The Maine Geologist

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Newsletter of the Geological Society of Maine

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PRESIDENTS MESSAGE

by Fred Beck

This message will be short since the description further in the newsletter of the upcoming summer field trip to Aroostook County is fairly lengthy. Suffice to say that it should be a good trip with a variety of geologic features which you won't see in southern Maine. Beautiful Aroostook State Park will be our headquarters / camping site and Bob Johnston has arranged that our group will not have to pay for camping space. GSM will provide the Saturday evening feed. How can you not come?

The Fall meeting will be in early or mid-November at the University of Maine in Orono. The next Spring meeting with student presentations will be hosted by the University of Maine at Farmington on April 4, 1997.

1996 SUMMER FIELD TRIP JULY 27 AND 28

This year's field trip will be to "The County" to look at two potentially economic mineral deposits, some surficial features and to hear a short description of some lake bottom coring. In addition we'll get a guided tour of the new science museum at the University of Maine at Presque Isle. There should be something for everyone! Our headquarters for the trip will be at beautiful Aroostook State Park a few miles south of Presque Isle off Route 1. This park boasts a small lake (Echo Lake) for swimming or fishing, miles of scenic trails on the mountain behind the park (Quaggy Jo Mountain) and well kept and uncrowded camp sites. A brief summary of the trip follows.

Friday, July 26 - Those planning to camp might want to arrive on this day to get tents set up and relax, swim, visit, canoe with the kids or whatever.

<u>Directions to Aroostook State Park:</u> from I-95 Exit 62 Houlton (last in Maine before Canada), take Route 1 north through Mars Hill to Presque Isle; park entrance is off Spragueville Road; watch for signs to park and for Trans-Atlantic Balloon Launch Site (left turn off Route 1 about 3 miles north of Presque Isle and Westfield town line; check Delorme's atlas Map 65 for location).

Saturday, July 27 - We'll meet Tom Weddle at the large DOT rest stop just north of the intersection of I-95 and Route 1 (Exit 62) in Houlton and leave from there at 9:00 A.M. Tom will show us an exposure in the Houlton esker. We will then proceed to Bridgewater and reassemble at 10:30 A.M. at the Town Park on Route 1 next to the grammar school (corner of West Road and Route 1, about 20 miles north of Houlton Exit 62). We'll have a little review there of local bedrock geology and iron formations by Fred Beck and then proceed east about 12 miles or so to Maple Mountain where we will see excellent exposures of the largest known iron-manganese deposit in Maine. This "iron formation" exhibits both oxide and carbonate facies and was extensively drilled and studied during the 1940's. Depending on road conditions at the time, there could be some walking involved - perhaps up to a mile or so. Depending on time we may also walk to outcrops on nearby Hovey Mountain. We'll then drive to the top of #9 Mountain for a scenic view of the entire area as well as a look at the basalts and volcanic fragmentals on that mountain. From there we'll return to Bridgewater and then on to Presque Isle to get a guided tour of the new science museum at UMPI. That tour will be led by Kevin McCartney. We'll aim to be back to Aroostook State Park by 5:00 P.M. for relaxing, swimming, grog or whatever. At 6:00 P.M. Chris Dorion will describe the coring program of lake bottoms he has been involved with, with emphasis on the core from Echo Lake at the Park. This will be followed by a cookout, with food and soft drinks supplied by GSM (harder stuff BYOB!)

Sunday July 28 - After breaking camp, we'll plan to assemble at Aroostook State Park parking lot at 8:30 A.M. and leave from there to look at an exposure in the Mars Hill moraine complex (people staying elsewhere can join up along the way at the Mars Hill municipal offices if necessary). From there we will continue on to Patten where we will reassemble at the Logging Museum at 11:00 A.M. Mike Scully will lead the group to the Mount Chase volcanogenic massive sulfide base metal (Zn, Pb, Cu, Ag) deposit. He will have some core which shows lithology and sulfides; we should also be able to find some gossan in some of the trenches. There are numerous outcrops of hanging and footwall rocks but no actual outcrops of the deposit (other than the aforementioned gossan). For those interested in geophysics, the deposit has a very strong VLF-EM signature and we will have two EM-16's along for those who want to rediscover the deposit. If you are interested in geochemistry, this deposit was discovered with the use of geochemistry and the soils are highly anomalous in all the base metals. Collect all you want.

We will need to know the number of people to expect for the cookout on Saturday night, so please contact Bob Johnston at 287-2801 to let him know if you plan to come. As always, kids and spouse/friends are welcome. Bring your own lunches. If you don't want to camp out, there are motels and a hotel in Presque Isle as well as a very hospitable geologist-owned Bed and Breakfast in Caribou, the Old Iron Inn (492-4766). For more information, call Bob or Tom at 287-2801, or me at 846-9065.

REPORT FROM THE CERTIFICATION BOARD

by Andy Tolman

The Maine Geologists and Soil Scientists Board sent out a newsletter to certificate holders this past winter. The newsletter included a questionnaire that was returned by more than 100 registrants. Given our pool of about 330 total, this is an excellent return. We appreciate the feedback from registrants, particularly those who took the time to provide written comments. We asked for guidance concerning the adoption of a national examination, among other items. While most respondents (82) believe that we should continue to test local knowledge, a majority (67) agree that Maine should affiliate with ASBOG (National Association of State Boards of Geology), and only three were opposed to affiliation, the remainder being uncertain. Fifty five respondents favored a national exam; 10 were opposed. Based on this feedback, the board has been working on obtaining access to the national geologists exam.

The board has sent a representative to several meetings of ASBOG. This group was started in the late '80s by a group in the south to coordinate their laws and examinations. It has grown slowly and has worked hard to develop a national examination and common laws and regulations. There are now fourteen member boards, and six states with registration that are not members. Recent additions include Pennsylvania, Wisconsin, and California.

I was both impressed by the care and work they have given to developing a professional credentialling examination, and somewhat depressed by the comparison with our Maine exam. Although we have worked hard to develop and maintain our local exam, it does not measure up to the standards of a national test. Current practice for professional examination writing includes conducting a statistical survey of the areas of practice and using that to select and weight questions on the exam. The national exam is divided into two parts: a fundamentals section and a professional section, each four hours. Most states have gone to the Engineers model, where they give the fundamentals section after graduation, and then the professional section when the individual has the required experience. The exam is all multiple choice, and is given twice a year. Each exam is also taken by a group of board members at an examination workshop, and their response to the questions is used by the correcting psychometrician to fine-tune question weighting. This provides on-going verification of validity of the exam. With more people challenging anything that holds still, this offers some comfort.

The group recognizes that all states will not be entirely uniform; there are local variations and needs. However, it does work to build consensus on issues and to provide as much transferability of both information and registrants as is feasible. ASBOG spends a lot of time discussing procedures for checking credentials, setting up boundaries for mutual recognition of registrants, and issues relating to other professions. Twelve states are now using the national exam; two more are negotiating a contract to use it.

