THE MAINE GEOLOGIST

NEWSLETTER OF THE GEOLOGICAL SOCIETY OF MAINE

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THE PRESIDENT'S MESSAGE

Spring Meeting 2004. Thank you to Irwin Novak and USM for hosting this year's Spring Meeting and making sure that everything ran so smoothly. As usual, the student presentations were very impressive and our judges, Sean Dougherty and Rob Peale, had a difficult time deciding on a winner in each category. This year's Walter Anderson Award recipients were Ted Levesque (UMF) for his poster entitled "A cold-water, carbonate-rich sand beach: Cape Freels, north-east Newfoundland," and Aaron Putnam (Bates College) for his talk entitled "Recent sedimentation of a transect of high arctic isolation basins, southern Queen Elizabeth Islands Archipelago, Nunavut, Canada." Congratulations to you both.

Summer Meeting. This year's summer field trip is scheduled for July 24th and 25th. Venues include Laudholm Beach at Wells, and the bedrock and surficial deposits in the Lebanon, Maine area. See the announcement on page 2 for details.

Fall Meeting. Kristin Tardif of Poland Spring has graciously offered to host this year's fall meeting. Once again, this year's meeting will focus on the consulting sector and applied geology. Geologists from a variety of Maine's regulatory and resource agencies will be asked to make a 20-minute presentation about their work, followed by a 10-minute question-and-answer period. The talks will be aimed at the generalist, whereas the Q&A portion will be structured for the specialists. Once again, the aim of the meeting is to generate more cross-talk among the disciplines and a better understanding of what each of us does. Anyone wishing to hear about a specific resource, or interested in giving a talk, should contact me.

New Officials. Liz Champeon is the newest member on GSM's Board of Directors. Liz will be replacing Joe Kelley whose term expired in December 2003. Thank you Joe for your time and effort. Also, nominations are presently being sought for Vice Presidential candidates for the 2005/2006 term. Please contact the Nominating Committee (see www.gsmmaine.org for contact information) if you are interested.

GSM Website. The GSM webpage has been significantly updated and includes several new features, such as an overview of Maine geology and the Photo-of the-Month. Other areas, such as the Publications for Sale page and a revision of the current links are still in development, but will be uploaded in the near future. Any institution or organization with ties to Maine geology whose webpage is not currently on the links page, and would like to be added, can send the information to me at paleo@gwi.net. One of our goals is to structure the website as a "kiosk" of sorts for Maine geology. Please take a moment to check it out and let us know what you think.

Lisa Churchill-Dickson, President (2002-2004) paleo@gwi.net

Corrections – in the March Newsletter we incorrectly cited **Steve Kelley** for the Fall Meeting 2003. In fact it was **Dave Andrews** of URS who spoke about his work concerning a dam at an out-of-state superfund site, formerly a massive mining operation. While Steve said that he was happy to take the credit for it, we still agreed it should go to Dave. So, thank you Dave for a great presentation on the superfund site, and we apologize for the mix-up.

Also, in footnote *7 of the Bylaws, the change was accepted in November of 2003 (not 2004, of course).

THE EDITOR'S MESSAGE:

Please send any items from individuals, schools or organizations for inclusion in the Newsletter to my e-mail address. Thanks.

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

GSM WEBSITE

www.gsmmaine.org

The GSM website contains copies of present and archived Newsletters, a calendar of events, and other items of interest to the Society, including the updated Bylaws. There are many important links to geology items in Maine and elsewhere. Mike (webmaster) and Lisa have just completed some major changes to the GSM website. Some of the new features include a page on Maine geology and the Photo of the Month. Other changes remain to be done, including the posting of the Short Course Notes, updating the links page and getting a list of publications for sale

online, but we think it represents a good first step. Let us know what you think.

Webmaster, Mike Lerley <mike@rentageekme.com>

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UPCOMING GSM/GSNH Joint Summer Field Trip 2004 *Surf and Turf*

Shore of Maine to the White Mountains Saturday and Sunday July 24-25

Back by popular request, GSM and GSNH are running another joint field trip this summer. The trip is scheduled for the weekend of July 24'th and will begin Saturday morning with a fieldtrip to Laudholm Beach at Wells National Estuarine Research Reserve led by Steve Dickson. Later that morning, Peter Thompson will give us a preview of his NEIGC fieldtrip and show us some of the work he has done while mapping the bedrock in the Lebanon, ME and Milton, NH region.

