THE MAINE GEOLOGIST

NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MAINE

June, 2003
Volume 29
Number 2

The President's Message

Spring Meeting

The Spring Meeting was a great success with an impressive array of research topics – the Abstracts are included herein on p. 4-8. Michael Choate from the University of Maine at Farmington received the Walter Anderson award for best poster presentation. Nicole Ouellette from Bates College received the Water Anderson award for best oral presentation. Both students had their names engraved on the Walter Anderson plaques and received $100 each for their work. Congratulations to them and to all the other presenters for such a great showing.

Many thanks to Dr. Jennifer Shosa of Colby College for her keynote address entitled *A Hydro-geochemical Retrospective*. Jen gave us a fascinating account of her training and research that has included work on acid rain, the pressure dynamics involved in sedimentary basins, as well as tracking the changes in seawater composition through time. Thanks again for such an interesting and impressive presentation, Jen. We're all looking forward to hearing the results of your research in the near future.

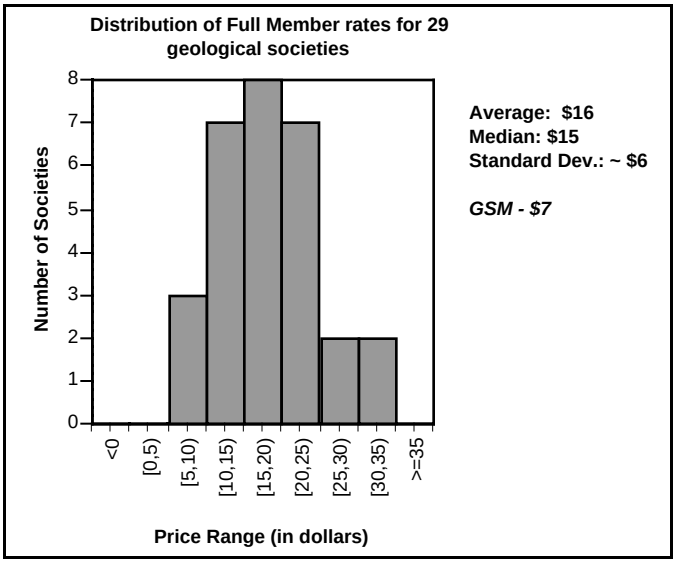
Bylaws

On a more tedious note, the GSM Council has been involved with pulling together an updated and revised set of GSM Bylaws. The last time the Bylaws were published was in 1976. Several amendments and revisions have been made since (e.g., changing the annual meeting from the summer to the fall) but have never been formerly recorded in the Bylaws. Therefore, an updated and revised set of bylaws is available at <www.gsmmaine.org>. Members are encouraged to read through the bylaws online and to send any recommendations, revisions, comments, etc. ***by October 1, 2003*** to Dan Belknap <belknap@maine.edu> or me <paleo@gwi.net>. Society members will be asked to vote on the revised bylaws during the Fall Meeting.

Dues increase and restructuring

For many years now, the money raised through membership dues has been inadequate to fully fund the Society's activities. GSM's major expenses include the printing and mailing costs of the Newsletter, incidentals associated with the spring and fall meetings (beverages and munchies when not supplied by the host institute) and summer field trip expenses (principally the one catered meal and sometimes lodging costs). Every three to five years, the coffers have been replenished through proceeds gained from a Short Course. However, this situation is far from ideal since it places too much emphasis on the continual support and volunteer efforts of a small percentage of members to keep the Society financially stable.

In order to get a better idea of how GSM's fee schedule compared with other state societies, I did a quick search on the web to collect information pertaining to yearly fees and services rendered for each state society. In some cases, more than one society existed in a particular state, so I randomly chose which ever first appeared. At other times, no societies were listed. Below is a graph showing the results of that search.



It is quite apparent from this figure that GSM's yearly dues are significantly lower than either the mean or median yearly dues of all 29 states. Maine's dues fall well outside the standard deviation ($15 - $6 = $9, which is still > $7). In fact, only one state society (Georgia at $5) charged less than Maine. Services offered by other societies were comparable to those offered by GSM.

Based on these results, and the budgetary issues outlined above, the Council felt that it was appropriate to propose an increase in yearly dues. The increase will take place in the next fiscal year, starting in August 2003. In addition, the $2 application fee will be dropped. See table below for comparison of present and proposed rates, and estimated yearly

revenues based on each. Membership numbers are based on current enrollment.

Membership Level	Number of	Present Rate	New Rate (8/2003)
Associates	33	$6.00	$10.00
Institutions	15	$7.00	$12.00
Regular	294	$7.00	$12.00
Students	52	$4.00	$5.00
Total	**394**	**$2,569.00**	**$4,298.00**

This information was presented at the Spring Meeting and met with unanimous support (via a show of hands) by all those present. Although the Council can technically make this decision without such input, it was reassuring to see that the other members of the Society also support this increase.

Joint Summer Field Trip

This year's summer field trip will be jointly hosted by the Geological Society of New Hampshire and GSM. The trip starts the **evening of July 25th (Friday) and will last through the afternoon of July 27th (Sunday)**. See the announcement on p. 2. Many, *many* thanks to Woody Thompson and Lee Wilder (President, GSNH) for pulling this trip together.

GSM Geology of Maine Short Course

CHANGE IN DATE – now scheduled for **October 15, 2003 at Bates College**. See final announcement on p. 3 of this Newsletter and www.gsmmaine.org for more details.

Upcoming Fall Meeting

Liz Champeon and I have been busy putting together a fall meeting that will emphasis the work of the consulting sector. The meeting is scheduled for **Tuesday, November 4th at the Elks Lodge in Augusta**. A midweek date was chosen to better accommodate many of the consultants who find Fridays a difficult time to attend. Unfortunately, Tuesday (Election Day) was the only day available, so make sure to cast your votes early that day!

The format of the meeting will be slightly different than those of the past, and will include a half-day of formal presentations followed by the usual business meeting, social hour, dinner and keynote address. Some groups will also be asked to set up poster presentations illustrating some of their recent projects.

A preliminary slate of speakers and subjects is listed below. Each presentation will be about 30 minutes in length (with the exception of the keynote address). Check the GSM website for more details in the upcoming months.

Peter Baker (keynote) - Corinna Superfund Site
Dave Andrews - dam removal
Liz Champeon -seismic risk or waste-water studies
Lisa Churchill-Dickson – National Environmental Policy Act and road ecology
Jim Hillier - bathymetric studies of lakes
Alice Kelley - geoarcheology
Steve Kelley - TBA
Steve Pinette - hydrogeological studies or metal concentrations in glacial deposits
Rudy Rawcliffe - geothermal projectsLisa Churchill-Dickson, paleo@gwi.net

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Geological Society of New Hampshire
and the
Geological Society of Maine
Joint Summer 2003 Geology Field Trip

Mount Washington and the Gorham Area of the NH White Mountains Friday evening July 25th through Sunday mid-afternoon the 27th

The GSM and the GSNH have planned a joint summer Geology Field Trip. Those wishing to camp for the weekend may stay at the group 4 or 5 site in Barnes Field at Dolly Copp Campground, on NH Rte. 16, south of Gorham. Or you can make reservations at one of the many motels in the Gorham area. Make your motel reservation early because this will be peak tourist season. The AMC Pinkham Notch Camp on Rte. 16 also provides very nice lodgings. Rates include bed, sheets, shower, and breakfast/meal options. Reservations can be made by calling 603-466-2727, Monday to Saturday, 9 a.m. to 5 p.m.

The trip's present itinerary includes:

FRIDAY EVENING, 7/25:

8:00 PM - talk by **Brian Fowler** (North American Reserve) on the Old Man of the Mountain, at the Visitor Center, Dolly Copp Campground. Park at our designated campsite in Barnes Field if space permits; otherwise, parking at the Visitor Center is subject to a National Forest $3.00 fee.

