The Maine Geologist

June 1993

Newsletter of the Geological Society of Maine

V.19, No.2

President's Message

by
Steve Pinette

After over six months as your president, I want to report that I am enjoying the experience. I am heartened by the cooperation and thoughtfulness of the members and officers and appreciate your support.

We had an excellent Spring Meeting at Bates College. Despite the non-traditional Thursday meeting (due to room schedule conflicts), we had very good attendance. I want to thank Dr. Dyke Eusden and the Geology Department at Bates College for soliciting student presenters and for organizing and hosting the meeting. I also want to thank and commend the student presenters for their high-caliber presentations. In several respects, the quality of the oral and poster presentations rivaled those given at GSA conferences. GSM's Spring Meeting continues to be a good opportunity for students to present their research, but it also provides an opportunity for professional geologists to briefly rekindle the enthusiasm that led us to pursue geology.

I want to thank Dr. George Denton for being our featured evening speaker at the Spring Meeting. His talk, titled "Abrupt Global Climate Change", very lucidly summarized the current data and theories on global climate change as recorded in the geologic record. For the bedrock types, it is noteworthy that a bedrock geologist's detailed observations led to recent reinterpretation of climate record data and substantial update of climate change theory. Dr. Denton's presentation is summarized in the Spring Meeting minutes.

By all accounts, our short course on "Geophysical Methods in Ground Water Resource Evaluation", held May 12th in Portland, was a success. I want to thank Jim Hillier and Fred Beck for providing the organizational skills and work that crafted this event. I also want to thank Pete Haeni, John Williams, Craig Neil, and Rudy Rawcliffe for their fine presentations. Their lessons provided attendees with a more effective grasp of both routine and innovative geophysical techniques and guidelines on avoiding their pitfalls. I also want to thank Mark Loiselle, Jan Wilcox, Martha Mixon, and Tom Brennan for helping with short course registration.

This past winter, I was reviewing some early issues of the *Maine Geologist* to get a perspective on GSM's early years. Some of the technical articles contributed by members in those early years covered a range of topics such as "Two Tills in Northern Maine", "Earth Tides", "Brittle Fracture and Seismicity", "Ground Water Modeling", and "The Androscoggin Moraine". These short articles are quite informative and I believe that publishing similar articles in our newsletter would be good for GSM and individual members. Reiterating a plea made by former President Bob Gerber more than a decade ago, Newsletter Editor, Susan Weddle, and I invite you to contribute short technical articles of interest to your GSM colleagues for publication in the newsletter. For now, there are no firm guidelines for articles submitted, but please try to limit your articles to 1 - 2 newsletter pages. Susan and I will review the articles for technical merit and work with you to get them into the newsletter. You may mail two copies of your articles to Susan at the following address:

11 Beech Drive
Brunswick, ME 04011

Response to the Education Committee's plea for volunteers and new members was less than overwhelming. The Committee needs your help. For those of you who are uncomfortable with teacher workshops as an outreach mechanism, there is also a need to lead both regional and local field trips for citizens, students -- for anybody. As an example, Doug Reusch, Art Hussey, and Bob Marvinney recently led two weekend field trips for teachers to examine the plate tectonic evolution of the Appalachian Mountains from Quebec City to Skowegan.

Our annual field trip meeting on July 24 and 25 promises to be a good one. Details on the field trip are elsewhere in the newsletter. I hope to see you on the field trip!

GSM Summer 1993 Field Trip

by
Jim Hillier

The weekend of the annual summer field trip, July 24 and 25, is now but a stone's throw away. Tom Weddle (Maine Geological Survey) and John Creasy (Bates College) are preparing their respective portions of the Field Trip Guide Book. You should make your preparations to attend what promises to be another fine GSM trip.

Tom, along with Cheryl Marvinney (MGS), Mike Retelle (Bates College) and Kathy Bither (R. G. Gerber, Inc.) will be guiding us to several locations along the Androscoggin River Valley to examine surficial deposits and discuss their genesis and history. This will be a part of the trip that he will lead for the Geological Society of America later this year. John will lead us up and around Rattlesnake Mountain in Raymond to examine the syenites associated with intrusions of the White Mountain complex. John's interpretations of this area have been published in the Maine Geological Survey's "Jackson" Volumes on Maine geology.

We have made arrangements with the Recompence Shore Campsites on Wolf's Neck peninsula in Freeport for group camping the nights of Friday, July 23 and Saturday, July 24 for those wishing to gather under the stars. The shore is accessible from the camping area, which includes a central camp fire ring. Other accomodations such as hotels are available in the Freeport-Brunswick area, but I suggest you make reservations early. If you plan to attend the trip or camp with the group, please notify me at 865-6138 or Bob Johnston at 287-2801 by July 16th so we can plan logistics and advise you of campsite availability.

Saturday, July 24 meeting place is at Recompence Shore Campsites at 8:30 AM, just north of Wolf Neck Woods State Park (see DeLorme's Maine Atlas and Gazetteer Map Number 6 for directions). Sunday, July 25 meeting place is the J.C. Penney entrance of the Auburn Mall parking lot at 9:30 AM. We look forward to seeing you in July.

Treasurer's Report
for the period 2/11/1993 to 6/4/1993

Beginning Balance:	**4972.94**
Income:	
Dues, application fees, etc.	336.00
Publication sales	0.00
Short course registrations	2810.00
Miscellaneous	34.08
Expenses:	
Spring 1993 newsletter	-364.00
State filing fee	-20.00
Bank service charges	-3.06
Short course:	
Mailing	-71.25
Sonesta hotel	-2413.00
Printing	-1136.72
Ending balance:	**4144.99**

Geophysical Short Course - A total of 87 people registered for the short course on geophysical methods in ground water resource evaluation. Expenses for the course totaled $3620.97; $2810.00 in registrations have been collected to date with another $1560.00 in registrations from State and Federal attendees invoiced but not yet received. When the dust settles, the short course will have enriched the Society's coffers by approximately $750.00.

A note on mailing addresses - Every newsletter, a half-a-dozen or more newsletters are returned because of unknown addresses or forwarding orders that have expired. This costs the Society, both in postage due costs for the returned newsletters and the cost of mailing the newsletters to the new address. Please consider the Society when you move; all it takes is a post card to me at the address on the back cover and you'll get your newsletter on time and save the Society money in the process.

A note on dues - The Society year begins **August 1, 1993.** A **"92"** on your mailing label means you will be **over a year delinquent** in your dues and **will not received the Fall newsletter.**

Submitted by Marc Loiselle, Treasurer

GSM SPRING MEETING MINUTES
APRIL 8, 1993

submitted by
Marita Bryant, Secretary

The meeting opened with the reading of the Treasurer's report. This was followed by the presentation by Walter Anderson of a plaque on behalf of the State of Maine to Olcott Gates in recognition of his many contributions to the understanding of Maine's geology.

GSM President, Steve Pinette, then raised the following issues for discussion and membership approval.

(1) It was decided that brief technical articles could be published in the newsletter. The selection and editing of such contributions would be done by the President and the Newsletter Editor.

(2) An updated version of the Society's by-laws will be printed and made available to anyone interested.

(3) As there have been numerous requests for a study guide for the State Certification Exams, Steve Pinette suggested compiling a reading list of pertinent materials. Otherwise, any questions should still be directed to Woody Thompson.

(4) The membership voted in favor of sponsoring the **Nitrogen in the Environment Conference** with a $200 contribution. The conference is non-profit and copies of the proceedings will be distributed among various school libraries and state offices.