Wells, Lebanon and Acton, Maine

Saturday, July 24th 8 to 8:30 a.m. - assemble in the auditorium (in the barn) at Laudholm Farm on the Wells National Estuarine Research Reserve in Wells, Maine. See http://www.wellreserve.org/ for directions to the Reserve.

8:30 - 11 a.m. – *Maine Coastal Barrier Beaches and Dunes: Past, Present, and Future* - Steve Dickson. A walking transect from Laudholm Farm across a glacial upland to a back-barrier salt marsh, coastal sand dunes, and beach will explore the geomorphology, stratigraphy, and coastal processes that have shaped and continue to change the dynamic beach environment.

11 a.m. –12 p.m. - regroup and travel to Peter Thompson's area; eat lunch in transit.

Meet at the Park-n-Ride area on the west corner of the intersection of Rte.202 and Little River Road in East Lebanon (stoplight). Ice cream bars and drinks may be purchased at the general store next to the parking lot.

12 - 4 p.m.- *Overview of Geology in Lebanon and Acton, Maine* - Peter Thompson. The trip will focus on exposures of the overturned bedrock stratigraphy (Rindgemere, Gully Oven, Towow, and Madrid and Littleton equivalents) at sillimanite grade, include a visit to an abandoned silver mine, and explore some Quaternary deposits: moraines, an esker, and boulder fields.

5 to 5:30 p.m. - Meet back at the Wells Reserve.

6 – 7:30 p.m. - Catered dinner* in the auditorium at the Wells Reserve.

Saturday night Lodging – The Wells Reserve has graciously offered 20 tent sites, free of charge, for Saturday night. Reservations are on a first-come, first-serve basis. People interested in this option can contact Lisa Churchill-Dickson at paleo@gwi.net. Otherwise, there are a variety of campgrounds and motels in the area that are also available.

Sunday, July 25th 8:30 a.m. - Continuation of *Overview of Geology in Lebanon and Acton, Maine* - Peter Thompson. Trip starts at Park-n-Ride area on the west corner of the intersection of Rte.202 and Little River Road in East Lebanon (stoplight).

Trip will focus on additional outcrops of Littleton in Maine, then Art's "Gonic" in North Berwick, before crossing the river into NH.

Menu

Teriyaki Chicken Breasts	Sirloin Kabobs
Crab-Stuffed Mushrooms	Garden Salad
Potato Fresh Vegetable	Rolls and Butter
Coffee	Soda, juice, water

For more information, contact either Lisa Churchill-Dickson (paleo@gwi.net) or Tom Weddle (Thomas.K.Weddle@maine.gov). Hope to see you there!

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THE STATE GEOLOGIST'S MESSAGE

The National Cooperative Geologic Mapping Program is currently before the House of Representatives (HR 4010) and the United States Senate (S. 2353) for reauthorization and will benefit from your support! If you feel as strongly as I do that the nation needs modern geologic maps to address numerous societal issues (water resources, environmental protection, natural hazards, etc.) then please contact your representatives and request that they co-sponsor these bills. You can review information about the program plus some fact sheets at http://www.state.me.us/doc/nrimc/mgs/mgs.htm.

Some important points about the National Cooperative Geologic Mapping Program

- The Program was created with the passage of the National Geologic Mapping Act of 1992. Since that time, the program has produced more than 7,500 new geologic maps nationwide.
- The National Cooperative Geologic Mapping Program has been reauthorized in 1997 and 1999, each time by unanimous consent of Congress and with strong bipartisan support, attesting to the success of the program.

- Only 25% of the Nation is mapped in the detail necessary to address important societal issues.
- Rigorous economic analysis demonstrates that the value of geologic maps exceeds their cost of development by at least a factor of 25.
- The program is an excellent example of federal/ state partnership. State geological surveys are awarded federal funds through a rigorous competitive process that ensures the relevancy of the mapping and must match federal funds dollar-for-dollar.