SATURDAY, 7/26:

6:30-7:00 AM: Assemble and consolidate vehicles in the large parking lot on the west side of Rte. 16, just south of the Mt. Washington Auto Road entrance. **Dyk Eusden** (Bates College) has made special arrangements for our group to get EARLY admission to the road at a rate of $18.00 per vehicle (including occupants). Sturdy vans would be good if colleges

or others can bring them. (Occupants of each van are responsible for somehow "coughing up" the $18…)

7:00 AM – 5 PM: Drive to summit of Mt. Washington. Depending on the weather…we will: study the Summit geology with Dyk Eusden, Brian Fowler and **Thom Davis** (Bentley College); tour the Mt. Washington Observatory and Museum; and descend the Auto Road, stopping at various turnouts and parking areas to examine bedrock, glacial, and periglacial geology. (Bring a lunch to eat en route.)

Mid to late afternoon: Bedrock and glacial stops along Rte. 16 with **Tim Allen** (Keene State College) and Brian Fowler.

"Free time" to relax and freshen up for the…

SAT EVENING, 7/26:

6:00 PM: Catered Barbequed chicken and steak Cook-Out at the covered picnic pavilion at Dolly Copp Campground. Hot coffee will be provided - members wanting other beverages must BYO. (If you have brought the family on this trip, they are welcomed at the Cook-Out of course! See pricing below.)

SUNDAY, 7/27:

8:00-8:30 AM: Assemble at State rest area on the north side of U.S. Route 2 in Shelburne.

8:30 AM - noon: Bedrock and glacial stops with **Woody Thompson** (Maine Geological Survey) along the Androscoggin valley in Shelburne. Drive to Mt. Jasper in Berlin for lunch, or have lunch at Shelburne Dam on the Androscoggin River. (Bring a lunch to eat en route.)

1:00-3:00 PM: Mt. Jasper Paleo-Indian site with **Dick Boisvert**, NH State Archeologist. (Note: this stop requires a short hike.) If time permits, there are one or two other glacial stops. Trip will end as close to 3:00 PM as possible.

(NOTE to those needing CEU's for their PG's…this entire GSNH/GSM Geology Field Trip is worth up to18 hours.)

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Reservation Form: Cut or Photocopy as needed

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The Geological Society of New Hampshire and the Geological Society of Maine

Joint Summer 2003 Geology Field Trip

Mount Washington and the Gorham Area of the NH White Mountains Friday evening July 25th through Sunday mid-afternoon the 27th, 2003.

1. Name(s) of those attending the GFT:

_____

_____

_____

(Include only those paying to attend, not family members who will be with you, but doing other activities during the trip times.)

2. I/We WILL camp at the Barnes Field group sites: Y/N

3. There will be _____ (#) attending the Barbeque Cook-out Sat. eve and a check made out to the Geological Society of NH is enclosed for: $ _____

4. We will be needing:

_____ # BBQ steak(s) and _____# BBQ chicken.

(# wanting the Barbeque Cook-Out X $17.00 each = check amount)

Kids: <5 free; 5-9 1/2 price ($8.50) and 10 or older $17.00. Drinks are BYO...but there will be hot coffee available.

SPACE IS LIMITED, so return this completed registration form (with check) well before July 15! to:

John Noble, GSNH/GSM FT, 226 Whitten Road, Milford, NH. 03055

(***Note***: John is collecting for **both** Societies.)

Questions? Contact Woody Thompson at: 207.287-7178 or Woodrow.B.Thompson@maine.gov

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The Editor's Message:

In this issue we begin a new section entitled **History of GSM**. This column by society historian **Art Hussey** is intended to provide a look back at the society's initiation and development, as well as advances in geology of Maine over that period. For those who were there in Art's barn at the beginning, it is a great look back. For those who have joined more recently, this column should provide valuable insights into the development of GSM. We thank Art for stepping up to perform this service.

Dan Belknap, Newsletter Editor (1998-present)
<belknap@maine.edu>

THE GEOLOGY of MAINE Short Course

The Geological Society of Maine announces a one-day short course on the Geology of Maine. The course is targeted at individuals who work on or are interested in the geological aspects of Maine. We anticipate an audience comprising state agency employees, journalists, teachers, undergraduates and practicing geologists. No strong science background is assumed. This is also a good review opportunity for those preparing to take the state's geology certification exam, as well as for professionals whose areas of expertise may lie outside of these subject areas. Continuing Education Units (1.0) are available.

SUBJECTS COVERED

Geologic History of Maine		**Metamorphism**
Plate Tectonics	**Glaciation**	**Stratigraphy**
Geomorphology	**Paleogeography**	**Volcanism**
Sea-level Rise	**Geodynamics**	**Paleontology**
Coastal Geology	**Igneous processes**	
Geoarcheology	**Applied Geology**	

DATE: **October 15, 2003**. Registration begins at 8 a.m.; workshop 8:30 a.m. to 5 p.m.; includes two breaks and a one hour lunch break.

PLACE: Bates College, Kresge Lecture Hall, Room 204, Carnegie Science Building ***COST***: $35 ($20 for students); includes morning and afternoon coffee break and snacks

Lectures (for complete titles and schedule please visit <www.gsmmaine.org>):

Part I – The Paleozoic and Mesozoic of Maine:
Dr. Robert Marvinney (MGS)* : overview;
Dr. David Gibson (UMF): Coastal Magmatic Province;
Dr. Stephen Pollock (USM): Ordovician to Devonian Sedimentary Environments;
Dr. Douglas Reusch (UMF): The Odyssey of Maine's Bedrock;
Mr. Christopher Gerbi (UM) Origin and Evolution of Maine's Mountains;
Dr. Rachel Beane (Bowdoin): History of Metamorphism in Maine;
Ms. Lisa Churchill-Dickson (GSM): Maine's Fossil Record.

Part II – The Cenozoic of Maine:
Dr. Thomas Weddle (MGS): overview;
Dr. Julia Daly (UMF): Glacial History of Maine;
Dr. Joseph Kelley (UM): Geomorphology of Maine;
Dr. Daniel Belknap (UM): Sea-level Change in Maine;
Dr. Stephen Dickson (MGS): Coastal Geology;
Ms. Alice Kelley (UM): Link between People and Landscapes;
Ms. Elizabeth Champeon (S. W. Cole): Science of Geology as a basis for Modern Life.
Moderator: Mr. Walter Anderson, Retired State Geologist

*MGS (Maine Geological Survey);
UMF (University of Maine at Farmington);
USM (University of Southern Maine);
UM (University of Maine at Orono);
GSM (Geological Society of Maine)

To Register: Send Check (payable to the Geological Society of Maine) and registration form to Ms. Elizabeth Champeon, S.W. Cole, 37 Liberty Drive, Bangor, Maine 04401 by October 10, 2003.
Questions?? E-mail Lisa Churchill-Dickson at paleo@gwi.net. (*seating limited to 140 persons*)
----------detach and mail----------

NAME_____

Professional ( ) Student ( )

ADDRESS_____

_____

PHONE and/or E-MAIL_____

GSM WEBSITE

www.gsmmaine.org

The GSM website contains copies of present and archived Newsletters, a calendar of events, other items of interest to the Societty, including a draft of our new Bylaws to be ratified at the Fall meeting. There are many important links to geology items in Maine and elsewhere.

Webmaster, UMF < megan.macdonald@maine.edu >

(please cc: Dave Gibson - dgibson@maine.edu)

GSM MEMBER NEWS

Tom Brennan (formerly of Magellan Enterprises, Inc.) became the Natural Resource Manager at Poland Spring in January. Kristin Tardif has been promoted to assisting the company's national headquarters with community and public relations and education.

Art Hussey (Bowdoin College) is a volunteer host/greeter on the DownEaster train between Portland and Boston several times a month. Art is also involved in the operation of the Narrow Gage Railroad in Portland.

Bob Marvinney (Maine Geological Survey) is the President-Elect of the American Association of State Geologists and will take over as President in June.

Rachel and Eric Beane (Bowdoin College) announced the birth of their son, Zander Ronald Chown, born on May 3, 2003. All are healthy and enjoying life together as a family.