(5) Jim Hillier reminded members of the Geophysical Short Course (held May 12) and the Summer Field Trip scheduled for July 24 - 25. See the announcement elsewhere in this newsletter for field-trip details.

(6) Carol White reported that the Education Committee has decided to use the $500 appropriated by GSM to support earth science education in Maine, to fund teacher workshops at the elementary school level, particularly since this group does not have the advantage of NSF funding. Such workshops need to be scheduled about one year in advance and volunteers are needed to organize and teach them. Contact the Education Committee if you are interested in helping.

To maintain a source of funds for the workshops Arthur Hussey suggested including a check-off space for additional contributions in the membership dues statement of the newsletter. This was approved by the membership and the Education Committee was made responsible for working out the details. In addition, names of corporate sponsors would be published in the newsletter.

The evening speaker, Dr. George Denton from the University of Maine, lectured on global climatic change and, in particular, the development of the idea of abrupt climatic change and its global distribution.

The concept of global climatic change has its roots in the late 19th century when Agassiz first proposed the existence of ice ages. The last 40 years have seen dramatic strides in the study of climate cycles, including an ice-age model driven by orbital variations as described by Milankovitch.

During the 1980's, however, examination of the stratigraphy of deep sea cores and ice cores from the North Atlantic, as well as entomological and palynological studies in Europe suggested that abrupt changes in thermohaline circulation appear responsible for glaciations and interglaciations in the Northern Hemisphere, although, exactly how the ocean and atmosphere are involved is still unknown. Furthermore, abrupt changes in climate have occurred many times during the past 50,000 years.

In addition, great pulses of ice-rafted carbonate sedimentation (Heinrich layers) can be correlated with times of peak glaciation, but not with the periodicity of the Milankovitch cycles, challenging the validity of the earlier model.

Having established the existance of abrupt climatic change in the Northern Hemisphere, the next step has been to look for evidence of similar events in the Southern Hemisphere to see if the same abrupt changes occur globally. To this end researchers from UM have been studying a transect from the Patagonian Ice Field down across Antarctica to the New Zealand Alps. The ages of glacial maxima at 45° N and 45° S match, raising several questions. Was the end of the last ice age also synchronous in both hemispheres? Are the abrupt climatic reversals in both hemispheres related? If so, how and how often do they occur? And finally, to apply all this to the question of "greenhouse warming", does humankind influence abrupt global climatic change?

GEOPHYSICAL METHODS IN GROUND WATER EVALUATION SHORT COURSE

by
Steve Pinette

The Geological Society of Maine recently sponsored a short course on "Geophysical Methods in Ground Water Resource Evaluation". Eighty-seven registrants attended the one-day course held on May 12 at the Sonesta Hotel in Portland. Attendees included undergraduate and graduate students; university professors; staff from Maine government agencies including the Department of Environmental Protection, the Department of Transportation, and the Geological Survey; staff from the federal government including the Environmental Protection Agency and the Geological Survey; and consulting engineers and geologists. Course instructors were F. Peter Haeni (USGS), John H. Williams (USGS), Craig D. Neil (MGS), and Rudy Rawcliffe (Northeast Geophysical Services).

The course consisted of two sessions and ended with a panel discussion. The morning session was a Methods Tutorial followed by an afternoon session on Methods Applications.

Peter Haeni started the first session with a surface geophysics tutorial. He discussed the theory, application, benefits, and limitations of seismic reflection, seismic refraction, electromagnetic, and ground penetrating radar techniques. Peter emphasized that geophysical solutions to hydrogeologic problems begin with selecting the appropriate method for the task at hand - one method cannot do it all. Geophysical data interpretation should be calibrated to "real" data such as data derived from wells, test pits, and borings. Frequently, multiple geophysical methods are required to assess the problem.

John Williams followed with a borehole geophysics tutorial. He discussed the theory, applications, benefits, and limitations of borehole electromagnetic, gamma, neutron, caliper, temperature, and acoustic logging techniques. He also showed a video of a several boreholes as seen through a borehole televiewer. While borehole geophysics cannot be applied to every borehole, John emphasized their cost-effectiveness in maximizing borehole information and value. For example, borehole geophysics coupled with lithic logs can (1) be used to determine optimum screened intervals for monitoring wells at contamination sites, (2) provide a nearly continuous vertical profile of water quality in a formation, and (3) identify temporal changes in water quality through sequential logging of monitoring wells.

Peter Haeni came on again before lunch to discuss some experimental geophysical methods that may be available commercially soon. Some of these methods include nuclear magnetic resonance used to measure percentage of free water in the ground, image reflection using a range of frequencies (CHIRP system), and airborne electromagnetic surveying.

Craig Neil started the afternoon session on Method Applications by providing an overview of the Maine Geological Survey's Sand and Gravel Aquifer Mapping Program and the data-gathering evolution that has accompanied the program. A key improvement on the original Sand and Gravel Aquifer Program Maps results from the more detailed data collection used in the more recent Significant Sand and Gravel Aquifer Program. This latter phase of aquifer mapping includes updated well inventories, seismic refraction profiling, installation of monitoring wells, and more detailed surficial mapping. In addition, by adding more shot points to seismic refraction lines, they have increased the accuracy of their aquifer profiles commensurately. Craig's insights were especially useful for those who base some technical decision solely on aquifer map data.

Peter Haeni came back to discuss the use of surface geophysical and borehole radar methods to detect bedrock fractures at the USGS fractured rock research site at Mirror Lake, New Hampshire. He and his colleagues successfully used azimuthal seismic refraction, direct current resistivity, and single-hole directional and non-directional borehole radar to detect fractures in the upper 60 meters of the bedrock at three locations.

Peter Haeni stayed on to fill in for Scott Calkin, who was called away on business, and talk about the forensic applications of ground penetrating radar. The USGS is not routinely a crime-fighter, but the FBI and the Criminal Division of the IRS have enlisted the USGS and their ground penetrating radar unit to help locate organized crime graves and buried money laundering safes.

Rudy Rawcliffe presented a local case-history on use of integrated geophysical methods and geologic wisdom to locate a high-yield bedrock well near Sebago Lake. Rudy described how he and Stephen Kelley first used very low frequency (VLF) electro-magnetics to screen the property for potential high-yield bedrock fractures. After identifying some candidate sites, they used horizontal loop (vertical dipole) electromagnetics, seismic refraction, and magnetometer surveys to select the best candidate sites for locating high-yield wells. With some perseverance, they finally drilled a 300-foot deep bedrock well that yielded over 110 gallons per minute.

John Williams gave the final presentation of the afternoon session with a talk on using borehole geophysics for ground water contamination studies. John provided much compelling evidence to justify using borehole geophysics to augment drilling lithic logs, hydraulic well tests, and ground water quality tests traditionally used for site characterization. Considering the expense of monitoring well installation and priority pollutant testing of ground water, using borehole geophysics to properly locate monitoring well screens and to minimize the number of monitored intervals can be very cost-effective.

The short course concluded with a panel discussion featuring the speakers answering questions from the audience. One interesting possibility raised during the discussion was the utility of borehole geophysics to augment ground water quality monitoring for compliance monitoring at some licensed waste storage sites.

Extra copies of the short course proceedings can be purchased from GSM through Marc Loiselle; call him at 287-2801.

A Historical Perspective

The following is reprinted from the *Lewiston Journal*, dated May 16, 1903.

