the Society.	
$ 5.00 STUDENT MEMBER	Persons currently enrolled as college or university students.	

THE GEOLOGICAL SOCIETY OF MAINE ANNUAL RENEWAL / APPLICATION FOR MEMBERSHIP

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2005/2006 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.

Return Service Requested

Correspondence about **membership** in the Society, **publications** and **dues** should be mailed to:
Rob Peale, Department of Environmental Protection
State House Station 17, Augusta, ME 04333-0017 <rob.n.peale@maine.gov>

Items for inclusion in the **Newsletter** may be directed to:
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Orono, ME 04469-5790 <belknap@maine.edu>

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