Kevin McCartney, (UMaine Presque Isle) writes that the Ocean Drilling Program Leg 183 research that **Robb Engel** (speaker), **Rita Williamson** and **Tracy Reed** spoke on at the GSM 2002 Spring Meeting has now been published, and can be seen at

<http://www.odp.tamu.edu/publications/183_SR/011/011.htm>. This is the fifth undergraduate paper to be published in the Proceedings of the Ocean Drilling Program (for a list see <http://www.umpi.maine.edu/~mccartnk/murl.htm>).

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

MAINE SOLAR SYSTEM MODEL

The Maine Solar System Model in Aroostook County is nearly complete, and ready for dedication on June 14. Check out progress on the webstie at: http://www.umpi.maine.edu/info/nmms/solar/index.htm
or contact:

Kevin McCartney, Professor of Geology
Director, Northern Maine Museum of Science
University of Maine at Presque Isle
Presque Isle, ME 04769
(207) 768-9482 (fax: 768-9608)
<McCartnk@polaris.umpi.maine.edu>

GSM SECRETARY'S REPORT

Geological Society of Maine
Spring Meeting, April 4, 2003
Bryand Global Sciences Center
University of Maine

President Lisa Churchill-Dickson called the meeting to order at 5:24 p.m.

Lisa thanked the University of Maine for hosting the 2003 Spring Meeting; and noted that Dr. Jennifer Shosa, Colby College, will give the lecture this evening.

Direction of the Society

Communication: Increase cross-talk between the various disciplines, including academia, consulting, government, and general public.

Member profiles consisting of projects/fields of interest to be included in each newsletter

Webpage: Make the webpage more up-to-date. David Gibson is working on full-year funding of the work study position to bring consistency to the GSM website.

Shortcourse: A geology shortcourse will be offered on October 15th at Bates College. Registration information will be available on the website.

Geology of Maine publication: In order to attract authors for this endeavor, Joe Kelley has volunteered to contact a publisher. More information will be available at the summer meeting.

Fall meeting: Lisa Churchill-Dickson and Liz Champeon are collaborating to have the fall meeting emphasis be on the practical aspects of geological topics with more involvement from the consulting community.

Bylaws: The most recent revisions appear in a 1976 newsletter. Dan Belknap will circulate a revised draft for approval before placing the Bylaws on the webpage and in the newsletter.

Officers: Pat Seaward, Secretary, and Liz Champeon, Treasurer, are both interested in stepping down from their respective offices. Please let the nominating committee (Tom Weddle, Marita Bryant, Pat Seaward) know if you are interested in either position.

Membership and dues: Lisa has concluded some research regarding what other societies charge for dues, which puts GSM into "sub non-profit" status. Approximately $2500 is collected in dues each year, and that supports mailing the newsletters and running the meetings. The Executive Committee decided to strengthen the dues base to eliminate reliance on short courses for our operating budget. The Committee decided to eliminate the application fee and initiate a dues structure as follows:

Regular Member	$12.00
Institutions	$12.00
Associate Member	$10.00
Student Member	$ 5.00

There will be an annual reminder in the Newsletter at the end of the calendar year.

Summer Field Trip: GSM will meet jointly with the NHGS on the last weekend in July (25th-27th) to study Mt. Washington geology (bedrock and Quaternary) with Dyk Eusden, Woody Thompson, and Tim Allen.

Other dates:

Friends of the Pleistocene	end of May
Pegmatite Short Course, Newry	end of May
Canada Quaternary Assoc.	June 8-12
NEIGC	October 10-12
GSM Short Course:	October 15

Walter A. Anderson Awards: Congratulations to you all!

Honorable mention: Mt. Blue High School students

Best Poster: Michael Choate, UM Farmington

Best Oral Pres.: Nicole Ouellette, Bates College

Evening Speaker

"A Hydrogeochemical Retrospective"
or "My geology identity crisis"

Dr. Jennifer Shosa, Clare Boothe Luce Assistant Professor of Geology at Colby College, gave a very entertaining and enlightening talk about several aspects of geochemistry. An autobiography of sorts, Dr. Shosa traced her evolution as a student, researcher, teacher so that the loop continued to bring her back to student; each time pointing her in a slightly different direction.

Undergraduate studies of calcite deposition in freshwater stromatolites found that the photo-synthesis and respiration of the individual animals upset the equilibrium of the calcite re-precipitation reactions, creating "chemical microenvironments".

Intrigued that acid precipitation mobilized aluminum to be toxic to aquatic life, Dr. Shosa's early graduate studies determined that organic matter bound a portion of the aluminum, reducing its toxicity in the environment.

Switching gears toward her doctorate, Dr. Shosa used an experimental reactor to determine the possible mechanisms causing the build up of pressure (capping) in sedimentary basins during oil formation. The practical application is the challenge of controlling that pressure during the extraction of the oil to prevent "blow-outs" which destroy oil rigs.

Other studies include geochemical modeling to determine equations of state, and numerical modeling to demonstrate how migration of metals (over millions of years) aids in the formation of massive sulfide deposits on the seafloor.

Since Dr. Shosa has been at Colby College she has compared surface to sediment porewater in two ponds in Bermuda, and worked with students studying the lake/bog water interactions and bog succession in the Great Bog in Belgrade, using that data to model seasonal hydrogeochemical variations in the bog.

Dr. Shosa's work with how black smokers form has led her to "experimental investigations of hydrothermal alteration of seafloor basalts as a function of Mg^{+2} concentration in seawater".

Where will we find her next?

Respectfully submitted,
Patricia O. Seaward, Secretary (1999 – Present)
<Patricia.O.Seaward@state.me.us>

GSM TREASURER'S REPORT

The Society currently has 333 members: They are distributed as follows:

Associates:	36
Institutions:	15
Regular:	242
Students:	40

Balance on Hand 02/14/03	**$**	**9,722.50**
Anderson Fund (Total)	$	5,081.79
Education Fund (Total)	$	872.70
Checking Account (other)	$	3,150.42
Receipts		
Dues, interest, etc.	$	245.00
Anderson fund (interest)	$	47.81
Anderson fund (contributions)	$	135.00
Education fund	$	0.00
Short Course Registration	$	545.00
Publications	$	0.00
Subtotal	$	972.81
Expenses		
Printing, mailing, stamps	$	511.95
Spring Meeting	$	405.78
Name tags, etc.	$	15.17
Anderson Awards	$	200.00
Plaques engraving	$	14.70
UMaine Farmington	$	406.80
Returned Checks	$	36.00
Subtotal	$	1,590.40
Balance on Hand 06/13/03	**$**	**9,104.91**

Respectfully submitted,
Elizabeth A. Champeon, C.G., Treasurer (1998-present) < Lchampeon@aol.com>

History of GSM

A Society is Born. July 28, 1974.

What a way to start a new scientific society for the State of Maine, in a barn to the tune and antics of

goats! That is exactly how it started, in my barn in Bowdoinham. Between 30 and 40 interested geologists from many institutions and organizations, and from many states (and 4 resident French Alpine goats) gathered to talk about the desirability and need to establish a professional geological society for the state of Maine.

The goats added their comments at appropriate times, and seemed to enjoy nibbling away at Bob Doyle's jacket (or so I have been told). The purpose of the society as it emerged from the discussion was five-fold. Quoting from the first newsletter of the society, compiled and edited by Jack Rand, the purpose of the Society is:

"1. to advance the professional improvement of its members;
2. to inform members and others of current and planned geologic programs in Maine;
3. to further the public awareness and understanding of the geology of the State of Maine, and the modern geologic processes which affect the Maine landscape and the human environment;
4. to encourage continuing social contact and dialogue among geologists working in Maine;
5. to provide a financial base to publish and distribute a periodic Newsletter, to cover matters of technical and general interest, and to announce future Society meetings."

Members present chose to have 3 meetings yearly with the annual meeting during the summer. Officers elected to carry on the work of the fledgling society until the following annual meeting were:

President: Arthur M. Hussey II
Vice President: William W. Rideout
Secretary: Gary M. Boone
Treasurer: Jack R. Rand

With a little arm twisting Jack Rand assumed the responsibility of Editor of the Newsletter for purposes of establishing a continuing address for the Society. He dutifully assumed his labors in August of the founding year, 1974, by publishing the 1-page Volume 1, Number 1 of the Maine Geologist. To my knowledge Jack and the subsequent editors who have assumed this important position of the society, have not missed a single edition of The Maine Geologist!