"A survey of the state had been partially completed, years before, by the distinguished Dr. Charles T. Jackson, and it was proposed to make an appropriation for finishing it under his supervision. Sewall opposed this on the ground that it was all a humbug, and to prove it he told a story how the doctor, during his survey, had come to Oldtown and the boys there had told him of a famous animal in that neighborhood that would break through ice two feet deep, with its tail in order to bathe; how the doctor had listened with interest and made a drawing of the supposed animal from the description given, and published the cut in his report.

'If you doubt this' said Sewall, 'you can take that report from the library and see for yourself.'

The House promptly voted down the appropriation, after which some of the members consulted the report. They, and not the scientist had been fooled."

MGS CREST Field Trips to Quebec City

by
Doug Reusch

On the weekend of May 22-23, the Maine Geological Survey's CREST project sponsored a field trip entitled "The plate tectonic evolution of the Appalachian Orogen" from the Quebec City area to Skowhegan. Three dozen people involved in K-12 public education from various parts of the state participated, including representatives from six of Maine's seven Beacon Schools. On the previous weekend, May 15-16, the same trip was held for two dozen teachers in Dr. Thomas Howick's Earth Systems Education project out of USM. The trip was organized by Doug Reusch, the 1992-93 CREST Coordinator, with help from Dr. Robert Marvinney and Dr. Arthur Hussey. In addition to developing the basic storyline of the Appalachians, representative field activities, with potential to be adapted for classroom use, were covered at several of the stops. Geological videos, including the new CREST bedrock video on the plate tectonic evolution of New England, were viewed on the bus trip north.

The trip focused on five major divisions of the orogen: (1) the telescoped continental margin of North America in the Montmorency Falls - Quebec City area (basement, Precambrian unconformity, limestone shelf with reefs, flysch, Montmorency Fault, melange along Logan's Line, and transported rift and slope facies sedimentary rocks); (2) oceanic crust and mantle at Thetford Mines (pillowed basalts, dikes, serpentinized mantle rocks, Coleraine breccia); (3) the region of the Ordovician volcanic arc (Attean Pluton) and its enigmatic Chain Lakes basement; (4) the "back-arc", "post-Taconic collision" Rangelely - Carrabasset sequence of Silurian through early Devonian age; and (5) metamorphic and plutonic rocks of Devonian age formed during the Acadian collisional event.

DEP Task Force Update

by
Carolyn Lepage

The DEP Task Force has continued to meet on a more-or-less monthly basis. A subcommittee of DEP staff will begin meeting in the near future to address the quality of applications issue the Task Force had been pursuing. As part of our on-going interest in staff accountability, we heard from representatives of the professional boards for engineers, land surveyors, and soil scientists and geologists at our May meeting.
They described criteria and procedures for registering a complaint with their respective boards, as well as board-specific procedures for investigating and prosecuting complaints. Discussion also touched upon application and interpretation of professional codes of ethics. At our next meeting, the Task Force will revisit its mission statement, evaluate the composition of the group, and redevelop both short-term and long-term goals. Your comments and suggestions are welcome, please give me a call at 865-6138.

The group is continuing to pursue opportunities to exchange technical information. The conference concerning lessons learned during remediation of underground tank spill sites will be held at the Augusta Civic Center on June 23, 1993. The other conference the Task Force is involved with will address soil barrier technology and will be held on February 9, 1994. The organizers have already received a number of abstracts from authors as far away as California.

New Natural History Journal for Maine

by
Joerg-Henner Lotze, Publisher

The *Maine Naturalist* is a new peer-reviewed and peer-edited journal focusing on the natural history of Maine and the surrounding bioregion. The geological sciences are expected to be one of a number of key subject areas of the journal. It is the hope of many that the journal will help to encourage a renewed interest in conservation efforts, the study of natural history and sound natural resource management practices in Maine.

MGS members are encouraged to submit general interest articles, research summaries and original scientific research articles that focus on the geology of the bioregion.
A detailed set of instructions for authors is available. The journal includes color photographs and illustrations, and follows standard editing and review procedures. It has an exceptionally efficient turnaround time for new manuscripts and there are no page charges for authors. It also offers an annual awards competition for the best articles and other contributions by college and university students.

With a new format and philosophy, this new journal continues in the tradition of *The Maine Naturalist* (1921-1930) and the *Maine Field Naturalist* (1956-1970). The journal will hopefully become a standard reference as the single most inclusive source of information about the natural history of Maine and the surrounding region. Volume 1, number 1 was issued in March of 1993. The journal serves both as an information source and as a communications forum for those who have interests in natural history. Because of the balance of general interest and more advanced articles, the journal also serves as an effective educational tool for those who would like to increase their knowledge about a given field. Subscriptions are available at a cost of $30.00 per year. For further information, contact:

The Maine Naturalist
P.O. Box 99
Steuben, ME 04680
207 546-2821

GSM 1993 SPRING MEETING ABSTRACTS

LATE GLACIAL HISTORY OF CENTRAL AROOSTOOK COUNTY, MAINE: THE YOUNGER DRYAS PROBLEM.

ASHLEY, Kay and BORNS, Harold W., Jr.
Institute for Quaternary Studies, 5711 Boardman Rm.320, University of Maine, Orono, ME 04469-5711.

The only physical evidence for an Allerød-Younger Dryas event in Maine is a deformed peat layer within a diamicton near Oxbow. Newman *et al.* reported ages on the peat ranging from 10,395±85 to 11,760±145 ^{14}C yrs B.P. New excavation of the site in 1992 did not reveal the peat. The presence of fine modern roots throughout the diamicton suggests that the earlier dates may be too young. Newman *et al.* reported a strong NNW-SSE stone fabric in the diamicton, which is consistent with regional flow directions and suggests that the diamicton may be a till.

Ongoing fieldwork has shown that the direction of strongest bedrock erosion records a Late-Wisconsin ice flow event which occurred along a mean trend of S26°E, based on 261 striation measurements at 36 localities. This indicates a mean flow from the NNW. Till fabrics exhibit a mean trend of S40°E, indicating flow from the NNW. A major drag fold found at the contact between the surface till and underlying gravel also indicates ice flow from the NNW (fold axis trend:S66°W). The surface till has not been dated directly. The genesis of the diamicton at Oxbow and its relationship to the regional surface till remains unclear.

SURFICIAL GEOLOGY OF THE KENNEBEC RIVER PALEODELTA

Barnhardt, Walter A., Department of Geological Sciences, University of Maine, Orono, ME 04469

Large sandy lithosomes, interpreted as paleodeltas, are reported seaward of several major rivers entering the western Gulf of Maine. The lobate, smooth-topped morphology of the Kennebec River paleodelta smothers high-relief bedrock ridges on the inner continental shelf of south-central Maine. Since 1991, 488 km of side-scan sonar records and 116 km of high-resolution seismic reflection profiles were collected in this recently glaciated region. Coupled with 120 previously collected bottom samples, observations from numerous submersible dives, and 14 new vibracores, these data were used to map the surficial geology of the area and elucidate its relationship to the late Quaternary stratigraphy.

The Kennebec paleodelta formed approximately 12-10 ka when sea level fell to a depth of 60 m and abundant sandy material was delivered to the lowstand shoreline. Subsequent marine transgression with reduced sediment input greatly modified the former delta, creating a patchwork of palimpsest deltaic and relict shoreline features. As barrier beach and estuarine systems transgressed from the lowstand shoreline to their position at the present coast, shoreface erosion exhumed underlying units, exposing a variety of textural facies across the delta surface. Rippled gravel covers broad areas of the delta in depths of 30-55 m. In adjacent areas 15-30 m deep and along much of the seaward margin, elongate bands of rippled gravel are oriented perpendicular to shore, indicating modern sediment reworking and cross-shelf transport. These rippled scour depressions were apparently created by excavation of foreset or other seaward-dipping beds which now crop out on the surface as gravel ribbons. Clean well-sorted sands, reworked landward from the paleodelta, presently accumulate in large barrier beach systems and tidal deltas at the mouth of the Kennebec River.