In Maine:

- Only 15% of Maine has the detailed map coverage necessary to address issues of water resources, environmental protection, and risk reduction from natural hazards, among others. 50% of Maine is unmapped at even an intermediate scale.
- Over the past decade the program has contributed over $500,000 to creating more than 70 new geologic maps in areas of important societal need.
- Geologic maps provide the underpinning necessary to address such important issues as landslide risk (e.g. Rockland), coastal erosion (e.g. Camp Ellis), and groundwater issues. For example:
- More than 50% of our citizens rely on groundwater sources for their domestic water supply. Mapping the characteristics of the bedrock is critical to understanding groundwater quality, quantity, and strategies for protection.
- Mapping surficial geology is the first step in identifying sand and gravel aquifers, among the most significant groundwater resources in the state for municipal water supplies, irrigation, bottling, etc.
- Surficial geologic mapping establishes the distribution of glacial-marine mud, the deposits most susceptible to landslides.
- The program has doubled the mapping budget of the Maine Geological Survey.

Contact your representatives

Letters and phone calls to our congressional delegation from constituents who use geologic maps are far more effective than messages from a bureaucrat like me. However, I am pleased to inform you that on my request Congressman Tom Allen has agreed to co-sponsor HR 4010! Please thank him for his support! Check our web pages for contact information for our Congressman and Senators. The time to act is now!

Thanks for your continued support.

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

GSM MEMBER NEWS

Walter A. Anderson, founding member and past President of GSM, received an Honorary Doctor of Sciences degree from the University of Maine on May 8, 2004. Walter was nominated by the Department of Earth Sciences at UM, and confirmed by President Peter Hoff and the UMS Board of Trustees. Walter received his B.S. in Geology from the University of Massachusetts in 1954 and his MS in Geology from the University of Rochester in 1956. He worked in the petroleum industry for Texaco, Inc., as an Exploration Geologist from 1956-1957 and Exploration Geologist and Development Supervisor from 1959-1969. He was a Research Associate at Pennsylvania State University in the interim, 1957-1959. Walter joined the Maine Geological Survey in 1969 as Assistant State Geologist, and served with great distinction as Director and State Geologist from 1979 to his retirement in 1995. Walter holds Maine Certified Professional Geologists certificate # 4. He was a leader of many state and national initiatives, including the US Nuclear Regulatory Commission projects that assessed Maine as a site for high- and low-level nuclear waste repositories. Other federal and state-funded initiatives included assessment of Maine's peat, aggregate, and hard minerals; hydrological, coastal and geohazards studies; and several educational initiatives. Walter was a major force behind the present Bedrock and Surficial Geological Maps of Maine. He is co-author of 33 scholarly publications. In addition to this strong record of intellectual accomplishments, Water has also been a prime advocate for the partnerships between MGS and academic institutions in the state, including UM, and with many diverse academics and professionals inside and outside Maine. Walter has been an active consultant since his retirement. This is a richly deserved honor, and despite the fact that the call came from President Hoff on April 1, Walter now believes that it is real.

Please send member news to:

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

GSM SECRETARY'S REPORT

Geological Society of Maine Annual Meeting
April 9, 2004,
Bailey Hall, University of Southern Maine
Gorham, ME

Lisa Churchill-Dickson called the Annual Meeting to order at 6:30 p.m. To make up for extra time spent with the poster and oral presentation sessions, the evening schedule was shifted slightly,

with the Business Meeting being held during the dinner hour.

Walter A. Anderson Awards: The high quality of posters and presentations made the decision a difficult one. Well done to all!
Best Poster: Ted W. Levesque, UM Farmington
Best Oral Presentation: Aaron Putnam, Bates College

Website: The GSM website is now managed by "Rent-a-Geek" of Augusta, Maine. The website is currently up to date and will be expanded in the near future. Thank you to those at UMF who previously maintained the website, for the fine job they did.

NEIGC 2004: The 2004 NEIGC is being hosted by Salem State College of Salem, MA. The event is scheduled for October 8th-10th, 2004. GSM will be a sponsor of the event by making a monetary contribution; the New Hampshire Geological Society contributed $300. It was decided, by unanimous vote by meeting attendees, that MGS would donate $300 (or perhaps $301) to NEIG. Conference information is available on the NEIGC website.