The national exam has traditionally had an access fee which pays for the work that other boards have put into the development of the exam to date: it has been running $18,000 per state. Pennsylvania is discussing an agreement where, rather than front-ending the access fee, they will be charging applicants an extra amount to be credited towards the fee. The exam costs $150 per part plus any local fee and access fee payback. California, which is still (now) doing its own exam, is also $200 per part. The advantage to using a national exam is that it helps registrants keep mobile, and also provides us with a higher degree of surety that we're testing what people need to know. The obvious downside is the cost. We also need to consider how we can test local knowledge.

In May, I attended an examination workshop and Executive Committee meeting with ASBOG. The Executive Committee made an offer for exam access for Maine. We could pay $3,000 up front, with an exam surcharge of $35 per part until the remainder of the $18,000 access fee is recovered. The alternate would be to pay $5,000 up front, with an exam surcharge of $25 per part for the remainder of the fee.

In either case, membership dues would be $10 per geologist registrant/year up to a maximum of $3,000. As more states join, these fees are likely to be reduced. Additional costs include the expense of Board participation in national exam workshops. The total cost to the Board would be an additional $3,500-$5,000 per year for membership and participation, plus loss of exam fee revenue to the Board. The current Board Revenue situation: income is approximately $20-25,000 per year. Bureau administrative charges and expenses are approximately $17-20,000 per year. In a good year we would have adequate funds. In a slow year, things would be tight. The administration has been working to reduce the overhead associated with board operation.

On June 5, 1996, the Maine Board met and discussed ASBOG's offer to allow Maine access to the National examination under one of two "time payment" plans. The Board discussed the offer at length and had some concern about the up-front payment, and a larger concern about the long-term costs of full ASBOG membership. Their concern arises from several bases:

1. In the early 1980's the Board came close to insolvency. We reached the point where we sold frameable certificates to raise the funds so that we could post rules raising our fees. As a result of that experience, we tend to be fiscally cautious.

2. The Board represents both Geologists and Soil Scientists, with about 25% being Soil Scientists. We need to have an agreement that does not result in Soil Scientists subsidizing an organization that benefits primarily the Geologist registrants.

3. Our current fiscal situation is roughly in balance. While we do have some funds in our balance that could be used to pay an access fee, the ongoing costs of membership and participation could require raising fees to registrants. Our renewal fees are legislatively capped, and it will not be easy to increase them.

4. The Board is uncertain whether the attractiveness of a strong National exam will outweigh the increase in cost in regard to our attracting new applicants. We believe that the economy and the demand for geologists will drive our applicant pool up or down. Like ASBOG, we have significant fixed costs, and the number of our applicants and registrants is critical in our continued fiscal viability.

With these concerns, the Board voted to continue discussions with ASBOG to clarify whether there is any possibility of reducing the continuing cost of membership for a state like Maine, and also whether ASBOG would consider other options for recovering sunk examination costs. One option that the Board would be likely to accept would be to allow Maine to continue in Associate status until we actually reach 300 geologist registrants, when we would automatically be considered a full member under ASBOG's charter. That would allow us time to see the effects of the National Exam on our applicant pool, and re-structure our fees, if needed.

The Board also voted to send a representative to the October meeting in Lexington, assuming that there would be something to discuss at that meeting. We will be meeting again in September to make another decision about continuing the process. We are also discussing whether to submit legislation that would allow us to charge geologists differently from soil scientists.

The Board would like continued feedback from Geologists. Please call (865-6138), write (Gerber-Jacques Whitford, 174 South Freeport Rd., Freeport 04032), or E-mail (ATolman@jacqueswhitford.com) me your thoughts.

WHAT IS THE NATURAL RESOURCES INFORMATION AND MAPPING CENTER?

by Robert G. Marvinney, Maine State Geologist

During the legislative session which ended in June of 1995, the Legislature and the Governor enacted a biennial budget which was $45 million in the red. As part of the legislation which allowed this unprecedented passage of an unbalanced budget, the Governor appointed a Productivity Realization Task Force to identify areas in State Government where efficiencies could be found without compromising services. Managers in the Department of Conservation were given a very short time frame in which to develop a plan that reduced the Department's overall budget but maintained services. Through this very painful process the Natural Resources Information and Mapping Center (NRIMC) evolved.

The NRIMC, our new official name, is the harmonious melding of the Maine Geological Survey, the Maine Natural Areas Program, and several parts of the Department's geographic information system functions under one administartive unit. The director of this agency is the State Geologist, by statute. Three formal divisions make up the agency: Applied Geology, which includes all our geologists (we managed to hang onto all of them), the Natural Areas Program, a group of botanists and ecologists who map and analyze the rare and endangered plant species in the State, and the Resource Data Services division which comprises our GIS and cartographic expertise. I might note that this organizational structure is not something simply pulled from thin air but is exactly the form of the very successful Natural Resources Center in Connecticut, headed by their State Geologist, and very similar to the Wisconsin Geological and Natural History Survey. While it will not be a simple task to get this organization functioning smoothly, I believe that our dedicated scientists, administrators, and staff will make it work and further that it will open up new opportunities for serving the people of our State. We will continue to use the name Maine Geological Survey on all the geological publications and communications because it is a respected and recognized name.

In closing, I note that the U.S. Geological Survey is taking on similar responsibilities with the absorption of the National Biological Service. Dirigo.

NORTHERN MAINE MUSEUM OF SCIENCE

by Kevin McCartney

The Northern Maine Museum of Science will have its formal opening on October 5, 1996. The museum uses hallway and stairwell space in Folsom Hall, on the University of Maine at Presque Isle campus. October 5th will be "Science Day" at the university, with science demonstrations and activities throughout the day. The special guest and speaker will be Dr. John "Jack" Horner, famed dinosaur hunter and best-selling author.

The museum is seeking the donation of Maine mineral specimens for display. All specimen donors will be acknowledged in the display. The museum also does not have a tourmaline specimen and is seeking one for a display on the Maine State Mineral. If you have donations, please send them to Kevin McCartney (Director), Northern Maine Museum of Science, University of Maine at Presque Isle, Presque Isle, ME 04769.

DEP TASK FORCE UPDATE

by Carolyn Lepage

In April, Allan Ball, Director of the Bureau of Remediation and Waste Management, approached the Task Force for assistance in improving the Bureau's contracting procedures. After a presentation by Ted Wolfe and Tom Benn on the development and use of pre-qualified consultants lists at our May meeting, Task Force members decided a working group consisting of 3 representatives from DEP, 3 from consulting firms, and a facilitator should be assembled to address the issue. The working group would keep the Task Force informed of their progress.

The list of technical guidelines *(Written Guidance Used by the Maine Department of Environmental Protection in the Review of Applications and Reports)* issued by the DEP has been deemed complete and up-to-date. The list has been placed on the Internet under the DEP Home Page - Regulatory Information: Guidance Documents, and will be re-evaluated on a yearly basis. The Task Force will continue to focus on the development and implementation of technical guidelines in the future, although the group may act as a conduit for information regarding procedural or administrative guidelines. An example of the latter is the *LUST Site Investigation and Remediation Guidelines for Determination of When to Contract or When to do the Work In-house* that were sent to a number of environmental consultants and other interested parties in April 1996.