MORPHODYNAMICS OF MAINE'S MESOTIDAL BEACHES

BEAM, J., G., Dept. of Oceanography, Darling Marine Center, Walpole, Maine 04573

Beach morphological controls in mesotidal settings are due to waves,sediment size and tides. Maine, with its discretized beach systems, variable wave climate and mesotidal setting provides a unique opportunity to study the morphologies of sand beaches. Beach profiles from 16 beach systems in Maine were taken over a two year period and surveyed to MHW. This information, along with sediment size and nearshore wave climate, was used to classify five distinct morphodynamic beach types in Maine. This includes a dissipative beach, exposed to prevailing and storm waves, composed of fine sand with a gently sloped beach face. A gently sloped Ridge and Runnel beach occurs in areas of high volume of fine sand exposed to only prevailing waves. An Intermediate beach type composed of medium-fine sand with a 3 to 5 degree beach face slope is found in wave sheltered environments. Low Tide Terrace beaches occur in sheltered wave environments with a distinct sediment size difference between the upper beach face and low tide terrace. A steep reflective beach occurs in most wave environments having sediment coarser than 1.5 phi. Tidal influence controls the type and length of time for wave processes such as shoaling, breaking, surf and swash/backwash.These findings indicate that specific sediment sizes and nearshore wave climate control mesotidal beach systems in Maine and can be used to predict their morphologies.

TWO PHASE DEGLACIATION INCORPORATING A LATE-STAGE READVANCE IN THE BRUNSWICK, MAINE AREA

BORELLI, Cynthia and SMITH, Peter; Department of Geoscience, University of Southern Maine, Gorham, Maine 04038.

Reinterpretation of late Wisconsinan glacial deposits indicate that retreat of the Laurentide ice margin occurred west of the marine limit in the Brunswick area. Marine transgression deposited the overlying Presumpscot Formation which locally contains organic rich, silty sand. A regionally extensive readvance deformed and truncated the uppermost glaciomarine sediments during the oceanic highstand. Striations and other ice flow indicators which are found underlying the Presumpscot Formation consistantly trend NW-SE, while those found on exposed outcrops above the Presumpscot Formation dominantly trend NE-SW. These otherwise anomalous directional flow indicators support a late stage readvance of the ice sheet. Areally extensive, stratified, and locally imbricated outwash caps the glaciomarine sediments. Mineral composition of the basal outwash differs from the upper outwash sequences, supporting the readvance model by indicating different source areas. Multi-phase emergence characterized by terraced landforms caused a reworking and redeposition of sediment in a fluvial, tidally influenced environment. Localized eolian deposits record a late phase reworking of sediment.

STORM-INDUCED SAND TRANSPORT AND BEDFORM GENESIS AT BEACH AND SHOREFACE ENVIRONMENTS OF THE MAINE COAST.

DICKSON, Stephen M., Department of Oceanography, Univeristy of Maine, 5741 Libby Hall-Rm. 218, Orono, ME 04469-5741.

Hurricane Bob passed over a taught-wire mooring array of current meters in Saco Bay, Maine on 19 August 1991. Current speeds and directions from Bob are compared to more common extratropical "northeaster" storms that dominate the extreme wind and wave conditions in the Gulf of Maine. Currents, sampled and averaged to produce 30 minute vectors and burst-mode 1 second vectors, yield combined wave, tide, and wind-driven flows up to 40 cm/s, sufficient to induce sand transport. Comparison of our data with wind and wave measurements at the nearby Portland Large Navigation Buoy suggest sand transport events occur many times a year. During storms, 10 cm/s tidal currents may enhance or impede wind-driven offshore-directed bottom flow (coastal downwelling). Preliminary results suggest that a rapidly moving northeaster with a peak wind velocity of 7.7 m/s (15 knots) during a rising tide will lead to net seaward transport of sand during the ebb portion of the tidal cycle.

Hurricane Bob data show 35 cm/s downwelling during the approach of the hurricane and 30 cm/s onshore-directed coastal upwelling following landfall. Upwelling lasted twice as long (24 hours) as downwelling and is believed to have been the cause of observed beach accretion. These data are the first of their type for the Maine coast.

Repeated sidescan sonar surveys of Saco Bay and Cape Small's Kennebec River paleodelta indicate the persistence of large shore-normal ribbons of ripple bedforms (rippled scour depressions) across the nearshore during a period when storms reworked the seabed and could have reshaped the bedform field. Calculations of the threshold of motion and wave orbitals under storm conditions explain the origin of large ripples in coarse sand and gravel as well as plane beds in medium sand. The spatial pattern of each bed type on the shoreface in the 10 - 40 meter depth range may be due to downwelling, although further study is needed.

OROGEN-PARALLEL STRIKE-SLIP FAULTING IN THE BEAUFORT AREA, FRENCH ALPS.

FANTINI, R., Dept. of Geological Sciences, University of Maine at Orono, Orono, ME 04469

Mountain belts tend to be considered only in terms of compressional tectonics, and little attention has been paid to strike-slip deformation in mountain-building processes. Strike-slip tectonics, however, should be expected in the case of oblique plate convergence. Evidence exists to support the possibility of significant Tertiary NE-SW oriented, right-lateral strike-slip movement in the area of Beaufort, western French Alps.

In an effort to demonstrate the significance of strike-slip deformation in the area of Beaufort, western Alps, 7 weeks of field-work were conducted in the summer of 1992. High angles of dip of the units and low-plunging lineations were often associated with strike-slip deformation. Samples were collected for kinematic indicators analysis and for radiometric dating (in process).

It is often difficult to differentiate thrust-deformation from strike-slip faulting. Yet, the results of the stereoplots, of thin-section work and of structural mapping clearly indicate in this case that a component of orogen-parallel deformation has been significant in the late tectonic history of the Beaufort area and, possibly, in other areas of the western Alps. Ignoring the possibility of strike-slip faulting in the context of orogenesis can result in misleading interpretations of the history of deformation of the mountain range.

RELATIONSHIPS BETWEEN THE DISTRIBUTION OF THE BEDROCK LITHOLOGIES, SOIL TYPE, AND THE ENDANGERED FLOWER *POTENTILLA ROBBINSIANA* IN THE WHITE MOUNTAINS, N.H.

GARESCHÉ, J.M., Dept. of Geology, Bates College, Lewiston, ME 04240.

The distribution of *Potentilla robbinsiana*, an endangered alpine flower, seems to be affected by the contact between the Silurian Smalls Falls and Madrid Formations between Mt. Washington and Mt. Monroe of the Presidential Range, N.H. The plant has done best in Madrid Formation stony pavement. Only a few individual plants survive in the Smalls Falls Formation stony pavement.

This study investigated several edaphic factors which may affect the distribution of *P. robbinsiana*. In the Monroe Flats next to the summit of Mt. Monroe, soil samples were taken along two transects perpendicular to the strike of the folded bedrock, and several samples were taken at outlier populations. Soil samples were also taken at five transplant sights in the Presidential and the Franconia Ranges. Soil was analyzed for moisture content, organic matter, grain size, pH, density, total iron and available nutrients including: Ca, Mg, Fe, K, P, NO_3, Al, Mn, Cu, and Zn. Rank sum tests showed a significant difference with available Al, Mn, and Ca, organic matter, moisture content, and density.