USEPA/NGWA Fractured Rock Conference: GSM is co-sponsoring the 2004 Fractured Rock Conference being presented jointly by the US Environmental Protection Agency and the National Ground Water Association. The conference will be held at the Holiday Inn by the Bay in Portland, Maine September 13th –15th, 2004. For more information please see the link located on the GSM web-page.

Fall Meeting: The fall 2004 meeting will be hosted by Poland Spring Co. in Poland Springs, ME. Lisa was to confirm the offer. The format for the meeting will be several (6 to 8) short talks on regulation and resources, with question and answer periods. The hope is that the majority of speakers will be from Governmental agencies, giving attendees an informal opportunity to speak with regulators.

Summer 2004 Field Trip: Lisa announced that the 2004 Summer Field trip will be held in Southern Maine and New Hampshire, jointly by GSM and the New Hampshire Geological Society. Currently, trips are planned in the Lebanon, ME/Milton, NH and Wells Beach areas. Dan Belknap asked for suggestions from society members for lodging/camping locations, as this was yet to be determined.

Future Meetings: Previously, Dan Belknap had suggested that the spring and fall meetings be scheduled by regular rotation. In an effort toward this end, Spring meetings for the next three years have been tentatively scheduled: 2005 at Bates College, 2006 at University of Maine at Presque Isle, 2007 at University of Maine at Farmington.

Board of Directors: Joe Kelley's term on the GSM Board of Directors expired this year. Former GSM treasurer Liz Champeon was nominated to fill the vacancy; no other nominations were brought forth. By unanimous vote, Liz was elected to sit on the GSM Board of Directors.

GSM President: It was brought to attention that Lisa Churchill-Dickson's term as GSM President will be up at the end of 2004. Current Vice President, Tom Weddle will take over as President, beginning in 2005. Nominations for the next GSM Vice President are currently open.

State Geologist's Report: State Geologist, Bob Marvinney, stated that overall the Maine Geological Survey continues to be productive, despite the current economic climate in the State. The Survey will have a full surficial mapping program, this summer, and a double sized bedrock-mapping program, with the addition of USM Geology Professor Steve Pollack. New projects for the Survey include an Acadia area aquifer mapping program and a near shore sea floor mapping program, facilitated by the Survey's newly acquired Near Shore Mapping Vessel. Bob brought to members attention that the Legislative Bill that funds the Geological Survey mapping programs expires in 2004. A new Bill, that would continue funding for the program is being presented this year, Bill # HR4010. Bob asked that all members that value the maps generated by the Maine Geological Survey, particularly those individuals that use the maps in a professional capacity, contact their Representative and encourage her/him to co-sponsor the Bill.

Geology of Maine Book: Dan Belknap talked about the creation of a "Geology of Maine" Book. The GSM Geology Short Course, held October 2003 at Bate College, will serve as the framework for the book. Dan, Joe Kelley and Art Hussey will be the editors. At this point, Dan plans to pursue a private publisher once the manuscript for the book is in place.

Lisa called for a motion to adjourn at 7:00 p.m.

Evening Speaker:
Robert E. Nelson
"The Geology of Ecuador: Analogs for the Silurian of Young New England" or "Young rocks, Younger Rocks & Dirt"

Bob Nelson, Professor of Geology at Colby College, gave a fascinating talk covering his field experiences in Ecuador. While focused on the geology of the region, the presentation touched on everything from flora and fauna to architecture and socioeconomic climate. To illustrate the talk, Bob showed a series of stunning photographs that he took of this beautiful country. The following is a brief summary of the talk provided by the speaker. Thank you Bob!

While it may not be a perfect match for northern New England in the Silurian, modern Ecuador has many features that can find counterparts with the interpreted environments that characterized the Taconic Orogeny. The Galápagos Islands, with their mantle-plume basaltic volcanism including pillow structures, are inexorably being pushed towards the subduction zone off the coast, as the Andes rise to altitudes above 6000 m (20,000 feet).

High stream gradients bring enormous quantities of eroded sediments from the mountains down into the northern end of the Peru-Chile Trench, where they're soon bulldozed back up into weakly cemented strata in the coastal mountains. Compressive stress produces numerous small- and large-scale thrust faulting and complex fold patterns, including overturned isoclinal folds. Highland volcanism from dozens of major volcanic vents (Cotopaxi, Pichincha, Tungurahua, Reventador, Cuicocha, and many others) produces andesitic flows, sometimes many meters thick and with columnar jointing, as well as pyroclastic units sometimes meters in thickness.