At the same meeting, attendees, with concurrence of the goats, established three classes of membership, **Regular** for geologists with academic degrees in geological disciplines or with recognized professional experience; **Associate** for any person interested in the geological sciences and wishing to associate with the Society; and **Student** for any person interested in the field of geology and enrolled as a student.

Furthermore, we established the annual dues of $5, $4, and $2 per year for these categories, respectively (and note how little they have changed in 29 years). Decisions were made to have a Board of Councilors and to formulate a set of Bylaws to be decided upon at the first regular meeting of the Society in October 1974.

After these momentous decisions were made the meeting adjourned late in the day, spurred on by the insistence of the goats for their nightly attention; they were hungry and needed to be milked.

I will continue with later aspects of the development of the Society in subsequent additions of this column from the non self-appointed Historian of the Society. Please, Dear Readers , if you have any corrections or additions you want to make to these and subsequent ramblings, either communicate them to me or write a Letter to the Editor!

Arthur M. Hussey II – Emeritus Professor, Bowdoin College. **e-mail:** <hussgeo@gwi.net>

Geological Society of Maine Spring Meeting

Friday, April 4, 2003, 1:00 – 5:00 PM
University of Maine, Orono, ME
Bryand Global Sciences Center
(Dept. Geological Sci. and Climate Change Institute)

ABSTRACTS

[**Poster**]– *** Honorable Mention: Anderson Award ***

SEDIMENTS OF THE SANDY RIVER

ANDERSON, T., BARKER, M., BAYNTON, M., BELANGER, A. CORMIER, E., DALRYMPLE, J., HANSTEIN, L., HINDS, K., HUDDLESTON, J., LOCHALA, C., SCRIBNER, M., SPAULDING, M., STARRETT, B., UNDERKUFFLER, W. WILDE, L., Science and Technology Dept., Mt Blue High School, Farmington, ME 04938,<patti.millette@maine.edu>

The Sandy River in Farmington Maine has shaped and reshaped the land it borders for many years. A group of local geologists endeavored to understand exactly what happened to form an area bordering the river, located at the western edge of Prescott Field. Cores were taken, sediment samples were gathered, and the surface's topography was surveyed to learn as much as possible about the location's past. The data gathered showed signs of water at one time flowing where the shore is now. It was concluded that this water was from the river, and that the river's course changed to what it is today due to the river eroding its own banks and shaping a more favorable path for the water to flow through.

[**Poster** presentation]

A STRATIGRAPHIC AND STRUCTURAL ANALYSIS OF THE NORTHERN PRESIDENTIAL RANGE, NEW HAMPSHIRE

BEAUDRY, Emma, Department of Geology, Bates College, Box 28 Bates College, Lewiston, Maine 04240, <ebeaudry@bates.edu>

The bedrock geology of the northern Presidential Range was mapped during the summer of 2002 and funded by the U.S. Geological Survey EDMAP 2002 program. A bedrock geological map was created as part of an ongoing project to map the Presidential Range. The goal of this study was to connect the bedrock and structural geology with previously mapped areas of the Presidential Range. Fieldwork was performed during July and August 2002. Samples were collected for the const-ruction of thin sections to study the mineralogy and microstructures present in the outcrop. Measurements were collected for analysis of the structural geology within rock types and throughout the field area. The units mapped in the field area, from youngest to oldest, are the Bretton Woods Granite, Devonian Littleton Formation, Silurian Rangeley Formation, Ordovician Ammonoosuc Volcanics and the Ordovician Biotite Quartz Monzonite. The Devonian Littleton Formation was subdivided based on ratios of schist to quartzite. Pegmatites and dikes were also mapped in the field area. Southwest plunging fold hinges were identified within the Devonian Littleton Schist near treeline, which correlates to the dipping limbs previously measured in the alpine zone. A southeast plunging fold hinge was identified within the Silurian Rangeley Formation. Joint measurements within the Bretton Wood Granite were studied for joint set similarities across the unit.

[**Poster** presentation]

AN EXPLORATION OF THE MINERALOGY ALONG THE ULTRAMAFIC - MAFIC CONTACT OF THE SOUTHERN MOXIE PLUTON, MAINE

BECKER, Christopher J. and ALLEN, D.B., Department of Geology, Colby College, Waterville, ME 04901 <cjbecker@colby.edu>

The Moxie pluton is a large mafic intrusion located in west-central Maine. The pluton is mid to late Devonian in age, intruding into early Devonian silts, shales, and sandstones as part of the Acadian orogeny. As the pluton crystallized, it formed a layered igneous complex extending from olivine-rich ultramafic units in the southwest and terminating in granites and granodiorites at Mount Katahdin.

The section of the Moxie pluton studied in this report is the contact zone between the ultramafic and mafic units of the southwestern bulge, near Moxie Mountain. Recent development in the region exposed a portion of this contact zone in a series of pits. G.H. Espenshade studied comparable samples from the Greenville quadrangle. However, little work has been done in the Bingham quadrangle, where this study was conducted. Samples were collected to determine if there is a significant change in composition along the contact zone, and if there is a significant difference in composition between the Greenville and Bingham quadrangles.

Rocks were collected from each of the five pits and returned to lab for analysis. Samples were powdered, and analyzed using X-ray diffraction techniques. Thin sections were also made to study the samples using a petrographic microscope and X-ray fluorescence.

Espenshade (1972) found olivine concentrations in the range Fo26 – 74 and plagioclase concentrations of An37-85 for the Greenville quadrangle. However, Visher (1962) determined a broader compositional range for olivines, ranging Fa10-88 (Fo12-90) and plagioclase ranging from An56-90. The olivine concentrations in this study are magnesium-rich, ranging from Fo100 - 75, approximately 30% more magnesium-rich than in the Greenville quadrangle. Plagioclase concentrations were more comparable between the Bingham and Greenville quadrangles, ranging from An25 to An100. However, half of the plagioclases sampled have a concentration of An100. No significant compositional variation along the contact was found.

[**Poster** presentation]

DETAILED PETROLOGIC INVESTIGATIONS OF THE SLOKO GROUP VOLCANICS, JUNEAU ICEFIELD, NORTHERN BRITISH COLUMBIA

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Reconnaissance mapping of the F-10 Ridge, Atlin Wilderness Provincial Park, British Columbia, was conducted in August 2002 in order to investigate the southernmost extent of the Sloko Group. Locally, these Eocene-age volcaniclastics, tuffs and lavas overlie the western edge of the Stikine Terrane, along its contact with the Coastal Plutonic Complex. To the north of our study area (58°56' 05.2" N, 134° 07' 41.7" W) the Sloko Group is intruded by the Llewellyn Granite, one of several intrusives formed during coeval and subsequent magmatic activity. Both volcanic and plutonic units have undergone regional metamorphism, which is reflected by widespread saussuritization, chloritization and hydrothermal brecciation. Detailed petrologic work focused on several microstructures found in characteristic F-10 lithologies. Thin sections, x-ray diffraction and x-ray fluorescence were used to determine the nature of amygdules in felsic lava, and examine spherulitic structures in a welded tuff. The latter may be the result of devitrification. Also, abundant filamentous crystallites were found within and around the spherulites, and their origin is speculative.

[**Poster** presentation]

DEFINING WETLAND TYPES: A CLARIFICATION OF CLASSIFICATION USING KEY FACTORS

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“Wetland” is a commonly used term that covers a vast number of environments where water is a significant factor in the functioning of the system. Wetlands are categorized as swamps, marshes, bogs, or fens. These classifications are an attempt to clearly delineate between wetland types; however, there is considerable overlap between popular definitions. It is important to have key factors for the classifications so categories of wetlands can be universally defined. These factors will facilitate the definition of the wetland Great Bog in Central Maine, which is currently being researched.