The low-flow ground water sampling workshop held in Portland on May 29th was a resounding success with almost 200 people attending. Field demonstrations are scheduled for June at several locations, including the Winthrop landfill and Brunswick Naval Air Station. Suggestions for future training are always welcome - please call me at 777-1049.

If there is enough interest, a fifth session of the *Ethics and Professional Practice* course will be held in the fall of 1996. Please contact Jim Hamilton at 772-5177 if you want to attend.

GSM TREASURER'S REPORT

Balance on Hand 2/26/96
$8,732.24

Receipts Subtotal	**$765.43**
Dues	$604.00
Anderson Fund	$141.43
Education Fund	$ 20.00

Expenses Subtotal	**$288.13**
Bank Charge	$ 1.88
Printing	$194.00
Postage	$ 67.86
Miscellaneous	$ 24.39

Balance on Hand 6/20/96
$9,209.54

Balance Summary	**6/20/96**
General Fund	$4247.41
Education Fund	$ 630.70
Anderson Fund	$4331.43
Total	$9209.54

Membership Summary	
Regular	264
Associate	26
Student	24
Institutions	14
Total	328

Members paid through 1996:	136
Members paid through 1995:	74
Members paid through 1994:	66
Members paid through 1993:	52

Submitted by Martin Yates, Treasurer

GSM SPRING MEETING MINUTES
COLBY COLLEGE
APRIL 5, 1996

by Rebecca Hewett, Secretary

The spring meeting began after completion of the student oral and poster presentations. Fred Beck, President, conducted the meeting. The items listed below were discussed at the meeting.

1. Fred Beck thanked Bob Nelson and Colby College for hosting the Spring 1996 GSM Meeting.

2. Treasurer's Report by Marty Yates: $5,163.00 in the bank and we added 2 new members. Walter Anderson Fund CD at 4.5% matures on May 17, 1996 and will be reinvested for another year. Also, a reminder for members to send past and current dues to Marty.

3. Fall 1995 Meeting Minutes were accepted as is.

4. Future GSM Meetings: Summer 1996 Field Trip is July 27-28 - Mineral types in Aroostook County. Saturday (7/27) is the Maple-Hovey Iron-Manganese Deposit near Houlton led by Fred Beck. Sunday (7/28) is the geology of the Mount Chase Copper-Lead-Zinc-Silver Deposit near Patten led by Mike Scully. Fred is looking for a camp site. The plan is to finish the field trip in the early afternoon on Sunday. Also, Fred is trying to tie in some surficial stops.

Fall 1996 meeting will be held at the University of Maine in Orono in early/mid November. The exact meeting date will be set in the near future. The plan is to hold a meeting in Orono after the new geology building is completed.

Spring 1997 meeting: Bob Nelson offered Colby College as the location if others are not interested. No one else spoke up.

5. Walter Anderson Fund: Next year the Fund will be used for undergraduate oral presentation and poster presentation cash prizes. Ideas to raise money for the Walter Anderson Fund - sell or raffle off minerals donated by GSM members at meetings. Also, the Spring Mineral Symposium is on May 3-4, 1996 in Augusta. Woody Thompson will check out if we can sell/auction minerals at a table.

6. Friends of the Pleistocene Meeting is May 31-June 2, 1996 in Machias. Hal Borns is the contact for more information.

7. AIH Meeting is April 21-24, 1996. The GSM is helping to sponsor it. For more information see Fred Beck. Also, Tom Weddle indicated that information is available at the Survey.

8. NEIGC Meeting is September 27-29, 1996 in the White Mountains of Northern New Hampshire. Headquarters will be in the Pinkham Notch area. Make arrangements early as the meeting coincides with fall foliage. Woody Thompson indicated that more information is available on a web site.

9. At the Northeast GSA, Tom Eastler listened to a talk by John Armentrout, from the oil pack. Tom proposed that we invite him to Maine to give his talk at one of our meetings. John Armentrout is a busy man and therefore, it was suggested that the location for the meeting be near an airport, say at Orono, to save travel time. Tom Eastler will write to him, after he gets the Fall 1996 meeting date, and invite him to give his talk to us. Tom will coordinate with Dan Belknap. Representatives from both Orono and Colby support having John Armentrout come and give his talk.

10. Short Course: Back to Basics - Geology of Maine (Bedrock and Surficial). Looking into getting continuing education credits. See Fred Beck or Joe Kelley to flush it out.

11. Bulletin 4: It is almost finished! Tom Weddle has a copy, minus the introduction. Expect Bulletin 4 to be ready for printing in about one month and ready for sale within two months. The cost has not

been decided yet, but the cost is expected to be in the $10 range.

12. Bulletin 5: Compendium of past GSM field trips. Carolyn Lepage and Bob Johnston will work on it. They want to see a hard copy of Bulletin 4 first, before they do Bulletin 5.

13. Deadline for the next newsletter is June 1. Therefore get newsletter information to Susan Weddle before then. Information can also be E-mailed to Tom Weddle.

14. DEP Task Force Update: A Low Flow Sampling Techniques Workshop will be held on May 29, 1996 in Portland. See Carolyn Lepage if you want to be on the mailing list.

15. Dan Belknap commented on the positive, upward trend seen at GSA. Dan thinks that the GSM organization has played a large part by encouraging students to give talks and gain experience.

Following the social hour and dinner, **Dr. Paul Mayewski**, Director of the Glacier Research Group, Institute for the Study of Earth, Oceans and Space, University of New Hampshire, gave a talk titled ***"The Ice Chronicles: Natural and Human Influences on Climate Revealed Through Ice Cores"***. Ice cores are collected from all over the world and studied. The long term goal over the next twenty years, is to connect information found in the Arctic, indicative of the North Atlantic circulation system, with the circulation system of the Pacific that can be monitored from the Antarctic. The hope is to put the entire global picture together.

Dr. Mayewski showed slides of ice cores collected from Central Greenland, Asia, and the Antarctic. The slides, and also overheads, illustrated for the audience 1) the living conditions involved in collecting ice cores, 2) how ice cores are collected, 3) how samples of the ice cores for testing are collected from ice cores, and 4) the type of tests conducted on the ice cores.

The field staff usually live in tent camps, travel is mainly via snowmobiles, temperature is around -25 to -30 degrees and UV radiation bleaches tents, clothing, etc. Ice samples are collected from snow pits (generally dug 2-6 meters in depth and take about 4 days to dig) or from depth via ice cores (requiring drilling equipment). Precautions, such as gloves and masks, must be taken to avoid contaminating ice samples during collection. The ice samples are analyzed to measure 8 or 9 different soluable species that represent approximately 95% of the chemical components in the atmosphere.

Over time, atmospheric conditions are recorded in the ice of glaciers throughout the world. The information contained in the ice record is made available to us by analyzing ice samples collected from the snow pits and ice cores. From the ice record, we see evidence of Chernobyl, gain an understanding of the ozone layer, trace a record of volcanic activities, measure pollution, etc.