On the high volcanic slopes, glaciers extend down to elevations of 4800 m (16,000 feet), making one wonder whether such could have been possible in the Taconic Mountains of the Silurian; these mountains, like modern Ecuador, straddled the Equator.

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

GSM TREASURER'S REPORT

The Society currently has 344 members, distributed as follows:

Associates:	24
Regular:	252
Institutions:	12
Students:	56
TOTAL:	344

Funds as of January 31, 2004

Key Bank CD	$ 5,351.70
Key Bank Checking Statement	$ 7,412.94
Total Funds	**$ 12,764.64**

Receipts 1/31/04-6/02/04

Savings Interest	$ 4.16
CD Interest	$ 92.02
Education Fund Donations	$ 12.00
Anderson Fund Donations	$ 14.00
Short Course Fees	$ 350.00
Receipts Subtotal	$ 1,281.18

Expenses 1/31/04-6/02/04

Student Awards	$ 214.70
Check Order	$ 9.77
Corporation Fee	$ 20.00
Website Fees	$ 149.95
Stamps	$ 7.65
Office Supplies	$ 228.83
Newsletter Printing (Feb. '04)	$ 425.60
Newsletter Printing (Nov. '03)	$ 252.48
Expenses Subtotal	$ 1,436.84

Funds as of June 2, 2004

Anderson Fund Savings	$ 397.29
Anderson Fund CD	$ 5,000.00
Education Fund Savings	$ 885.12
General Fund Savings	$ 6,326.16
General Fund Checking	$ 0.41
Total Funds	$ 12,608.98

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

GSM SPRING MEETING
APRIL 9, 2004
Department of Geosciences
University of Southern Maine, Gorham, ME
ABSTRACTS

[Poster Presentation]

MINERALOGY OF FINE-GRAINED GLACIOMARINE SEDIMENTS, COASTAL MAINE.

BEEM, Lucas H., GRANNELL, Kristen T, McCOOG, Michaela L., RICH, Justin L., WEISS, Holly F., and ZOGBY, Molly R., Dept. Geosciences, Univ of Southern Maine, Gorham, ME 04038. <lhbeem@hotmail.com>

Very fine-grained glaciomarine sediments occur in surface exposures and in the subsurface throughout coastal and interior Maine. These sediments, generally referred to as the Presumpscot Formation, are of variable thickness and are commonly interbedded with sands. Thicker sequences of clay and silt sized sediments are frequently varved. Sediments collected from eroding coastal bluffs, gravel pits and vibracores from Mount Desert Island to Wells, Maine are characteristically >80% silt and clay. Clay - silt ratios vary both within and between localities. These glacial-marine deposits all conform to the definition of rock flour. Bulk mineralogy of both silt and clay-sized fractions consist of quartz, albite, orthoclase, white micas (muscovite and phengite), chlorite and biotite.

Mineral percentages vary with sample location. Mineralogical variation due to grain size tends to include an increased amount of micas in clay-sized portions. Silt-sized portions tend to exhibit increased amounts of quartz and feldspars relative to the micas. Mineralogy also varies between geographic locations. However, this variation does not display an apparent or consistent trend.

[Oral Presentation]

FOLD PROPAGATED FRACTURES IN THE WHITEROCK LIMESTONE: INDICATORS OF REGIONAL STRESS IN WHITEROCK, NORTH CANTERBURY, NEW ZEALAND

BLUM, Jen, Department of Geology, Bates College, Lewiston, ME. <jblum2@bates.edu>

In North Canterbury, New Zealand, joints and faults are the surface expressions of brittle deformation at a transpressional plate boundary. The objectives of this study were to compare brittle structural data in the Miocene Whiterock Limestone, located in Whiterock, to an ideal model for fractures in flexural slip folds to understand the mechanisms of fracturing and faulting. Methods used included air photo analysis, orienting fractures and faults and observing crosscutting relationships. After a synoptic analysis of the data, the field area was divided into four structural domains and the data were evaluated using two fracture models. The relationship between predicted models and measured joint sets and relative age relationship indicate the folds and fractures were formed in the same deformational phase. The azimuth of maximum compression for these features, 125˚, supports previous work in the region and indicates active folding. Thrust faults were associated with local stress caused by folding. Strike slip faults, the youngest structural feature, were associated with the Porters Pass-Amberley Fault Zone, a dextral shear zone striking ENE to WSW. An estimate for the direction of maximum compressive regional stress from the fault orientations is ESE to WSW. This newly forming shear zone marks the initiation of stress evolution and migration of the stress regime towards the southwest.