A census was completed for the entire population and the plant distribution was mapped. A geologic map, cross section, and structural analysis of the area were completed to constrain the location of the Madrid Formation. The mapped distribution of the Smalls Falls and Madrid Formations is controlled by a southeast-facing, F1 syncline that is strongly refolded by east verging, F2 folds and in turn refolded by open, F3 folds.

The findings of this study help determine why *P. robbinsiana* grows where it does, what types of soils are suitable for future transplants, and where future transplants should take place.

THE BEDROCK TOPOGRAPHY OF BRUNSWICK, MAINE

HOUSE, Jason R., Dept. of Geology,
Bowdoin College, Brunswick, Me. 04011

The bedrock topography of Brunswick, Me. was mapped using well data and seismic reflection and refraction profiles. It was discovered that in Brunswick, the seismic reflection method was a more succesful method of acquiring bedrock depths. The problems inherent in refraction seismology were realized in Brunswick, mainly due to the blind-zone problem. A major linear topographic depression was found in Brunswick which may be a subsurface expression of preferential erosion of the Flying Point Fault.

THE BEDROCK AND STRUCTURAL GEOLOGY OF THE BOOTT SPUR QUADRANGLE IN THE PRESIDENTIAL RANGE, N.H.

JOHNSON, Aaron H., Dept. of Geology, Bates College, Lewiston, ME 04240

Detailed mapping has been done of the polydeformed, sillimanite grade, Silurian and Devonian metasedimentary rocks in the Boott Spur Quadrangle of the Presidential Range, N.H. These rocks are part of the cover sequence in the Central Maine Terrane of the northern Appalachians. Folding and associated metamorphism is thought to be related to both the Acadian and Alleghanian orogenies.

The stratigraphy consists of 3 units of the Silurian Rangeley Formation, the Silurian Smalls Falls Formation, the Silurian Madrid Formation, and 9 units of the lower Devonian Littleton Formation. Stratigraphy is well defined by excellent graded beds both in the Boott Spur quadrangle and in adjacent quadrangles.

The area has undergone three phases of deformation, D1 - D3, during the Acadian and Alleghanian Orogenies. D1 is characterized by a macroscopic, F1, nappe stage, syncline; D2 consists of numerous asymmetric, east vergent, outcrop scale, F2 folds; and D3 is characterized by later stage, broad, warping, F3 folds.

Four metamorphic events, M1 - M4, are recognized within the quadrangle. M1 and M2 are both prograde events associated with D1 deformation. M3 is a static prograde event associated with the injection of the Slide Peak Granite and reaches partial melting in places. M4 retrograde metamorphism occurred after the end of compressional tectonism. The correlation of the metamorphic study and the sequence of deformation suggest that significant folding in this part of the Central Maine Terrane occurred during the Alleghanian Orogeny.

GLACIAL-MARINE AND GLACIAL LACUSTRINE SEDIMENTATION IN SEBAGO LAKE, MAINE: LOCATING THE MARINE LIMIT

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The marine limit in Maine marks a sea-level highstand at approximately 13 ka. It was inferred to cross Sebago Lake near Frye Island by Thompson and Borns (1985) on the Surficial Geologic Map of Maine, dividing the lake into a northern glacial-lacustrine basin and a southern glacial-marine basin. This study examined the accuracy of the mapped marine limit in the lake and the nature of glacial-lacustrine and glacial-marine facies in Maine. Recognition of the marine limit is usually based on mapped shorelines, glacial-marine deltas, and contacts with glacial marine sediments. This study, in Maine's second largest lake, collected 100 kilometers of side-scan sonar images, 50 kilometers of seismic reflection profiles, and one core. Side-scan sonar records show coarse sand and gravel and extensive boulder fields at an inferred grounding-line position near Frye Island, where the marine limit was drawn. ORE Geopulse seismic reflection profiles reveal a basal draping unit similar to glacial-marine units identified offshore. Later channels cut more than 30 m into the basal stratified unit. In addition, till and a possible glacial-tectonic grounding-line feature were identified. Slumps and possible spring disruptions are found in several locations. The top unit is an onlapping ponded Holocene lacustrine unit. Total sediment is much thicker in the southern basin; the northern basin, >97 m deep, north of the marine limit appears to have been occupied by an ice block. Retrieved sediments include 12 meters of rhythmites. Microfossil identifications and dating will resolve the environments and time of deposition in this core.

PARTICLE CLASSIFICATION AND CHEMICAL ANALYSIS OF BOTTOM ASH FROM A HAZARDOUS WASTE INCINERATOR IN SAUGET, ILLINOIS.

KILLEEN, KELLY J., Department of Geology, Bates College, Lewiston, Maine, 04240

A study was conducted of a suite of hazardous waste bottom ash samples produced during the primary incineration process at a rotary kiln incinerator in Sauget, Illinois. Techniques used were petrography with an optical microscope and chemical analysis with a scanning electron microscope (SEM) that is equipped with an energy dispersive spectrometer (EDS).

Twelve different ash particles were classified according to size, shape, mineralogy and texture. X-ray maps were produced of representative particle types in order to determine their chemical content and to verify crystal phases identified through light microscopy.

Rounded quartz and plagioclase grains observed are most likely byproducts of contaminated soils burned in the incinerator. The only particles of concern for potential disposal problems are of Type 7, where there is a large amount of surface area available for leaching, and heavy metals such as Cd, Zn, Ni, Cr and Cu have been detected.

STRIKE-SLIP TECTONIC OF MIOCENE AGE IN THE BEAUFORTIN (WESTERN FRENCH ALPS).

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The Beaufortin constitutes the northern part of the Belledonne Massif, which belongs to the pre-Triassic basement of the Hercynian external crystalline massifs. A thin belt of cover rocks (the so-called "synclinal median") oriented N40E separates the Belledonne Massif into internal and external portions.

Many workers have emphasized the role of thrust deformation directed E-W during the Tertiary in the western Alps. But areal photographs and field observations show abundant strike-slip faults cutting into the crystalline basement and its Mesozoic cover.

Striated fault-planes studied in outcrops are synthetic faults (N60E), antithetic faults (N150E) and normal faults (N85E). The faults are interpreted as "Riedel" R and R' and T faults, connected with the movement of a (N40E) lineament.

Field work shows that the stretching lineations are defined by the boudinage or elongation of pre-tectonic objects and a preferred orientation of the minerals as the result of ductile deformation in the context of simple shear. The stretching lineation map shows a very regular pattern (N140E) which is consistent with the model proposed. In the shear zones, S-C mylonites are well developed and the average orientations of the S-C fabric and the stretching lineation defined by elongate augen indicates dextral shearing.

The synclinal median evolved from west-directed thrust to northward strike-slip during the Miocene; and is associated with Chamonix suture and Simplon dextral faults.

THE BEDROCK AND STRUCTURAL GEOLOGY OF TUCKERMAN RAVINE AND BOOTT SPUR IN THE PRESIDENTIAL RANGE, N.H.

MACONOCHIE, Jenna-Marie, Dept. of Geology, Bates College, Lewiston, ME 04240

Detailed mapping has been done of the polydeformed, lower sillimanite grade, metasedimentary rocks in the southeast part of the Presidential Range, N.H. These rocks are part of the Central Maine Terrane of the northern Appalachians. Folding and metamorphism is thought to be related to the Acadian and Alleghanian(?) orogenies.