My goal is to provide concise definitions for wetland types using previously researched sites. My research involves clarifying these definitions by examining and comparing key factors of selected study sites. I am investigating six wetlands

that are diverse in environment and location. They have been comprehensively researched and documented in the literature. Four of the sites are located in the United States. Another site is located in Newfoundland, where blanket bogs are prevalent. The last site is located in East Anglia, UK. I will identify key factors for the classification of wetlands and place the investigated wetlands as well as Great Bog in my classification framework.

[**Poster** presentation] *** Anderson Award Winner ***

DISTRIBUTION, PETROGRAPHY AND CHEMISTRY OF RAPAKIVI FELDSPARS IN THE MT. WALDO PLUTON, COASTAL MAINE

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The Mt. Waldo pluton crops out over an area of 150 km^2 at the northern end of Penobscot Bay, coastal Maine. Emplaced at 371 Ma (Stewart et al., 1995), it is one the younger granitoids of the Coastal Maine Magmatic Province. Recent field, petrographic and geochemical evidence suggests a definite role for magma mixing in the evolution of the Mt. Waldo magma chamber with abundant magmatic enclaves, mafic schlieren and a diverse feldspar population including rapakivi feldspars and boxy cellular plagioclase.

Rapakivi feldspars (plagioclase mantles on K feldspar) are common throughout the Mt. Waldo granite. They occur 1) as euhedral megacrysts (up to 5 cm in length) in the granite, 2) associated with all types of magmatic enclaves either bordering them, cutting across the host/enclave contact or as phenocrysts within the enclaves, 3) as part of equigranular, feldspar cumulate autoliths (?) that often enclose enclaves and 4) aligned parallel to planar mafic schlieren. Their distribution throughout the Mt Waldo pluton is random with modal abundances ranging from 10 – 80 rapakivis per m^2, irrespective of height within the intrusion or relative distance from its margins. This is in sharp contrast to the Deer Isle pluton (see Terrien and Hogan, this session) where there is a systematic variation of rapakivi feldspars with position in this intrusion. Thin section petrography reveals that the plagioclase rims are formed either by a continuous zone of plagioclase (some of which exhibit oscillatory zoning) or numerous small grains upon resorbed K feldspars. These are usually < An_{20}, which is also consistent with the outer rims of normally zoned groundmass plagioclase.

The formation of rapakivi feldspars has been assigned to a number of processes such as 1) decompression during magma ascent, 2) syneusis 3) megacrystic growth and 4) magma mixing. The distribution of rapakivs in the Mt. Waldo pluton and their composition may suggest that they were formed as a result of repeated thermal inputs at lower levels in this magma chamber. An exposed example of a rapakivi forming environment is present in the co-mingled zones observed in the lower parts of the Vinalhaven pluton (Wiebe and Hawkins, 2000) where rapakivi feldspars are particularly abundant. Rapakivi feldspars (and enclaves) were subsequently distributed throughout the chamber by thermally induced convection.

[**Poster** presentation]

WEATHER-INDUCED EROSION AND ACCRETION AT SEAWALL BEACH, PHIPPSBURG, MAINE

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An examination of Seawall Beach, a barrier beach in Phippsburg, Maine, and the collection of local weather data were used to determine patterns of erosion and accretion of sediment under summer and winter weather conditions. Methods included topographic profiling of five transects perpendicular to the shoreline at different locations along the length of the beach, and digital photographs were taken to support the profile data. The NOAA Portland Weather Buoy and a weather station installed at nearby Morse Mountain recorded weather conditions, including wind, waves, tides, and local barometric pressure. Storms were classified using the Dolan-Davis intensity scale for northeast storms. The responses of the eastern, central, and western sectors of Seawall Beach were studied to determine spatial variability in erosion and accretion.

Results indicate a correlation between characteristically storm-like weather and wave conditions with increased erosion. The eastern sector of Seawall Beach has been in an erosive mode since the summer. The central sector of the beach was scarped during storms from November through January, but heavy erosion was limited due to the extensive presence of berm-colonizing plants on the backshore and possibly the presence of Morse Hill to the east, which may have blocked erosive winds. In contrast, recent storms have caused more scarping and removal of the berm in the western sector of the beach, which was more exposed to easterly winds.

[**Poster** presentation]

ORIGIN OF GARNETS FROM THE PERALUMINOUS NORTH JAY PLUTON, WEST-CENTRAL MAINE. MAGMATIC OR XENOCRYSTIC?

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The North Jay Pluton (NJP) is located in west-central Maine and crops out over an area of approximately 30km^2. The preliminary bedrock map of the Farmington 7.5 minute quadrangle (Pankiwskyj, 1978) suggests that the NJP is post-tectonic as it crosscuts the local Silurian country rocks (Sangerville formation). Most likely it is similar in age to the nearby Togus, Rome and Hartland plutons which have recently been age dated by U-Pb systematics at around 380 Ma (Bradley, 2000). Garnet occurs as a minor phase in many of these two-mica granitoids, including the North Jay, the focus of this study.

The NJP, a garnet bearing two-mica peraluminous granite, is cut by several late pegmatites and contains metasedimentary xenoliths of unknown origin. The granite is medium grained with an equigranular texture and contains abundant microcline along with K feldspar and plagioclase. Muscovite is present forming large euhedral crystals and is more abundant than biotite. Quartz displays undulatory extinction and sutured

contacts are also common. Garnet in the granite is typically sub- to anhedral, 1 – 3mm in diameter and is often embayed with many quartz inclusions. The pegmatites are up to 2 m across trending N – S and are Kf + Plag + Qtz assemblages with garnet glomerocrysts and minor beryl. The xenoliths are usually angular, range in size from 5 – 25 cm, quartzo-feldspathic gneisses and schists. Garnets in the latter are euhedral and lack inclusions.

The garnets in the NJP could have originated from a number of possible sources. They could be metamorphic formed during a later event as the granite does appear to have been subjected to some post-crystallization strain. Alternatively, they may be xenocrysts inherited from either the adjacent country rocks or from xenoliths representing deeper crustal levels, proximal to the melting zone where the perlauminous melt formed, and therefore restite in nature. However magmatic garnets are not uncommon in peraluminous granites, e.g. the Cardigan pluton (Plank, 1987), and this would have implications for melt composition and origins. Electron microprobe data, including compositional maps and profiles for garnets from the NJP, its pegmatites and xenoliths along with data for the country rocks and geothermometry calculations should help us constrain their origin.

[**Oral** presentation]

ENVIRONMENTAL AND GEOCHEMICAL STUDIES IN THE BELGRADE LAKES WATERSHED, CENTRAL MAINE

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Public concern over water quality has prompted an investigation of the hydrogeology, geochemistry, and environmental health of the Belgrade Lakes, a system of seven interconnected lakes in central Maine. The Belgrade Lakes watershed faces problems due to algal blooms and invasive plant species. There are four major groups that study the Belgrade Lakes Region in an attempt to improve the health of the watershed: (1) the Maine Department of Environmental Protection, (2) the Lakes Associations, which are groups of concerned citizens, (3) Conservation and land trust organizations, and (4) independent scientific researchers. While there appear to be overlaps among study interests and goals, the concerns that are driving the research are not the same for all groups. Through interviews and survey of previous work, I am evaluating the driving forces behind each group, and will make suggestions for improving communications and collaboration between the groups in order to improve watershed management.

I am also investigating the surface water chemistry of North Bay, a shallow bay in the northeastern corner of Great Pond (one of the Belgrade Lakes), in order to understand the interaction between the lake and the peripheral wetlands. I have sampled water at 17 sites along the shore of North Bay, and analyzed them for temperature, pH, conductivity, oxidation-reduction potential, dissolved oxygen, alkalinity and cation concentration. I will present and discuss my data from this fall.