Three areas (Antarctic, Asia and the Arctic) of the globe were discussed by Dr. Mayewski. In Antarctica, work is generally in inland areas. As you go inland, the ice elevation increases, eventually to as much as 4.5 kilometers. In the future, the hope is to core through the 4.5 kilometers of ice and recover a record of approximately one million years.

In Asia, the study is of a circulation phenomenon called the Indian Monsoon. Summer moisture from southern regions (Indian Ocean) is transported up into the Himalayas and deposited in the form of rain. During the winter, dry cold air masses from the north cover the area. The circulation pattern is recorded in the ice record, generally in elevations in excess of 18,000 feet, where the ice record is well preserved (low temperatures and no ice melt).

Studies began in Greenland in the 1980's. The U.S. Environmental Protection Agency was looking to determine if pollution from the industrial activities in North America and Europe had reached remote areas. Two ice cores were collected (one each from southern and central Greenland). By having two ice cores 30 kilometers apart that go down to the base of the ice sheet, the record is a true environmental record. The record goes back well over 110,000 years.

The 110,000 year record from Greenland shows a series of rapid changes in climate, some as much as the difference between ultimate warmth and ultimate cooling. They no longer see slow coolings. The record indicates that climate changes occur and go away within about two years and they are in motion for a few 100 years. Also, the record indicates that the Holocene (modern climate) has a lot more signal in it than originally thought.

The size of the Greenland ice core is 5.2 inches in diameter, with 3,043.54 meters of ice and 1.5 meters of bedrock. Twenty-five universities worked together to gather 75% of the desired samples that were collected in the field through a series of connected stations. For example, one station looked at layering of the ice (tree ring type layering). Using layers, they counted back 110,000 years and calibrated with other methods. As many as 50 other measurements were collected which include greenhouse gases, all soluable components of the atmosphere, particles, molecular properties, etc. The data set consists of 160,000 measurements on the chemistry and required 20,000 hours to collect.

Changes in the atmosphere that make their way to Greenland are recorded in the ice record. Examples of what can be seen from the ice record are: 1904-1906 sulfuric and nitric acid levels increased, which correlates with industrialization. In recent years, they see a lowering in sulfuric acid levels in relation to nitric acid, which correlates to the effects from the Clean Air Act. Volcanic events correlate into an increase in sulfuric acid. Late 1800's increase in carbon dioxide may be due to the deforestation of the North American West. High calcium levels indicate cold dust climate conditions. Younger Dryas, Little Ice Age, event ended about 11,600 years ago and lasted 1,300 years.

The Younger Dryas is the most recent of the big, rapid climate change events that we see in the ice record. The marine record that records the Younger Dryas mirrors what we see in the atmospheric changes. The atmosphere and oceans are closely tied during these climate events.

The data obtained from the ice record can be used for environmental reconstruction of the past. Also, from the ice record, we can characterize air masses by their chemical signatures and thus can reconstruct the atmospheric circulation. Additionally, we can identify each orbital component and their influence (growth and decay of ice sheets) on the ice record. The orbital component is confirmed in the marine record.

What events cause rapid climate change? By comparing changes in the atmospheric oscillation of ice records from different parts of the world (Arctic and Antarctic), we can see if rapid climate changes are seen in both hemispheres. If rapid climate change is seen in both hemispheres, then this means global changes are occurring and we can determine what controls the changes. If the events match perfectly, then we can conclude that the change is caused by influences external to the earth. Unfortunately, at present, the Antarctic record is not as detailed as the Arctic record. The plan is to collect an ice core from the Antarctic and produce a record as detailed as the Arctic record we have from the Greenland ice core.

Changes in the atmospheric circulation record correlate to changes in civilization (i.e., fall of Mesopotamia, height of the Mayan empire in Mexico, transition into the Little Ice Age ended the Viking migration into Greenland, etc.). As for predicting future events, we'll say that the polar circulation may be coming out of the Little Ice Age. Is this due to man's influences or fluctuation of the Little Ice Age?

Dr. Mayewski predicts that the Holocene is described by a series of periodicities. Assuming that we are at a certain point in the periodicities, we can predict that the circulation system should last another 500 years. Therefore, the Little Ice Age should last another 500 years and we should expect little ups and downs. In fact, the last 100 years in the North Atlantic have been stormy. Human activities (pollution, depletion of natural resources, etc.) may also have an effect on the future climate.

GSM STUDENT ABSTRACTS SPRING MEETING, COLBY COLLEGE APRIL 5, 1996

COMPARISON OF HOLOCENE TSUNAMI AND MODERN STORM-OVERWASH DEPOSITS, NORTHERN BRISTOL BAY, SW ALASKA

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Coastal bluffs around the northern shore of Bristol Bay expose a pumiceous sand layer attributed to a volcanogenic tsunami associated with the caldera-forming eruptions of Aniakchak Crater ca. 3430 yr BP, as well as gravelly deposits related to recent storm overwash. The distribution, grain size, and nature of contacts of these deposits provide insight into erosional and depositional processes during these two types of large-magnitude run-up events on a low-relief erosional coast.

The 1- to 70-cm-thick tsunami deposit extends discontinuously along at least 100 km of this coast, in areas both exposed to and sheltered from dominant wind-generated waves. Height varies with pre-existing topography, locally ranging to 20 m above mean high tide. The tsunami incorporated sand and water-rafted pumice from adjacent beaches and at least locally eroded blocks and organic detritus from the peat surface. In many exposures, however, the tsunami deposit appears conformable atop *in situ* peat, and fine airfall ash is locally preserved directly beneath pumiceous sand. The maximum size of lithic particles in the deposit rarely exceeds coarse sand, despite the availability of gravel on beaches.

During a recent storm surge on the fetch-exposed side of Nushagak Peninsula, storm waves eroded large blocks of peat from the upper layers of 3- to 7-m-high bluffs that back a sand-and-gravel beach. Waves transported these blocks, granules and pebbles from the beach to the bluff top, creating a 10- to 30-cm-thick,gravel sheet that conformably overlies the former tundra surface and extends up to 45 m inland from the bluff edge.

The data from storm-surge and tsunami deposits suggest that both types of events are non-erosive over much of the run-up area beyond mean high tide. Significant erosion is localized in areas of breaking waves (e.g., bluff margins) or where the shear stress beneath zones of deep run-up exceeded the strength of underlying peat. Coarser grain-size of the storm-surge deposit relative to the tsunami deposit may reflect either (1) hydrodynamic differences between higher-frequency, steeper storm waves and essentially unidirectional surges characteristic of tsunamis, (2) a difference in bed load source, or (3) coastal retreat, which may have removed the coarse, seaward margin of the tsunami deposit.