The Silurian Rangeley Formation, the oldest unit, is a schist and quartzite that has been divided into three members based on the degree of migmitization and presence of calc-silicate pods. The next unit is the Silurian Smalls Falls Formation, which is a rusty schist. Overlying this is the Silurian Madrid Formation, a well layered calc-silicate granofels. On top of the sequence lies a thick section of schists and quartzites of varying thicknesses and relative abundances. This section has been divided into nine members that form the lower Devonian Littleton Formation. The stratigraphic order of the Littleton members is well defined by excellent graded beds.

An early macroscopic fold, F1, dominates the area. The fold faces southeast and is interpreted to verge in the same direction. Bedding, S0, is parallel to an axial planar surface, S1, in all areas except where fold hinges are found. L1 pseudo-andalusite lineations parallel to this axis are related to this folding. Asymmetric, east vergent, F2 folds are abundant, with an associated axial planar cleavage, S2. Pegmatite veins are folded by F2 suggesting that the igneous bodies predate F2 folding. Evidence for later stage F3 folding exists as map scale swirls of S0 and S1.

CHEMICAL AND PETROGRAPHIC ANALYSIS OF BOTTOM ASH FROM A MUNICIPAL WASTE INCINERATOR

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Bottom ash from a municipal waste incinerator was studied in order to understand the petrography and chemical components of the ash particles. Eight thin sections of the bottom ash were analyzed. The petrographic analysis was conducted using an optical microscope. The chemical analysis was conducted using a scanning electron microscope (SEM) equipped with a energy dispersive spectrophotometer (EDS).

Nine particle types were identified using the optical microscope. The particles were classified according to the percentages of clear glass, isotropic (black) glass, epoxy-filled holes, gas bubbles, minerals, micro-crystalline structures, schlieren patterns, and granular-like particles. The predominant particles were glass slags produced during incineration. The micro-crystalline structures within these glass slags were also abundant.

Chemical analysis with the SEM-EDS system was conducted on the glass slags and micro-crystalline structures, as well as some of the other particles. The x-ray maps indicate that the glass slags are composed of aluminosilicates and iron oxides. The aluminosilicate present is mullite and the iron oxide is magnetite.

The proposed mechanism for formation of these minerals in the glass slag is that mullite forms first during combustion. The formation of magnetite is believed to be from the molten silicates dissolving hematite or pyrite and precipitating magnetite crystals. This suggests that the temperature of incineration is approx. 1700 °C. The results of this study corroborate with other studies done by Vehlow et .al. (1992) and Hansen et. al. (1981).

SOLUTE TRANSPORT OF CONSERVATIVE THROUGH A SATURATED SOIL COLUMN

Marshall, Ross Kenyata, Geology Dept. Bates College, Lewiston, ME 04240

This experiment focuses on the breakthrough parameters of a miscible displacement experiments. Transport parameters found from solute displacement were calculated with CXTFIT (Parker and van Genuchten, 1984). CXTFIT is a curve-fitting technique that estimates transport parameters from the observed effluent curve.

Chloride and bromide may not be the best tracers to choose to mimic ground flow. There is evidence that these tracers experience slight retardation, which may be attributed to the tracer ions sorbing with certain minerals in the column.

The results from the experiment indicates that the fluctuation of dispersion can be attributed to the apparatus. In future research it will be necessary to experiment with different apparatus to determine which one will minimize dispersion.

ICE AND SNOW AVALANCHE PATHS ON MT. KATAHDIN, MAINE.

MELICK, ROGER A., Geology Dept., University of Maine, Farmington, Maine, 04938; LINDSAY, Scott ,University of Maine, Farmington; White, Charles, University of Maine, Farmington.

Snow and ice avalanche paths within North Basin, Great Basin, South Basin and along the south facing slopes of Baxter Peak, the "Knife Edge", Pamola Peak, and Keep Ridge are mapped using remote sensing methods and confirmed by field reconnaissance. Mapped avalanche paths are characterized as being primarily snow or primarily snow-ice in nature.

In November of 1991, aerial photographs of the Mt. Katahdin region of central Maine (taken during the month of November) were viewed. Of interest were the linear features extending from treeline well into the glacial cirques, locally called "basins". These features were suspected to be avalanche paths and landslide scars. A need to identify, locate, confirm and map these features was anticipated by the interpreters, as Katahdin is a mecca for outdoor enthusiasts and scientists from around the globe; the avalanche phenomena presents both a hazard and an enigma for study. This report and map are an attempt to place known and possible avalanche paths on an accurate, readable map, in order to inform the scientific community where avalanche hazards exist on Katahdin and that areas of future study await.

THE EFFECTS OF LAND USE ON NONPOINT SOURCE PHOSPHORUS LOADING IN THE HIGHLAND LAKE WATERSHED, BRIDGTON, MAINE

ORDWAY, Laura, Department of Geology, Bates College, Lewiston Maine, 04240

Phosphorus is a major component of our natural environment. Phosphorus is crucial to the balance among the producer, consumer, and decomposer parts of the biocycle. However, lake water quality is threatened when excessive amounts of phosphorus are introduced into the watershed. Nonpoint sources of phosphorus, such as storm water runoff from urban land development and private homes, contribute excessive amounts of phosphorus to the waters. When phosphorus concentrations reach 15 to 20 ppb it can create an algal bloom which, if maintained, can accelerate the natural aging of the lake, threaten species that depend on the lake for their habitat, and destroy the water quality of the lake.

The effects of this phosphorus loading in Highland Lake were evaluated for this study. The private property, roads and hydrologic features of the watershed were manually mapped and then digitized on a Geographic Information System (GIS) at the Portland Water District. The water quality in Highland Lake was evaluated using dissolved oxygen, water temperature, transparency and total phosphorus levels. The maps and water quality data were used to model present and future phosphorus loading in the lake. Phosphorus levels were seen to increase with the increased development in the watershed. It is recommended that the town of Bridgton continue with it's land utilization management, which restricts high phosphorus loading activities, to ensure the health of Highland Lake.

Lithofacies logging and interpretation of a Late Wisconsinan, glacialmarine ice-contact landform, in the Androscoggin River Valley, Lewiston, Maine.

Slayton, Jeremy T., Department of Geology, Bates College, Lewiston, Maine 04240.

Numerous exposures in ice contact deltas and glacial marine fans in the lower Androscoggin Valley of S. Central Maine detail a history of the Wisconsinan ice sheet retreat in contact with marine waters ca. 12,000 to 13,000 years B.P. The ice contact deltas and fans probably form by many similar processes and have common stratigraphic sequences that are represented by a facies of poorly sorted gravelly sand and boulder in ice proximal regions, by coarse to fine bedded sands in medial regions and terminating in the ice-distal region in beds of silty clay.

This study investigates the sediments and stratigraphic relationships in a glaciomarine fan complex in the Lewiston, Maine area. The study focusses on a composite landform that is triangular in map view and encompasses approximately 1 km^2. The model proposed for the formation of the studied complex is that of a fan formed when ice sheet retreat is halted by a bedrock topographic high. Low discharge early in the development of the complex result in coarse gravels deposited proximal to the fluvial source, and flanked laterally by plane-bedded medium to coarse sands. In addition, low discharge causes sediments to accumulate in the esker tube, forcing the esker tube to increase in elevation. Aggradation of sediments, and increased flow result in vertical growth of the fan until it reaches the sea surface at the marine limit (approximately 335 feet). Extensive south-dipping coarse gravelly sands interpreted as deltaic foresets complete transformation of the fan into a delta. Progradation occurs until further ice retreat from the study area.