[**Poster** presentation]

POCKMARKS, GAS-ENHANCED REFLECTORS AND ACOUSTIC WIPEOUT IN AN ACTIVE ESTUARINE POCKMARK FIELD, PENOBSCOT BAY, MAINE

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Sidescan sonar and bathymetric surveys of Penobscot Bay, ME reveal abundant large pockmarks. Nearly 6000 pockmarks ranging in size from a few meters to >300 m diameter and 30 m relief were mapped in eight fields, with densities approaching 1400/km^2. Pockmarks are the result of pressurized pore fluids escaping from the subsurface, most likely including biogenic methane. Repeated sidescan sonar surveys from Belfast Bay show that the pockmark field is actively producing more new pockmarks than are lost with a net gain of 9 pockmarks/year (4% growth) averaged over a nine-year period (1989-1998).

Several reconnaissance and two detailed geophysical surveys using sidescan sonar and shallow seismic reflection profiling conducted near the Black Ledges indicate large areas of acoustic wipeout curtains and gas-enhanced reflectors. The detailed surveys allowed correlation of pockmarks and activity zones with indicators of shallow gas. Forty-six vibracores correlate seismic stratigraphy with physical sedimentology. Enhanced reflectors appear to relate to a locally pervasive gravel lag surface and sandy lenses. These zones of higher permeability produce strong (enhanced) acoustic reflections due to trapped gas bubbles.

Active regions of the fields are typically marginal to areas of acoustic wipeout and/or gas-enhanced reflectors. Directly below pockmarks are “windows” through the acoustic wipeout revealing the stratigraphy, indicating a depletion of gas below the pockmark. Conversely, inactive areas are devoid of large-scale wipeout and host only occasional gas-enhanced reflectors. Pockmarks in these areas do not appear “crisp” on sidescan sonar images. Several seismic lines suggest slumping on the pockmark margins and filled pockmarks. The relationships observed suggest that pockmark fields actively deplete the gas reservoir from the margins of fields. As a result, the activity of the field is concentrated on the margins in thinner sediments and typically away from definitive gas indicators.

[**Oral** presentation]

PALEOCLIMATE RECONSTRUCTION USING LAMINATED SEDIMENTS FROM A HIGH ARCTIC ISOLATION BASIN: DEPOT POINT LAKE, CORNWALLIS ISLAND, NUNAVUT, CANADA

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Annually laminated sediments from high arctic coastal lakes may provide valuable high-resolution records of Holocene paleoenvironmental change. The coastal lakes, or isolation basins, have evolved from marine inlets and fiords due to postglacial isostatic uplift and subsequent trapping of seawater in the basins. Anoxia in the bottom waters favors preservation of finely laminated sediments by precluding bottom fauna. High arctic lakes have distinctly seasonal

sediment inputs primarily from snow and glacier-melt runoff in the summer melt season.

In this study (in progress), two vibrocores up to 4.96 m in length from Depot Point Lake are investigated. The lake is located on southeastern Cornwallis Island (75º45'N, 93º39'W) and is presently at 12m ASL; it is a freshwater lake or isolation basin. The sediment cores contain up to 2.83m of finely laminated sediments overlying massive marine mud. AMS 14C ages on mollusk valves in the marine mud range from ca. 5760±40 B.P. near the top of the massive mud to 9120±40 B.P. near the base of the cores. Variations in lamination structure and thickness, organic matter content (%LOI) and sediment particle size are proxies examined in this study to determine past environmental changes that may be controlled by changes in temperature and precipitation through the Holocene.

[**Oral** presentation]

MAGMA CHAMBER DYNAMICS IN THE DEER ISLE GRANITE, COASTAL MAINE.

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The Deer Isle granite shows evidence for an interaction with a more mafic, less evolved magma. This interaction is preserved in the forms of hybrid magma enclaves, schlieren layers, mineral textures, dikes, and chemical mixing trends. The granite is markedly texturally heterogeneous, ranging from a feldspar-framework cumulate (Oak Point facies) to a seriate to porphyritic granite (Crotch Island facies). A transition facies (Stonington) shows a mixture of these two rock textures. Enclaves found in the granite generally show intermediate chemistries and show textural evidence for being the product of magma mixing. They are most abundant as large (meter scale), elongate inclusion in the Oak Point facies. Stonington contains more evolved, fist-sized, rounded enclaves and Crotch Island is mostly enclave free. Enclaves are formed by injection and mixing of a new magma and are distributed by convection of the host melt. Schlieren are defined by the alignment of mafic minerals and plagioclase. These layers are found throughout the pluton, but are most common in the Stonington facies. Schlieren are thought to form by flow sorting of minerals or by crystal settling. The ladder dike and tear-drop schlieren found in the Stonington facies suggest a formation by flow sorting. This would indicate a more dynamic magma. Many minerals show chemical zonation, suggesting a change in the conditions of crystallization. Plagioclase is the most common. Some zones in the plagioclase suggest cycling between melts of different chemistries and temperatures. Numerous aplites as well as composite and quartz diorite dikes cut the granite. These dikes are late stage introductions of fractionated melts. The aplites are the restite melt from the granite while the diorites are the fractionation of the mafic end member. Simple mixing trends are shown for all major and trace elements. The trends, however, suggest that the system was more complex then simple mixing by showing a basaltic fractionation trend as well. A simple model for the evolution of the Deer Isle pluton would be A) introduction of basalt into granite prior to, during, or after emplacement, B) formation of hybrid magma and enclave followed by their distribution via convection cells as well as formation of schlieren by magma movement and shearing, C) reintroduction of fractionated basalt in the forms of quartz diorite and composite dikes, and D) filter-pressed late-stage melt collects in small aplitic dikes.

[**Oral** presentation]

ELECTRON MICROPROBE AGE DATING OF MONAZITE FROM THE BRETON WOODS GRANITE, PRESIDENTIAL RANGE, NEW HAMPSHIRE

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The aim of this thesis is to augment the tectonic models of the Presidential Range, New Hampshire, through electron microprobe age dating of the Bretton Woods Granite. Determination of an absolute age for this pluton on the northwest flank of the range contributes to an understanding of the geologic activity during the Acadian Orogeny in the region. Monazite, $(Ce, La, Nd, Th)PO_4$, proves to be a useful accessory mineral in geochronology as it contains the radioactive elements uranium, thorium, and lead, and possesses the structural integrity to preserve complex thermal histories. Monazites are found with varying degrees of chemical zonation depending upon, and representative of, the conditions of their formation. The monazites of the Bretton Woods Granite are chemically zoned and require a complex growth model.

Quantitative compositional data from monazite grains located in the Bretton Woods Granite were generated on an electron microprobe and used to obtain dates for chemical zones. These data were corrected for trace elements and Montel et al.'s (1996) age calculating equation was applied to the resulting concentrations of U, Th, and Pb. No age domains were detected within the resolution of the technique. The mean age of the Bretton Woods Granite is 368.9 +/-5.8 Ma. The presence of chemical domains and the absence of age domains is interpreted to be a function of magma systematics during the cooling and crystallization of the granite, rather than a record of multiple crystallization events.

This study finds the Bretton Woods Granite to be a post-tectonic pluton, following the peak metamorphism of the Acadian Orogeny in the Presidential Range 402-406Ma (Eusden 2000). This result is consistent with regional plutonism documented in the Presidential Range throughout the orogeny. Thus, the Bretton Woods Granite is understood to be post-Acadian and associated with thermal relaxation in the region (Eusden 2000).

[**Poster** presentation]

INTERNAL STRATIGRAPHY OF DRUMLINS IN SOUTHERN MAINE FROM RESISTIVITY (ERM) PROFILES: TWO-TILL IMPLICATIONS

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Southernmost Maine was glaciated at the last glacial maximum (LGM) 23-18 ka, and deglaciated between 15 and 13

ka. Hundreds of streamlined hills including drumlins were emplaced at that time, and pre-LGM glacial sediments were over-ridden and preserved, producing two tills. We applied the medium-depth geophysical technique of Electrical Resistivity Measurement (ERM) to drumlins and other streamlined hills along 9 km of survey lines, yielding interpreted longitudinal profiles and cross-sections to about 20 m depth. Especially significant is the ability of the ERM survey to reveal the inflection point (where the slope of the streamlined hill begins to rise from a subhorizontal plane), a feature that is routinely hidden beneath surficial sediments.