SCANNING ELECTRON MICROSCOPY AND ENERGY DISPERSIVE SPECTROSCOPY ANALYSIS OF ROCK-LICHEN INTERACTIONS IN THE SILURIAN / DEVONIAN ROCKS OF THE MT. WASHINGTON AREA, NH

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Lichens may colonize a substratum by physical or chemical processes. Chelating of the substratum by oxalic acid excreted from lichen hyphae releases elements which may then be bound by cations to cell walls in the mycobiont and photobiont members of the lichen. For this reason a substratum may be predominantly selected by lichens on the basis of chemical composition.

The bedrock of the Camel Patch, Mt. Washington, NH consists of Silurian and Devonian metasedimentary rocks and a Devonian igneous body. The Silurian Madrid Formation consists of alternating calc-silicate rich and biotite-rich layers, the Devonian Littleton schist, and Devonian two-mica granite with medium- to coarse-grain size were sampled and analyzed using Scanning Electron Microscopy and Energy Dispersive Spectroscopy.

SEM was used to locate grains which had been effected by lichen hyphae, indicated by bore holes approximately 2-3 microns in diameter. Holes could be found in all three samples, including some with hyphae structures protruding from the grains. EDS was used to identify the grains which had been effected. Spectra were collected from samples and a qualitative chemical analysis performed for identification purposes. The known mineralogy of the rock formations was used to identify the effected minerals .

SEM/EDS analysis of the rock samples found the effected minerals to be biotite and actinolite in the granofels, and biotite and calcium plagioclase for the schist and granite formations. This study determines that the lichen species Lecanora subfusca shows definite preference for minerals containing elements such as Ca, Fe, and Mg.

A PETROLOGIC STUDY OF THE SEBAGO PLUTON, MAINE

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The Sebago pluton is a two-mica granite that intruded the Kearsage-Central Maine metamorphics during the Early Permian (Tomascak et al., 1995). The basic mineralogy of the granite consists of quartz, feldspar, muscovite, and biotite. Wise (1995) further describes the pluton as a peraluminous fertile granite enriched in rare alkalis. Al_2O_3, SiO_2, Ga, Sn, B, F, and P. Moreover, the Sebago pluton has been mapped into two spatially distinct phases by Creasy (1979) and Wise (1995). The granite found in the central portions of the pluton is a fine- to medium-grained biotite granite, while the granite in the northern and easter margins of the pluton has a coarse-grained, pegmatitic texture and consists of both muscovite-biotite and muscovite granite. Moreover a recent study by Behn (1996) found these spatial phases to be related to the thickness of the pluton, with the central regions being substantially thicker than the margins of the pluton.

In order to examine these spatial distributions of the Sebago pluton 5 samples of the granite were taken from the central and outer regions of the pluton and examined using a JEOL JSM 6100 scanning electron microscope and a Kevex EDS detector. X-ray maps were created for each of the 5 samples to qualitatively examine the elements present and further quantitative analyses of the feldspars and micas were conducted. Based on the relative compositions of the feldspars and micas, information was gained on the temperature and water pressure present during the emplacement of the pluton.

Based on preliminary data this study appears to support the spatially distinct phases mapped by Creasy (1979) and Wise (1995). Moreover, composition of the feldspar and mica crystals seems to show higher temperatures and lower water pressures present in the central, thicker portions of the pluton. Final results will be presented at the conference.

AN INVESTIGATION OF THE OCCURRENCE OF STEEP SLOPES AND GEOLOGIC HAZARDS IN WATERVILLE, ME

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A study in progress examines the occurrence of slopes greater than 20% and their relationship to Presumpscot Marine deposits in Waterville, Maine. Slopes of 20 percent or greater are susceptible to erosion and mass movement and fall under restrictive zoning in certain cases. The Presumpscot Formation was deposited during the late Wisconsinan and was subsequently uplifted by isostatic rebound. Presumpscot deposits have historically been associated with mass movements, especially under conditions of high water content, loading, and erosion. Consequently, knowledge of the accurate distribution of steep slopes is essential for prospective land-use planning.

Previously unidentified steep slopes were located in possible areas of future development. Large-scale maps (1:1200) were used to delineate the areas of steep slopes; map analyses were verified in the field. Newly identified slopes are being correlated with the occurrence of Presumpscot deposits.

The results of this study will be provided to the Waterville City Planner to assist in the evolution of a comprehensive plan and to increase public awareness of local geologic hazards.

AN N MANAGEMENT PROGRAM FOR CORN: ADVANCES IN MAINE.

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Nitrate-nitrogen (N) management of corn fields in Maine is crucial to reducing groundwater contamination due to agricultural runoff. The objective of this project is to determine whether N management practices for corn fields developed in Iowa are applicable to the soil types found in Maine. N content in the soil is established by chemical analysis in the early spring, with N being quantified by the cadmium reduction method. N availability to the plant is measured by analysis of N in the corn stalks after harvest, N being quantified by potentiometry.

Comparison of the soil N levels to the stalk levels showed that the two values correlated well with one another. If the soil N level was low (< 20 ppm N), the stalk level was also in the low range (< 700 ppm N). This correlation also held for the optimum ranges (soil 20 - 25 ppm N, stalk 700 - 2000 ppm N), and the high range (soil > 25 ppm N, stalk > 2000 ppm N). This correlation held irrespective of soil type.

Preliminary data indicate that the N management practices developed in Iowa are directly applicable to production agriculture in Maine.

DEVELOPING A MAP OF POTENTIOMETRIC SURFACE AND POTENTIAL GROUND WATER HAZARDS FOR WATERVILLE, MAINE.

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Future development in the City of Waterville outside the reach of public water supply is dependent on ground water resources. Potential hazards to this resource, identified on a municiple Water Quality Planning Map, were site-verified. A potentiometric surface map, in conjunction with bedrock fracture data, provides a rudimentary local representation of ground-water flow.

Potentiometric data were collected from participating home owners' wells. Bedrock fracture and joint data were obtained from outcrops. Fractures control ground water flow in the Waterville area due to the low primary porosity of the bedrock aquifer.

From this information, decisions on future development in the City of Waterville can be made with respect to potential ground water contamination.

An investigation of the physical properties of Hinckley C soils under different land uses: Horse Point, Belgrade, Maine.

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Hinckley soils are excessively well drained soils formed on glacial outwash deposits and river terraces. Four soil profiles in areas of different land uses: undisturbed forest, second growth forest, hayfield, and a disturbed site, were compared to determine if significant differences in the soil profiles could be attributed to historic land use patterns. Land use was reflected only in the O and A horizons of each profile. The second growth forest soil had an A horizon two to three times as thick as that of the undisturbed forest. The second growth forest plant-soil system is an aggrading system and is accumulating subsurface organic material in its A horizon from its high annual turnover in the form of dying roots and trees, thick leaf litter, and abundant forest floor vegetation. The undisturbed forest is a climax community and may be close to equilibrium with regard to the cycling and conversion of sub-surface organic material and nutrients to above-ground biomass. Differences in the way that the A horizons were bound together by plant roots were due to root distribution and character. No significant differences in chemical composition or in the eluviation of fines were found. Non -disturbed soils have been developing for less than 12,000 years, which is not long enough for significant clay enrichment to occur. The extreme heterogeneity of glaciofluvial parent material makes comparisons difficult and potentially inaccurate without corrections.