CONFIGURATION OF THE WATER TABLE ALONG AN ESKER-WETLAND MARGIN AT HORSE POINT, MAINE

Barrett L. Smith, Paul K. Doss, Dept. of Geol., Colby College, Waterville, ME 04901

A network of shallow piezometers, staff gauges, and a rain gauge were installed in and adjacent to the Great Bog near the Horse Point Esker in Belgrade, Maine during summer 1992. Water levels were measured to determine the configuration of the water table along the margin of the wetlands. Chemical field parameters were measured for samples of ground water and precipitation, and analyses for major cations and anions is in progress

The water table is consistently higher in the wetlands than in the adjacent esker deposits, suggesting that the wetlands function as a recharge zone or are hydraulically isolated from the surrounding groundwater system. The esker-wetland margin may be a discharge point for both upland groundwater and wetland waters. Wetland water levels respond immediately to precipitation events while upland water levels do not; groundwater levels in the esker sediments did not rise in response to rainfall suggesting that infiltration in upland areas recharged the soil moisture reservoir. Groundwater flow reversals are rare and are only observed parallel to the wetland margin. Additional monitoring is needed to more completely characterize the configuration of the water table along the esker-wetland margins.

Preliminary data suggest that the wetland water and the adjacent ground water have different geochemical signatures.

A NEW ANALYTICAL TOOL FOR CORRELATING SEDIMENTS IN COMPLEX DEPOSITIONAL ENVIRONMENTS

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Much of the greater Brunswick, Maine area is covered by massive deposits of medium to fine grained sand which appear visually similar. Wt. % comparisons of phi intervals in samples from an erosional river terrace showed consistent numerical relationships which were not apparent on probability graphs. These relationships are expressed as $(A\text{-}B)^{1/3}$, where A is the wt. % at a 1/4 phi value and B is the wt. % at the previous1/4 phi value. When plotted along a linear 1/4 phi scale the resulting graph shapes were consistent among the terrace samples.

Prior to the application of this technique, these deposits were considered the erosional remains of a laterally and vertically continuous glaciomarine fan assemblage. Comparison of the terrace sample graphs with those from nearby localities suggest different origins. Subsequently identified constructional and erosional sedimentary structures support this interpretation.

Graphs of additional samples enabled sand units to be constrained and mapped both horizontally and vertically, aiding in the reevaluation of the local depositional environment. Graph shapes are consistent from proximal to distal portion of the deposits, while variations in amplitude recorded accumulation or depletion of grain sizes.

EFFECTS OF THE OCTOBER 30, 1991 STORM ON THE DUNE AREA OF SEAWALL BEACH, BATES-MORSE MOUNTAIN CONSERVATION AREA, PHIPPSBURG, ME.

SNYDER, Noah P., Dept. of Geology, Bates College, Lewistion, ME 04240.

Seawall Beach is a 2.2 km long, undeveloped, south facing barrier spit. It is located south of Bath, ME, near the mouth of the Kennebec River. The beach consists of well-sorted, fine-grained quartz sand. Morse Hill, a rocky headland, forms a natural division on the beach. The storm of October 30, 1991 caused extensive erosion on Seawall Beach, and other coastal areas throughout the eastern seaboard.

Detailed topographic mapping (at 1:600) of the dune area on Seawall Beach was undertaken to determine the extent of overwash deposits, the line of maximum storm wave penetration into the dune area, the vegetation and scarp edges, and the elevation of the current and relict frontal dune ridges. In addition, sediment samples were taken to compare storm overwash deposits with dune and berm sands. Also, the ongoing study of beach and dune changes was continued by surveying beach profiles at different stages in the yearly cycle.

Unlike other local and regional beaches, minor overwash deposition occurred at Seawall Beach as a result of the October 1991 storm. The only measurable overwash was a sandy fan deposit approximately 100 m^2 with a maximum thickness of 10 cm. The lack of overwash can be explained by the presence of a well-developed frontal dune ridge which dissipated wave energy along most of the beach. The ridge averages 1.5 m in height above the berm, although it is virtually nonexistent near the overwash fan. When the ridge is well-developed, the storm waves were largely unable to breach it, defining a relatively stable shoreline equilibrium position. A 15.2 m^3 unit volume of sediment was excavated from the berm and frontal dune ridge on the eastern section of the beach. The western section suffered minor scarping of the ridge and erosion of the berm. The storm of December 12, 1992 continued the erosion, scarping the frontal dune ridge over the entire beach.

The recent sequence of storms including December 4, 1990, October 30, 1991 and December 12, 1992 has flattened the protective berm, and brought Seawall Beach into a phase of frontal dune ridge erosion. The current dune ridge may be destroyed in the event of another major storm. The shoreline position, currently being cut back, will not re-equilibrate until eolian transport builds a new dune ridge out of a storm scarp.

THE FATE OF ALUMINUM SULFATE IN COCHNEWAGON LAKE, MONMOUTH, MAINE

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In June, 1986, Cochnewagon Lake was treated with aluminum sulfate and sodium aluminate to remove phosphorus from the water. As a result of this treatment, phosphorus concentrations in the lake decreased from about 20µg/l to about 10µg/l, algal blooms were eliminated and the water clarity improved.

Water and sediment samples were taken in the fall of 1992. Trace amounts of aluminum and phosphorus were found in the water column. The sediment samples were highly bioturbated and dark brown-gray in color. After the removal of water and total organic matter, the cores showed a color gradation from light red-gray at the surface to dark gray at 8 cm. depth.

The lack of aluminum in the water column and the color gradation in the cores indicate that aluminum concentrations in the sediments may have increased. Preliminary SEM-EDX studies show that the calcium and sulfate correlate positively in the sediments. Phosphorus and aluminum do not show a correlation in the sediments perhaps due to the high aluminum content of clay minerals.

FAUNAL IDENTIFICATION AND PALEOECOLOGICAL RECONSTRUCTION FROM A MICROFOSSIL SITE IN THE MIDDLE OLIGOCENE WHITE RIVER GROUP, SIOUX COUNTY, NEBRASKA.

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Small vertebrate fossils are generally very poorly known. One method of obtaining these little known specimens is to collect anthills from fossiliferous areas The site I am investigating is a harvester ant mound located on a productive layer of the Orella member of the Brule Formation, which has been dated at approximately 31 my. Due to the fact that the 7kg of material was collected by insects, the largest particles are between 5-7mm in diameter. Thus the fauna represented in this sample represents only the smallest organisms preserved in the mudstones of the Brule Formation.

The Oligocene epoch represents a time of great ecological change on the Great Plains. The evolution of grasses and drying of the climate due to the uplift of the Rocky Mountains had significant effects on the tertestial fauna of this age. The area was changing from a forested woodland area to the grasslands that cover the region today. The collection of small animals from this site supports these conclusions. There is a mix of grassland forms such as rabbits and burrowing rodents and woodland organisms, opposums and moles. The greatest diversity occurs in the rodents with at least 6 families represented, followed by 3 families of insectivores. Comparisons with previous studies of faunas from the region from different time periods allows for the study of paleoenvironmental change and long term evolutionary trends.

GEOPHYSICAL EXPLORATION AND HYDROLOGIC IMPACT OF THE CLOSED GRACELAWN LANDFILL IN AUBURN, ME.