[Poster Presentation]

STRAIN ANALYSIS OF SYNTECTONIC GRANITE INTRUSIONS EAST OF THE NORUMBEGA FAULT ZONE AT PEMAQUID POINT, MAINE

CASTLE, N., Earth and Environmental Sciences Dept. & Dept. of Chemistry, Lehigh Univ., Bethlehem, PA 18015; HEFFRON, E., Dept. of Geography, Geology and the Environment, Slippery Rock Coll., Slippery Rock, PA 16057; McCOOG, M., Dept. of Geosci-ences, Univ. of Southern Maine; SWANSON, M., Dept. Geosciences, Univ. of Southern Maine; BAMPTON, M., Dept. of Geography & Anthropology, Univ. of Southern Maine, Gorham, ME 04038; mswanson@usm.maine.edu

The Pemaquid Point area of mid-coast Maine is 30 km SE of the main zone of the dextral Norumbega fault system. Regional strain accommodation has resulted in initially orthogonal granites that were rotated CCW to oblique asymmetric boudin strings due to sinistral as opposed to dextral shear. Other granites were intruded along the metamorphic layering and were then elongated parallel to a regional near-horizontal stretching lineation forming symmetric layer-parallel boudin strings. Seven sites within the Pemaquid exposures were mapped using total stations, survey grade RTK GPS, and handheld mapping grade GPS. The data were displayed and edited using ArcGIS and ArcView software. The shear strain calculations determined using β angles (boudin strings relative to the fold limb layering, assuming a simple shear model) yielded an average γ value of 3.02 and ranged from 0.64 to 10.07. Elongation values for the oblique asymmetric granite boudins averaged 209% and varied from 35-520%. The layer-parallel symmetric boudin elongations averaged 178% and ranged from 14-416%. Asymmetric boudin reconstruction yielded an average layer-normal shortening of 50%, ranging from 32%-81% compared to the outcrop string method, which yielded a 60-65% layer-normal shortening. Dextral shear strain estimates from last year's work in the Casco Bay region in closer proximity to the main shear zone, were higher compared to the sinistral shear strain estimates from the Pemaquid study area. The layer-normal shortening values for both study areas are in a similar range. The change in shear sense can be explained by either the oblique fold rotation model (Swanson, 1999) or the lateral (southerly) escape model for a midcoast block between the dextral Phippsburg and sinistral Pemaquid area shear zones during regional strain accommodation associated with dextral Norumbega shearing.

[Oral Presentation]

ORGANIC CARBON DEPOSITION IN LAMINATED SEDIMENTS FROM COASTAL LACUSTRINE AND MARINE ENVIRONMENTS, EASTERN CANADIAN ARCTIC

FELTON, Anna A., JOHNSON, Beverly, J., RETELLE, Michael J., Department of Geology, Bates College, Lewiston, ME. <afelton@bates.edu>

The study of modern processes and past changes in polar regions is critical because of the close linkages of high latitude environments to the global climate system. The terrestrial organic carbon pool of the Arctic appears to have increased in recent times due to the CO_2 fertilization effect brought about by fossil fuels. Little is known, however, about long-term changes in terrestrial carbon cycling under natural climate variations, particularly in coastal lakes and inlets that have undergone glacial-isostatic rebound. Paleoenvironmental proxies, such as microfossil and isotopic analyses, have been useful in reconstructing paleovegetation from these settings. However, recent developments in the use of lipid biomarkers in fossil organic matter may provide a relatively new paleoenvironmental indicator. In this study lipid biomarkers, C/N values and stable carbon/nitrogen isotopic analyses of laminated lacustrine and marine sediments are used to understand changes in terrestrial/marine carbon cycling in arctic coastal sedimentary basin. Undisturbed surface cores were recovered from basins on Cornwallis and Devon Island in the central Canadian arctic archipelago. The core records, spanning approximately the last 500 years allows evaluation of climatic and other environmental influences on organic carbon deposition through the reported Little Ice Age and 20'th Century Warming. Fatty acids from lake sediments are being analyzed to determine distinctive shifts in marine and terrestrial organic deposition through time. The total lipid concentration and C/ N values of open marine basins is significantly higher than values from isolated lakes, indicating higher productivity in the marine environment.