THE PHYSICAL AND CHEMICAL HYDROGEOLOGY OF A FRACTURED BEDROCK AQUIFER IN WATERVILLE, ME.

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The bedrock aquifer below the campus of Colby College is dynamic, both physically and chemically. Two piezometers are installed in a fractured, vertically dipping phyllite member of the Waterville Formation. The shallow piezometer is open at a depth of 15 feet below the bedrock surface, and the deep piezometer is open at a depth of 110 feet; downward vertical gradients average 0.095.

Porosity and permeability are dominantly secondary, consisting of joint sets and cleavage planes. Aquifer responses to recharge and pumping were analysed using hydrographs. Response to recharge and pumping in the shallow piezometer was more rapid and of a lesser magnitude than the deep piezometer. Slug tests are being used to determine hydraulic conductivity. The physical hydrogeology is thought to be controlled by changes in fracture aperture size with depth. Increased weathering and decreased confining pressure at shallow depths result in higher hydraulic conductivity.

Samples from the shallow piezometer are oxidizing and acidic, with calcium and chloride the dominant ions. In contrast, the deep piezometer samples are reducing and slightly alkaline, with higher concentrations of magnesium and bicarbonate than the shallow piezometer samples. Ground water geochemistry is thought to be controlled by the interaction of the weathered fracture surfaces and the ground water.

GROUND WATER FLOW MONITORING IN LOW FLOW RATE REGIONS OF FAIRBANKS, ALASKA

KOPCZYNSKI, Sarah E., Department of Geology, Colby College, Waterville, ME, and LAWSON, Dr. Daniel, Principle Investigator, and WILLIAMS, Christopher R., Engineer, United States Army Corps of Engineers Cold Regions Research and Engineering Laboratory Hanover, NH & Fairbanks, AK.

The US Army Corps of Engineers has designed a ground water flow probe to be used to trace the flow of contaminants through the complex discontinuous permafrost zones of Fairbanks, Alaska, where the seepage rate through these permafrost zones reaches as low as 1 foot per day.

Research and development combined with rigorous in-situ and laboratory testing culminated in the design of a new ground water flow probe. The probe and the internal platinum resistive temperature sensing devices are calibrated in a flume chamber under seepage rates ranging from 1 to 10 feet per day. We account for the electronic offset of the probe through the calibration testing which allows for greater measurement accuracy in the field. Human error in the data collection process has been eliminated by installing a program which allows the probe system to be completely self-automated in the field for extended periods of time. Liquid potting of the internal electronics and other weatherproofing steps have been taken to ensure that the probe is able to withstand the harsh environmental rigors of these permafrost zones in Alaska. We increased the accuracy of the probe installation process through the design of extension rods which are resistant to twisting error during installation. These probe design improvements provided accurate ground water seepage velocities and directions in discontinuous permafrost zones of Alaska in which previous probes were not able to accurately measure.

APPLICATION OF THE SEM AND EDS TO CLASSIFY IGNEOUS SAMPLES FROM ZIMAPAN VALLEY, HIDALGO, MEXICO

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Igneous rocks can be classified by weight percentages of SiO_2 from whole rock analysis, type of feldspars, relative amounts of dark minerals, and texture. Polished thin sections were obtained for analysis of two samples, one a float and the other a sample from a dike on the southwest edge of Cerro Grande in the Zimapan Valley region of Hidalgo, Mexico. Mirofiche maps were used to locate regions of interest on the slides. The maps and light microscope analysis revealed differences in textures between the two samples. The fine texture of the groundmass and phenocrysts of the float is characteristic of an ash deposit. The felsic texture of the Cerro Grande sample is characteristic of a lava flow.

The SEM was used initially for imaging with secondary electrons (SEI), and then with backscatter electrons (BSE) for an image of differences in composition for both samples. Optimum resolution of images were obtained with the following parameters for SEI and BSE imaging: 20 KeV accellerating voltage, OL aperture 1, and working distance 17 mm. The EDS in conjuction with the SEM system was used to acquire X-ray maps and spectra of regions of interest. The optimum parameters for EDS use were: 20 KeV, OL aperture 1, and WD 39 mm with the detector set at 5 cm.

Results show that the composition of the two samples are characteristic of low temperature rhyolites and dacites. The float is composed of a fine grained orthoclase feldspar groundmass and biotite and orthoclase feldspar phenocrysts. The groundmass of the Cerro Grande sample is composed of plagioclase, alkali feldspars, biotite, and muscuvite. The highly altered phenocrysts contain inclusions of groundmass minerals and rounded quartz grains. Further results are pending.

INDIRECT REMOTE SENSING AND STRATIGRAPHIC ANALYSIS OF ARCHAEOLOGICAL SITE ME 16.7 SHELL MIDDEN, INDIANTOWN ISLAND, MAINE

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The Ceramic Period shell midden on Indiantown Island on the Sheepscot River, ME is primarily composed of soft shell clam (*Mya arenaria*), blue mussel, wood ash, bone, and stone and ceramic artifacts. After a 4 by 1 m. pit was excavated in the fall of 1995, the shell midden and the surrounding subsurface were surveyed using remote sensing. The archaeological reconnaissance utilized four geophysical techniques. Seismic refraction profiling, electrical resistivity, electromagnetic terrain conductivity, and ground penetrating radar were employed to observe anomalies, and to calculate the depth to bedrock, and the type and sequence of the underlying archaeological and geological deposits. The surveys produced a data set of three layers, a shell midden layer with a thickness of 0.6 m, a saturated glaciomarine layer with a thickness of 0.8 m, and a metamorphosed sandstone and shale bedrock layer at a depth of 1.4 m. These methods proved very applicable when observing this shallow shell midden and the surrounding subsurface.

A sedimentological analysis of the strata was also conducted. The stratigraphy of the layers and the characteristics of their sediments were analyzed; shell/non-shell percentage, grain size distribution, loss-on-ignition, pH, and manganese and carbonate concentrations were determined. The average shell percentage of the midden units was 74.8%. In relative percentages, the organic, carbonate, and manganese concentrations were high. Grain size analysis showed the majority of the units to be slightly gravelly sandy mud. This sediment analysis, along with four radiocarbon dates define each stratigraphic layer as separate cultural and geological units, reflective of cultural adaptations to changing environmental resources. The shell midden is situated in a south facing, mid-estuarine setting, adjacent to a beach, as well as travel routes, mud flats, and a freshwater source. Thus, the Indiantown Island site, most likely encompassing the Middle to Late Ceramic Period beginning roughly around 1500-2000 B.C., was located in an ideal environment for prehistoric occupation (Kellogg, 1994).