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Several geophysical methods were used over portions of the Gracelawn landfill, in Auburn, Maine to determine the surface boundaries and subsurface structure of this closed landfill, and to determine the landfill's effects on groundwater quality. The landfill was originally a sand and gravel pit excavated in the 1950's and early 1960's, and was used as a landfill from 1964-1977. The site is unlined, has a clay cap, and has been graded and developed as a baseball park.

Two seismic refraction lines were performed to obtain a thickness of dry refuse of 17.6 meters. Seismic velocities of methane gas-saturated trash ranged from 250 to 310 m/s, and sand velocities were approximately 800 m/s. Three electrical resistivity Wenner surveys over the trash yielded a depth to saturated material and thickness of the trash layers. Resistivity values for dry refuse ranged from 2500-3500 Ω•m. A fourth electrical resistivity survey yielded the thickness of unsaturated and saturated sands bordering the landfill. Dry sands were found to have resistivities in the range of 3000-3300 Ω•m, and saturated sands resistivities ranged from 150-1500 Ω•m. A generalized cross-section was constructed based on data from the seismic and resistivity traverses and published site research. Magnetic survey grids across the site revealed anomalies which were mapped to illustrate the irregular morphology of the buried trash as well as its surface boundaries.

Groundwater elevations determined by the geophysical survey, combined with a survey of existing water monitoring well logs, indicate that the groundwater flow in the sand and gravel aquifer is to the southeast, away from the public water supply, Lake Auburn, which lies to the north of the site. However, correlations between the bedrock fracture analysis and the geophysical survey illustrate that there is potential for contamination of Lake Auburn via the bedrock aquifer.

HIGH ARCTIC GLACIAL MARINE SEDIMENTS, CENTRAL TACONITE INLET, NORTHERN ELLESMERE ISLAND, CANADIAN ARCTIC ARCHIPELAGO

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Fiords of Northern Ellesmere Island contain unique glacialmarine sediment records which document changes in circulation patterns with the Arctic Ocean, isostatic rebound, and ice shelf growth since the last glacial maximum ca. 9,500 B.P.

Presently, Central Taconite Inlet is a permanently ice covered basin free of glacier ice. The major sediment flux into the basin consists of valley-train outwash deposits carried by Taconite River into the head of the basin. Temperature, oxygen, salinity, and transmissivity profiles reveal a partially stratified water column, and indicate that sediment enters the basin as an overflow plume.

A 1.55m sediment core records the the events following the retreat of glacier ice out of the basin. The core contains 60cm of till with striated pebbles overlain by a 35cm structureless benthic foraminifera bearing silty clay unit. The marine unit is followed by a 15cm sequence of black sulfide stained layers indicating oxygen depletion. Overlying this unit is 45cm of cyclically laminated brown silty clay sediments.

Textural composition of the diamicton and local raised deltaic sequences of interbedded diamicton, sand, and silt suggest a warm-based thermal regime associated with glacier ice at the time of deglaciation. Grain size analysis of the upper units reflects little change in sedimentation rates following deglaciation to present. Thus, changes in depositional conditions of the basin are largely interpreted by changes in the sedimentary structure, organic content, and microfossil content. It is concluded that the structural and compositional variations associated with the units of core CTI92-III may be responses to early Holocene land emergence following deglaciation and Holocene climatic fluctuations.

SUGGESTED READINGS FOR THE GSM 1993 SUMMER FIELD TRIP

Maine Geological Survey
Studies in Maine Geology: Volume 6
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Late Wisconsinan Glacial and Glaciomarine Sedimentary Facies in the Lower Androscoggin Valley, Topsham, Maine

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ABSTRACT

A facies model is proposed for late Wisconsinan glaciomarine deposits in the lower Androscoggin Valley that includes four lithofacies assemblages that are defined by morphology and detailed stratigraphic and sedimentologic analysis. The end moraine facies assemblage includes subglacial and resedimented diamicton, and interbedded and locally deformed sand and gravel beds. The sediments form linear ridges which are former grounding line positions of the tidewater glacier margin. The submarine outwash fan facies assemblage commonly drapes or flanks the end moraine assemblage. In proximal regions of the fan, gravel, bedded sand, and diamicton lithofacies predominate and represent rapid deposition at the mouth of the meltwater tunnel by fluvial and mass flow processes. Distal and lateral to the ice margin, fan sediments consist of graded and cross-laminated sands deposited by underflow currents and slump-generated turbidites interbedded with rhythmically bedded silt attributed to suspension deposition from overflow or interflow plumes. The submarine plain facies assemblage is laterally and distally transitional with the submarine fan assemblage and consists of apparently massive, structureless fine-grained sediments deposited from suspension. The shallow marine facies assemblage consists of well-sorted tidal to subtidal sand lithofacies, poorly sorted gravelly and bouldery lag deposits on moraine crests, and lagoonal muds. Collectively, these lithofacies were deposited as a result of reworking previously deposited sediments during isostatic emergence.

Maine Geological Survey
Studies in Maine Geology: Volume 4
1989

Geology and Geochemistry of the Rattlesnake Mountain Igneous Complex, Raymond and Casco, Maine

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ABSTRACT

Early Jurassic igneous rocks exposed in Casco and Raymond, Maine, intrude quartz monzonite and migmatite of the Carboniferous Sebago pluton. Northeast-trending dikes of trachyte, nepheline trachyte, and minor lamprophyre emanate from, but in part predate, the spatially associated silica saturated and undersaturated alkali syenites of the Rattlesnake Mountain pluton. These rocks, termed the Rattlesnake Mountain igneous complex, are assigned to the White Mountain magma series on the basis of age, mineralogy, and texture and constitute the most easterly known occurrence of this distinct petrotectonic suite.

Several bodies of syenite are distinguished by texture, abundance, and proportion of ferrohastingsite and biotite, and abundance of nepheline. In order of decreasing relative age these are: melanocratic syenite, medium-grained biotite-ferrohastingsite syenite, coarse-grained ferrohastingsite syenite, fine-grained chilled syenite, nepheline-bearing syenite, and nepheline syenite.

Compositions of trachyte and nepheline trachyte closely parallel those of ferrohastingsite syenite and nepheline-bearing syenite, respectively. However, correlated variations in Sr and Rb abundances and in Ba/Sr values define one group of rocks that contain cumulus alkali feldspar, e.g. ferrohastingsite syenite. Compositions of a second group are representative of residual liquids and require removal of alkali feldspar, e.g. nepheline syenite and dike rocks. The variations of Sc and LREE abundances in the plutonic rocks require fractionation or accumulation of minerals, e.g. amphibole ± sphene and apatite, that have partition coefficients >1 and that preferentially incorporate the HREEs. These chemical data are consistent with the accumulation or fractionation of alkali feldspar, amphibole, and accessory minerals such as sphene and apatite. The presence of alkali feldspar and hornblende as phenocrysts in dike rocks supports this conclusion.

Outcrops of melanocratic syenite are observed to be mechanical mixtures produced by the intrusion of syenitic magma into rocks of lamprophyric composition. Major and trace element abundances generally fall on a simple mixing line between these two end member compositions.

Sr isotopic data from the pluton (Creasy, 1988) indicate an Sr initial ratio of 0.7027. This requires derivation of the syenites from melts of strongly depleted mantle or by partial melting of Rb depleted lower crust (mafic granulite ?).

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Correspondence about membership in the Society should be mailed to Marc Loiselle, Maine Geological Survey, State House Station 22, Augusta, ME 04333.
Items for inclusion in the newsletter may be directed to Susan Corderman Weddle, 11 Beech Drive, Brunswick, ME 04011.

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