These longitudinal profiles commonly reveal masses of sorted sands at the initiation point of drumlinization. In ascending stratigraphic order, the ERM surveys show: 1) a bedrock protuberance located beneath the surface, ice-distal relative to the inflection point; 2) a body of sorted sand, ice-proximal relative to the bedrock protuberance and coincident with the inflection point, extensively deformed, draped over the bedrock, accumulated in the lee of the bedrock, and entrained thereafter for some distance; 3) a deeply-weathered lodgment (the lower) till; 4) an unweathered sandy (the upper) till; and 5) various shallow surficial sediments.

Southern Maine's coast-parallel and glacial-flow-normal bedrock ridges present an ideal geometry for pinning retreating ice on parallel ridges and accumulating proximal and distal sorted sands in the topographic lows between ridges. Remnant concentrations of sand, backed by bedrock topography, can initiate the construction of streamlined hills during subsequent glaciation. Streamlined hills are particularly well preserved in the lee of the Agamenticus uplands, with their stoss ends arrayed in ranks normal to regional ice flow and coincident with lines of minor bedrock ridges. In these rock-cored drumlins, late-glacial marine erosion (50-70 m above present sea level), as well as modern commercial excavation, commonly expose abundant sands. Our ERM surveys trace these sands beneath the surface to the point of initial drumlinization. In our interpretation, the drumlins preserve within them extensive pre-Late Wisconsinan material, either in the form of flow-perpendicular moraines arrayed in arcuate bands oriented roughly SW-NE, or, as suggested by fabric studies, in the form of a dissected lodgment till sheet from a pre-LGM ice flow arriving from the NE.

[**Oral** presentation] *** Anderson Award Winner ***

LIPID BIOMARKERS AND PALEOVEGETATION DETERMINATIONS FOR THE LAST 60,000 YEARS AT ELIKCHAN LAKE, NORTHEAST SIBERIA

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Sedimentary cores from Elikchan Lake, northeast Siberia, provide a continuous sequence of deposition for at least the last 60,000 years (Lozhkin and Anderson, 1996). Pollen analysis indicates several shifts between forest and tundra dominated vegetation between 30,000 and 60,000 years ago (Lozhkin and Anderson, 1996). Lipid biomarker concentrations of modern plants, a plankton tow, and core sediments from Elikchan Lake have been investigated to better understand organic matter sources, deposition and diagenetic effects within the catchment. A tertiary plot of unsaturated C-26, C-28, and C-30 n-fatty acids indicate that modern plant groups have distinctive n-fatty acid compositions. The concentrations of these n-fatty acids shift downcore in response to changes in source material deposition and diagenetic effects. The lipid biomarker concentration data parallel the pollen data and indicate that terrestrial vegetation has been a major source of input to the basin over the last 40,000 years. This is important in evaluating carbon cycling and improves our understanding of terrestrial responses to climate change.

[**Oral** presentation]

AN INVESTIGATION OF THE SEASONAL HYDROGEOCHEMICAL DYNAMICS OF A COMPLEX WETLAND IN CENTRAL MAINE

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Investigation of the physical and chemical processes that operate in small watersheds is one of the keys to understanding global hydrological and biogeochemical cycles. The Belgrade Lakes Watershed in Central Maine provides an ideal location for such an investigation because it is a well-defined system that is small enough to instrument and monitor at high resolution. This watershed also allows for the evaluation of seasonal changes in storage because a relatively large portion of the watershed is wetland and because there is significant snow-pack during the winter months.

Great Bog is an excellent example of a freshwater northern peatland located in the Belgrade Lakes Watershed. It is flanked by local bedrock to the east, the Horse Point esker to the west, and Great Pond to the north. Previous work has yielded a ^{14}C date of about 8500 yr BP at the base of the peat and has indicated that Great Bog was an open water embayment until about 6500 yr BP.

We are currently monitoring the southern portion of Great Bog in an attempt to quantify the seasonal dynamics of the peatland hydrogeochemistry. We have pulled 10 vibracores, correlated the stratigraphy along two transects, and determined the water content of the sediments. We have also installed a piezometer nest (with wells at ~0.76m, 1.52m, and 3.05m) at each core location and we are measuring water levels and major ion chemistry of these 30 wells on a monthly basis. We will present the results of our investigation and discuss how our data provides insight into the processes that operate in small watersheds.

[**Oral** presentation]

PALEOECOLOGY OF THE GLACIOMARINE PRESUMPSCOT FORMATION (LATEST PLEISTOCENE) OF SOUTH-CENTRAL MAINE

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The Presumpscot Formation was deposited during deglaciation of the northern Gulf of Maine between 15 and 11 ka. Exposures on land originally depressed well below sea level were raised by postglacial isostatic rebound to present elevations of as much as 140 m above present. Fossil mollusks were collected from various exposures of Presumpscot Formation in southern and central Maine, with particular

attention paid to Whitney Corners and North Waldoboro, pits near the town of Waldoboro. Both localities are on the flanks of the Waldoboro moraine, and expose tongues of glaciomarine mud that interfinger with till and subaqueous fan sand and gravel. A radiocarbon date from the mollusks in the Whitney Corner pit, at 46 m a.s.l. is 11,720 +/- 125 BP. More than 500 specimens were identified to 13 species. Taxa are composed of 12 species of mollusks, 8 bivalves and 4 gastropods. In addition, we identified one species of barnacle (*Balanus sp.*). The paleoecology of the collection indicates a muddy embayment in cold water conditions equivalent to those found off Labrador today. The lower units contain a mixed fauna of deep and shallow marine types, while the uppermost sandy units are inhabited almost exclusively by *Mytilus edulis*, the inter-to-subtidal blue mussel. This suggests an emergent succession. All specimens were examined for shell handedness (minimum number of individuals), shell size, and evidence of predation, in the form of boreholes from gastropod predators. Bivalves are the most abundant fossils seen (n = 230), with *Hiatella arctica* being the most abundant (n = 144). *Natica clausa* is the most abundant gastropod (n = 8 out of 16). Shell lengths range in size from 12.1 mm (*Natica clausa*) to 83.4 mm (*Neptunia despecta*). Symmetry of bivalves indicates only slight preference towards right-handed shells, suggesting little post-death redistribution of shells. Evidence of predation indicates that *Macoma balthica* is the preferred prey species (25%). There appears to be no preference as to prey size; many different species have radula drill holes in them.

[**Poster** presentation]

DENDROCLIMATOLOGY INTERPRETED FROM WHITE PINE (*Pinus strobus*) ON COLBY COLLEGE CAMPUS, WATERVILLE, MAINE

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During January of 2003, 21 samples were taken from specimens of white pine (*Pinus strobus*) on the Colby College campus in Waterville, Maine. Cores were taken using a 16-inch tree corer to determine if the variations in annual rainfall in the Waterville area influenced the width of the tree rings produced during the interval between 1958 and 2002. Rainfall was selected as the variable for study as it is the most readily documented stress indicator. After removal from the trees, cores were mounted on grooved boards and then sanded to allow measurement of the rings. No dye was used. Rings were measured, analyzed and then compared to annual rainfall data collected in Gray, ME from 1961 to 2001. Gray is approximately 68 miles away from Waterville.

During the 40-year collection interval, rainfall had an average of 44.81 inches per year with a maximum of 66.33 inches in 1983 and a minimum of 28.25 inches in 1965. Peak precipitation years occurred in 1969 (55.00 in.), 1977 (57.63 in.), 1979 (61.15 in.), 1983 (66.33 in.), 1991 (57.14 in.), 1996 (57.73 in.) and 1998 (57.28 in). Significantly low (below 35 inches) precipitation occurred in 1965 (28.25 in.), 1980 (33.88 in.), 1985 (34.00 in.) and 2001 (34.80 in.).