MORAINES PRESERVED ON THE INNER SHELF OFF SOUTH-WESTERN MAINE

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Interpretation of 150 km of new side-scan sonar (SSS) profiles and 100 km of seismic reflection profiles within the Wells Embayment, southwestern Maine depicts a series of end moraines subparallel to the present coastline. The SSS records show that the Wells Embayment is a sand-covered, rocky basin with gravel areas associated with the moraines. The moraines are highly variable in size, ranging in length from 10 m to 800 m, widths from less than 5 m to 100 m, and heights of 1 m to 12 m. A typical moraine is 70-150 m long, 25 m wide and 2-5 m high, with large moraines in deep water. The moraines are associated with bedrock, which strikes parallel to the coast within the embayment. In addition, seismic reflection data reveal that the moraines are often rock cored. These moraines were deposited in a marine environment as the ice margin retreated from the continental shelf ca. 14,000 BP and are presently within 10-40 m water depth. These small-scale moraines are identical in form to fields of similar features found on land nearby. As the ice retreated, partially or completely draping the moraines with the glaciomarine Presumpscot Formation mud. Isostatic uplift exposed the moraines ca. 11,000-9,000 BP before the ongoing transgression rapidly submerged them. On two brief occasions (during uplift and later submergence) the moraines were probably islands, and partially reworked into barrier island systems. The rapid rise in sea level between 9,000 and 7,000 BP, the temporary protection by glaciomarine mud cover, and coarse lag armoring appear to have preserved these features on the inner shelf. Identification of these features provides a continuity between processes acting on the present inner shelf and present coastal lowlands during deglaciation in Maine, and provides a means for examining degree of preservation versus reworking of pre-Holocene sediments on the inner shelf.

THE CHEMISTRY OF CRETACEOUS LIMESTONE FROM CERRO DEL MUHI, ZIMAPAN, HIDALGO, MEXICO

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Cerro del Muhi is located within the Zimapan Basin, Hidalgo, Mexico. The Zimapan Basin has been a focus of geologic focus due to the unusually high levels of arsenic within the drinking water. The well with the highest level arsenic (1.026 mg/L) is located on the south side of Cerro del Muhi (Armie 1994).

The Zimapan Basin is part of an aulacogen system which was formed during the Jurassic. This system was fyrther deformed during the Laramide Orogeny. The basin is composed of sediments ranging from the Late Jurassic t the Quaternary. Cerro del Muhi is composed of three rock units, ranging from thinnly bedded to massive Cretaceous limestone. The three units are fairly discontinous due to fluctuations in sea level.

Armienta (1994) believes that there is a connection between the Cretaceous limestone and the presence of arsenic. The arsenic is leached from the sulfides which form in the fracture zones within the limestone (Armienta, 1994). This project studies the chemistry of these limestones and hopes to create conclusions towards the presence of arsenic within the Zimapan Basin. These results will be presented at the conference.

MULTIMEDIA APPLICATIONS OF SEM IMAGING IN MICROSTRUCTURE CURRICULUM DEVELOPMENT

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The SEM system can be used to obtain images of microstructures with great clarity, these images are useful in correlating microscopically scaled structures to similar structures of meso and macroscopic scales. The purpose of this project was to make a portfolio of SEM images using a variety of mediums for use in class presentations focussed on microstructures. Samples of a variety of microstructures were obtained and gold coated using the Hummer VII Sputter Coater and then placed on slides to be examined under the microscope. Gold coating improves resolution by increasing the number backscatter and secondary electrons reflected off of the sample and detected by the KEVEX SuperDry unit.

The SEM was used for imaging with secondary electrons (SEI) and backscatter electrons (BSE) on all samples. Optimum images were attained using an accelerating voltage of 5 keV, a working distance of 10-15 mm, a probe current of approximately .8 nA, OL Aperture 3, and the detector set at 10 cm.

The final corrected images were preserved using a standard 35mm cam and a TV/ VCR livetime link which recorded the images onto a standard videotape. With these two methods a variety of presentation styles could be derived including a photo portfolio, slides, a prerecorded and editted VHS video, or a livetime video format utilizing a hardwire link between the SEM and classroom video monitor. These methods could be applied singly or in combination to compliment a normal class lecture focused on structural geology, mineralogy, or introductory tectonics.

From this project a number of possible curricula were developed in a effort to emphasize the correalation between macro, meso, and microscopically scaled structures. A variety of presentation styles were developed utilizing the many possible SEM applications dependant on personal preference and class dynamics.

Electron Microprobe Partition Coefficient Measurements Near the Ol-Opx-Cpx-Gar Join at 19 Kbar

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Temperature, pressure and composition parameters of previously run experiments giving crystal assemblage of cpx+gar+gl were duplicated and experiments repeated, this time doping the experiment with a mix of trace elements including the REE. The objective was then to use the CAMEBEX microprobe at Lamont Doherty Earth Observatory to determine the partition coefficients between the crystal and liquid. The purpose of this was twofold; to gather data on the separation of trace elements in a system at known temperature and pressure, and also to evaluate the performance of the electron microprobe in determining trace elements at low concentration. The data would then be compared to the accepted results obtained using the ion probe on the same sample.

One element, Lu, without significant spectral interference, was comparable with published results. Data on other elements were obscured by interference from major element peaks. These abnormally high trace element counts require careful selection of doping elements to eliminate peak overlap. Longer counting times are essential for improved peak to background ratios, leading to improved $D_{cryst/liq}$ values.

BEDROCK GEOLOGY AND TECTONIC HISTORY OF THE NORTHERN GEORGES ISLANDS ARCHIPELAGO, MUSCONGUS BAY, MAINE:

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Study of the northern portion of the Georges Island Archipelago provided a unique opportunity in that it had been one of the last unmapped localities in Maine. The study area, which consisted of Caldwell, Little Caldwell, Sister Caldwell, Teel, Bar, Little Eagle, Big Eagle, Stone, Ram and Seavey Islands, lies within the peri-Gondwanan, St. Croix Terrane.

The bedrock in the northern portion of the study area is comprised primarily of meta-sedimentary rocks of the Teel Island Formation, which may be correlated to the Benner Hill Formation. Five major meta-sedimentary units were mapped. Meta-sedimentary rocks often appear in the form of xenoliths within a felsic matrix. These xenoliths range in size from a few millimeters to mappable scale. There are also xenoliths of a rusty, calc silicate lens rich schist that occurs in the more southern Georges Islands.

Multiple phases of deformation are recorded within the bedrock in this portion of the archipelago. They are, in order of youngest to oldest: isoclinal recumbent folding; asymmetric overturned folding; ductile shearing; disharmonic localized folding; broad, regional NE plunging folds. Due to the extensive magmatic intrusions, the most clearly seen phase of deformation in the southern portion of the study area is the large right-lateral strike slip shear zone.

Six phases of igneous intrusions, probably spanning the Silurian to Devonian, were observed. From youngest to oldest these include: 1) coarse-grained gabbro; 2) fine to medium-grained, garnet bearing granodiorite/tonalite; 3) commingled basalt and granite dikes; 4) xenolith rich granodiorite/diorite plutons and dikes; 5) pegmatic to applitic two-mica granite veins; and 6) basalt dikes.