[Poster Presentaion]

SURFICIAL GEOLOGY OF THE RICHMOND QUADRANGLE, MAINE

FROST, Daniel S., Department of Geology, Bates College, Lewiston, ME 04240, dfrost@bates.edu and WEDDLE, Thomas K., Maine Geological Survey, 22 State House Station, Augusta, ME 04333

The surficial geology of the Richmond, Maine, 7.5-minute topographic quadrangle located in southwestern Maine was mapped in 2003 as part of the STATEMAP component of the USGS National Cooperative Geologic Mapping Program awarded to the Maine Geological Survey. Additional financial support by the Association of American State Geologists Field Mentoring Program provided for an educational and practical field research experience to an undergraduate geology major employed as a field assistant.

Striations and glacially streamlined features record the strongest glacial flow direction, 150º-174º; also, a younger late stage flow component is present, 180º-190º. At one site, relative striation age was determined: oldest to youngest 116º, 143º, 184º, 150º-174º. The trend of the older 184º set and the younger 180º-190º set is near parallel to local bedrock structure and topography, which may have controlled the advance and retreat of thinner ice, before and after the Late Wisconsinan glacial maximum. During deglaciation, the sea submerged most of the quadrangle and the glacier margin was in tidewater conditions; maximum marine limit in the quadrangle is 83 m elevation. Features in the Kennebec River valley indicative of the tidewater margin include glacial-marine subaqueous fan deposits and related proximal to distal interbedded sand and marine clay. The fans represent ice-marginal discharge points for subglacial drainage, traced in the quadrangle by segmented eskers and fans, which are exploited for aggregate and provide a municipal water-supply source. Sequential east-northeast trending moraine ridges, near perpendicular to the esker trend, record an active northward retreating ice margin.

The most widespread surficial geologic deposit in the quadrangle is glacial-marine mud known as the Presumpscot Formation. Glacial-isostatic emergence of the land began before 12,200 radiocarbon years BP (-600 year marine reservoir correction factor) based on age analysis of Mya arenaria from nearshore deposits at 35 m elevation. Silty alluvium in broad areas adjacent to the Kennebec, Abagadasset, and Eastern Rivers was deposited during the later part of emergence and transition to a freshwater flood-plain environment.

[Oral Presentation]

STRAIN VARIATIONS OF A HINGE-PARALLEL LINEATION, CHANDLER RIDGE, MOUNT WASHINGTON, NEW HAMPSHIRE

GUITERMAN, Chris, Dept. Geology, Bates College, Lewiston, ME. <cguiterm@abacus.bates.edu>

A pseudo-andalusite porphyroblast lineation (L1) in Devonian Littleton Formation schists of the Presidential Range, New Hampshire has been examined in order to evaluate its strain history. L1 lineations are an early Acadian deformational (D1) structure because they are hinge parallel to F1 nappes and lie within the S1 axial plane schistosity. These lineations are enigmatic in terms of strain because they require hinge parallel extension during D1, which has historically been considered to create a structural room problem.

L1 shows extreme variations in the degree of alignment at both outcrop and, more importantly, regional scales of observation. To evaluate this partitioning of L1 strain, lineations were measured on S1 foliation surfaces at thirty-one sites (most with 50 cm x 50 cm quadrats) along a transect from the summit of Mount Washington 2 km down to treeline on Chandler Ridge. Additionally, the patterns of the deformed L1 lineation, as affected by F4 folding, were analyzed for four outcrops where a single S1 containing an L1 lineation was folded by D4.