Preliminary analysis of tree ring widths from 7 trees showed a maximum width of 11.5 mm and a minimum of 0.2 mm. The average ring width was 3.87 mm with a standard deviation of 0.94 mm. Comparing data reveals a slight correlation between rainfall and tree ring width. Other factors may affect tree growth such as slope, substrate composition and permeability, average annual/seasonal temperature, date of snowmelt and amount of sunshine. In addition, ring width may be less varied due to the maintenance done on Colby's campus.

[**Poster** presentation]

DETERMINING AEGEAN REGIONAL TECTONICS USING DIGITAL MAPPING TECHNIQUES APPLIED TO SATELLITE-DERIVED AND WEB-BASED DATA RESOURCES

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The tectonic activity in and around the Aegean Sea offers a unique vantage point for understanding crustal dynamics of the Anatolian, Eurasian, and African plates. The position of the sialic crustal slab of the Aegean plate between these plates plays an important role in crustal motion for this part of the Mediterranean. By quantifying tectonic activity in terms of seismic activity, bathymetry, and structural elements with the help of satellite imagery and other digital data resources a more comprehensive evaluation of the regional tectonics may be ascertained.

WEB-based information on stress patterns from the World Stress Map (WSM) database and Global Positioning System (GPS) motion vectors were integrated as thematic layers into a Geographic Information System (GIS). NASA's Moderate Resolution Imaging Spectroradiometer (MODIS) satellite imagery of Greece and the Aegean Sea served as a base for considering regional geology and tectonics. In the object-oriented GIS layers additional layers included Aegean Sea bathymetry, geology, fault mapping, and seismicity data. The composite result produced a new and integrated view of the tectonic character, as well as the terrestrial and sub-sea geomorphology of Greece, the Aegean Sea and western Turkey.

GSM MEMBER PROFILES

Riverbed-Sediment Mapping in the Edwards Dam Impoundment Using Geophysical Techniques

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INTRODUCTION

The Edwards Dam, in the City of Augusta, was removed during the summer of 1999. The dam was built in 1836-37, founded on ledge, and constructed

of timber cribs filled with rock ballast. Over the next 162 years, the dam was breached five times and underwent extensive repairs and improvements during which boulders, crushed stone, and concrete were added. The impoundment had a gross storage of approximately 740 million ft^3 and extended about 15 mi to the city of Waterville, near the confluence of the Sebasticook River with the Kennebec River.

In July 1997, the Federal Energy Regulatory Commission (FERC) issued an Environmental Impact Statement recommending that the Edwards Dam be removed (Federal Energy Regulatory Commission, 1997). Because the removal of Edwards Dam would change the hydraulic characteristics of the river in the impoundment, the potential transport of erodible, fine-grained sediment currently in the impoundment was a concern. In an effort to build upon available information regarding the composition of the riverbed in the Edwards Dam impoundment, the U.S. Geological Survey (USGS), in cooperation with the Maine State Planning Office, and Maine Geological Survey (MGS), classified riverbed sediment types and mapped their areal extent in the lower (southern) half of the impoundment.

GEOPHYSICAL SURVEY METHODS

The USGS survey of the riverbed sediment was conducted from June 25 to July 23, 1998, and covered 8 river-miles of the impoundment from the boat launch in the town of Sidney to the Edwards Dam site. In this area, the Kennebec River has no extensive flood plains and is bordered by high-relief eskers, which comprise much of its gravel riverbanks. Side-scan sonar (SSS) was used to identify surficial sediment types and their areal extent in the river channel and ground-penetrating radar (GPR) was used to determine the thickness of mud and mud-containing sediment types. A hand-held Global Positioning System (GPS) unit was used to record all locations of geophysical data collection and sediment sampling.

Sediment-thickness data were collected with Geophysical Survey Systems, Inc. (GSSI) SIR-10 ground-penetrating radar. The GPR data-collection system includes a pair of modified 100-MHz antennas, which were floated on the water surface beside a fiberglass-hulled boat. GPR is capable of penetrating water and earth materials and has been proven to be a capable tool for the study of sediment layers (Izbicki and Parker, 1991; Haeni and others, 1992; Placzek and Haeni, 1995; Breault and others, 1998). GPR data were collected along 18.4 mi of zig-zagging transects from Seven-Mile Island to Edwards Dam during July 8-10 and from Seven-Mile Island to the Sidney boat launch on July 15, 1998.

SSS data were used as the primary record for classifying the riverbed sediment types. The riverbed was imaged with an EG&G model 260, slant-range corrected SSS device with a 272T towfish, which had a nominal frequency of 105 KHz. The SSS technology is useful for imaging underwater environments and has been used extensively by the University of Maine and the Department of Conservation, MGS, to produce accurate surficial geologic maps of the Gulf of Maine (Barnhardt and others, 1998; Fish and Carr, 1990). The SSS imaging, analogous to aerial photography of the land surface, creates a gray-scale image of a 490-ft-wide swath of the river bottom in real time. A single SSS image of the riverbed was generated by pulling the towfish along the center of the river channel on July 21, 1998, from the Sidney boat launch to within 400 ft of the Edwards Dam. A 14.6-acre area behind the dam was not imaged because of navigation hazards close to the dam. GPR transect data coincided with SSS imagery in about 79 percent of the surveyed area.

Sediment was sampled, cored, and probed on July 14 and 23, 1998, to aid interpretation of the geophysical record. Muddy sediments on the riverbanks were probed with a steel rod to measure sediment thickness.

In all, 580 acres of the river channel upstream of the dam site were mapped. The sediment-type classification scheme used in this study was the same used for sediment mapping in the Gulf of Maine by Barnhardt and others (1998). The classification scheme defines 16 sediment types based on four basic units — rock (R), gravel (G), sand (S), and mud (M) — and 12 composite map units. The twelve composite map units represent combinations of the four basic units in which the dominant surficial texture comprises greater than 50 percent of the area of the map unit.

Mud thickness was estimated from interpreted GPR records. All mud or mud-containing sediment mapped in the study area was layered over sand and gravel or rock. The lower bounds of mud deposits were determined by identifying the location of sand, gravel, and rock beneath them. The distance from the first return signal of mud to the first return signal representing these other sediment types represented the two-way travel time of the radar signal through the mud. These time estimates, in nanoseconds, were converted to thicknesses by use of radar wave velocities reported by Markt (1988).

SEDIMENT DISTRIBUTION, VOLUME, AND LOAD

Coarse sands, gravel, and mixtures of gravel with cobbles of various sizes were the most common sediment types found comprising the riverbed. The remaining area consisted of mud or mud-containing sediment types in which mud is mixed with other sediment units. Overall, the observed sediment types form long, thin units oriented longitudinally with the

river channel. Mud was found at the mouths of tributaries and along the riverbanks where flow velocities are low and overland runoff enters the river. Mud rarely extended more than 100 ft from the riverbanks and was never seen along the centerline of the river channel. Computations of the volume of mud and mud-containing sediment yield estimates ranging from 1.5 to 3.7 million ft^3. The mud sediment types were distributed along the riverbanks in scattered, discontinuous deposits of highly variable extent and thickness. This estimated volume of mud and mud-containing sediment represents approximately 40,000 to 100,000 tons of material.

Suspended-sediment and streamflow data collected at the USGS gaging station in North Sidney from 1978 to 1993 were used to estimate an average annual suspended-sediment load of about 152,000 tons (or about 28 tons/mi^2 of drainage area) at the North Sidney station. Most of the suspended sediment is transported in the river during high flows, which typically occur in the spring. For example, on the basis of the above technique, the mean monthly flow in April of 22,320 ft^3/s transports about 1,300 ton/day of suspended sediment.

Results of this investigation indicated that the surveyed area of the Edwards Dam impoundment was a relatively high-energy river environment where accumulation of fine-grained riverine sediment was minimal. The river has low channel sinuosity, steep valley side-slopes – particularly on the west bank where it is bound by a large esker, and limited development of floodplains. It is probable that the narrow, confined nature of the river in the study area and the relatively small hydraulic impact of the dam during high flows precluded significant fine-sediment accumulation in the impoundment.

The report and map documenting the methods and results of this investigation (Dudley, 1999) can be found on the Internet at the following address: http://me.water.usgs.gov/newreports.html.

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