ELECTRON DISPERSIVE SPECTROSCOPY ANAYLSIS OF MONAZITE AND ZIRCON CRYSTALS IN SCHISTS AND GRANITES FROM THE PRESIDENTIAL RANGE, NH

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Monazite and zircon crystals were analyzed for chemical composition for future use in radioactive age dating of the schists and granites from the Presidential Range, NH. Analyses with a standard were done on monazites and standardless analysis were done on zircons.

Two thin sections from each rock type were selected for analysis. Schist samples were analyzed for monazite and granite slides were analyzed for zircon.

Preliminary results indicate slight variation of chemical composition of the monazite crystals. Data also indicates that the monazite crystals are internally homogenous with no zonal variation. Element constituents of the monazites are O, P, Ca, La, Ce, Nd, and Th. Although the element concentrations do vary, differences are not too severe and overall composition seems to be homogenous. Analysis of zircon crystals indicates very small amounts of trace elements such as U, Th, and Fe. Most of the zircons in the granites seem to be detrital. Zircon analysis, however, is still underway and results will be posted at GSM.

PHYSICAL SCALE MODELING OF ELECTRICAL AND ELECTROMAGNETIC SURVEYING TECHNIQUES

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We have constructed a physical scale modeling tank facility in the geophysics laboratory at the University of Southern Maine. We are currently able to collect resistivity and slingram-type electromagnetic (EM) data over various targets in free air (for EM techniques), or in a water background of varying conductivity. Surveys can be completed as soundings, profiles, or with an azimuthal array. Transmitters consist of a Phoenix T-3 resistivity/IP transmitter, a function generator, and 12V DC batteries. Receivers consist of a Phoenix V-5 multipurpose receiver, a Hewlett Packard digital oscilloscope, and a Fluke digital multimeter.

We have performed several experiments to test and calibrate the modeling tank apparatus: resistivity and EM soundings were performed with satisfactory results, and previously published azimuthal resistivity scale modeling results were successfully duplicated. We have also collected azimuthal resistivity and azimuthal EM data over the same target, and have worked (with limited success) to reproduce the "Paradox of Anisotropy" in our tank with an azimuthal EM array.

MORPHODYNAMICS OF A REFLECTIVE SAND BEACH, REID STATE PARK, MAINE

SMITH, C.L., and RUTER, B.D., Geology Dept., Bowdoin College, Brunswick, ME 04011

The mesotidal barrier-beach system at Reid State Park comprises two SE-facing segments bounded by bedrock headlands. The beach is reflective, characterized by coarse sand, a steep shoreface and foreshore, plunging breakers, and well-developed cusps. Fetch is unrestricted from the SE, but limited from the ENE. Wave climate varies seasonally; the strongest winds are northeasterlies associated with fall and winter storms.

Hand-leveled profiles from September to November illustrate spatial and temporal variations from the NE to SW end of the 1-km-long main beach. Foreshore slope and grain size decrease progressively from NE to SW, implying net longshore transport to the SW, and suggesting that the Sheepscot rather than the Kennebec River may have been the source for beach sand. Fairweather profiles of September were eroded by October and November storms. Net lowering of the beach by up to 2 m occurred at the NE end, while the SW end showed little change. Beach erosion on this topographically complex coast thus depends on direction of wave approach and sheltering by headland and nearby islands.

Daily surveys of two horn-hollow systems monitored changes as the location of the high-tide swash zone varied with the neap-spring tidal cycle and with wave height. Large cusps at the foreshore-backshore transition persisted over the two-week period, with deposition occurring mainly during periods of high run-up related to significant storms or spring tide. During periods of moderate run-up, the horns of these large cusps were eroded to form 15- to 80-cm-high scarps at the upper limit of the swash zone. Low run-ups related to neap tide and small waves initiated secondary and tertiary cusp systems on the foreshore below the semi-permanent, first-order cusps. The return of high run-up with the next spring tide eliminated these incipient cusps. Extremely high run-up and offshore transport of sand from the upper foreshore during a series of significant storms in October and November eliminated the large, well-developed cusps that had been in place during September. Renewed growth of cusps began as the beach recovered from individual storms, but ensuing storms prevented these from becoming mature horn-hollow systems.

A RECONSTRUCTION OF AN EARLY TO MIDDLE HOLOCENE CLIMATIC OPTIMUM AND THE PALEOENVIRONMENTAL LANDSCAPES OF LAKE AUBURN, AUBURN, ME

TALBOT, Jessica S., Box 720, Bates College, Lewiston, ME

An analysis of the paleoenvironmental landscapes of the Lake Auburn basin region was used in this study as a measure for the reconstruction of regional paleoclimate. The past vegetation cover for the early to middle Holocene was interpreted through an analysis of the fossil pollen assemblages preserved in the lake basin. This pollen study was integrated with an examination of the lake basin sediment stratigraphy.

The post-glacial changes of the Lake Auburn basin show evidence of a warm, xeric period occurring at approximately 9000 years BP. Sediment cores have revealed reworked and redeposited shoreline plant material in the transitional sediments between the glacial marine and the lacustrine facies. Acoustic sub-botton profiles show a truncation of finely laminated glacial marine clay that is overlaid with gyttja; this indicates the presence of an unconformity in the sedimentary sequence of the basin. Bulk 14 C dates taken at and above the unconformity boundary have been dated at 6930 +/- 105 years BP and 8435 +/- 95 years BP, suggesting that the lake level may have dropped prior to the later date, at approximately 9000 years BP. The acoustic sub-bottom profiles reveal that this lake level drop may have been as many as 10-15 meters below present level.

An analysis of the fossil pollen preserved in the lake sediment show that three main forest types have defined the Lake Auburn watershed since the retreat of the Laurentide Ice Sheet.These zones correspond to a regional early Holocene hypsithermal interval. The successional development of pine and hemlock mixed hardwood forests coupled with lake level data for the Lake Auburn basin show evidence of a Holocene thermal optimum occurring at approximately 9000 years BP.

MINERALOGY OF SULFIDE ORES, ZIMAPAN, HIDALGO, MEXICO

TICHENOR, Sara, Department of Geology, Bates College, Lewiston, ME 04240

The town of Zimapán has been a mined since 1632. Silver, zinc, and lead are currently being mined. Tertiary intrusives north and west of the town have been identified as possible sources of arsenic contamination of the groundwater. These intrusives are thought to follow the orientation of the regional normal faults running NW to SE.

Team REU Mexico '95 collected several mineral samples from the El Monte mine, north-northwest of the town. This final project, for a scanning electron microscope class, studies the galena, sphalerite, pyrite, chalcopyrite, and arsenopyrite minerals collected. The microstructure of the minerals were photographed in detail to portray mineralogic characteristics typical of the ores. An EDS unit was used to identify chemical content of the samples. Photographs and spectra of each sample will be presented.

MEMBERSHIP DUES STATEMENT

The GEOLOGICAL SOCIETY OF MAINE, INC. 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 cor 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 mod 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:

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Items for inclusion in the newsletter may be directed to Susan Weddle, 11 Beech Drive, Brunswick, ME 04011.

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