It has been deduced from the deformed lineation patterns that D4 deformation did not significantly reorient L1 lineations. This means that the L1 lineations when unfolded about F4 hinge lines are in their original L1 orientation. Variations in L1 alignment have been quantified down transect. Statistical analysis showed a reverse correlation between degree of L1 alignment and thickness of schist beds in the schist/quartzite units. Examination of this relationship showed that L1 development was higher in thin schist horizons. It is concluded that lithology was the dominant influence on L1 development. In domains where L1 is not developed, the strain is typical of S tectonites where S>>L, L=0 and the strain is oblate. Domains where L1 is the most intensely developed are characterized by L>>S, the rocks are L-S tectonites and the strain is within the prolate field. These variations prove that L1 strain was heterogeneous.

[Poster Presentation]

GPR OF THE DEAD RIVER

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The Dead River is a ten-mile long channel that typically acts as an outlet from the Androscoggin Lake to the Androscoggin River. During high water events on the Androscoggin River, however, the flow reverses. A bird's foot delta has formed where the anomalous flow discharges into the lake. This rare feature stands alone as a source for geological consideration, and my interest was compounded by the presence of large, non-fluvial rock debris and possible bedrock along the southern shore of the delta. The Dead River channel appears to be structurally controlled at several critical points and is bisected by the remnants of an esker. These details suggest that the delta may have a rich history of formation. Ground-penetrating radar (GPR) data were collected along traverses on the delta, both parallel and perpendicular to the Dead River channel. Relevant coordinates were recorded via GPS so that the data could be tied into a GIS format and a contextual map. The GPR data displays the parallel, slightly dipping, stratification indicative of bird's foot delta formation. Yet, at depth, less cohesive patterns reinforce the notion that glacial deposits played a role in shaping the ultimate form of both the Dead River and the delta.

[Oral Presentation]

FIRN ACCUMULATION RECORDS FOR THE PAST 1000 YEARS ON THE BASIS OF DIELECTRIC PROFILING OF SIX CORES FROM DRONNING MAUD LAND, ANTARCTICA

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This paper presents an overview of firn accumulation in Dronning Maud Land in Antarctica over the past 1000 years. It is based on a chronology established with dated volcanogenic horizons detected by dielectric profiling of six medium-length firn cores. In 1998, the British Antarctic Survey retrieved a medium-length firn core from western Dronning Maud Land. During the Nordic EPICA traverse of 2000/2001, a 160-meter long firn core was drilled in eastern Dronning Maud Land. Together with previously published data from four other medium-length ice cores from the area, these cores yield 50 possible volcanogenic horizons. All six firn cores cover a mutual time record until the 29th eruption. This overlapping period represents a period of approximately 1000 years with mean values ranging between 43 and 71 mm w.e. The cores revealed no significant trend in accumulation. Running averages over 50 years, averaged over the six cores, indicate temporal variations of 5%. All cores display evidence of a minimum in the mean annual firn accumulation rate around the year 1500 AD and maximums around 1400 and 1800 AD. The mean increase over the early 20th century was the strongest increase, but the absolute accumulation rate was not much higher than around 1400 AD. In Eastern Dronning Maud Land a 13% increase is observed for the second half of the 20th century.

[Poster Presentation]

BEDROCK CONTROLS ON SUBMARINE GROUND-WATER DISCHARGE (SGD) IN EASTERN CASCO BAY, MAINE, AND NUTRIENT ANALYSES OF SGD SPRINGS

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Submarine Groundwater Discharge (SGD) is associated with nutrient loading and subsequent eutrophication of coastal waters. Previous studies have found temporally and spatially persistent SGD in eastern Casco Bay, Maine, where fractured crystalline bedrock is variably overlain by Quaternary marine mud. These studies tentatively suggested that bedrock lithology and fracture patterns play a role in determining where SGD is observed. A side-scan sonar survey in Quahog Bay, coupled with additional hydrogaphic sampling, suggests that this working hypothesis has to be modified to include consideration of whether a specific bedrock unit is covered by a drape of relatively impermeable marine sediments. While SGD is widespread throughout Quahog Bay, the lowest salinity values appear in the deep, relatively sediment-free hole in the channel on the western side of Pole Island, an area of presumed scouring tidal currents. In addition, nutrient sampling in areas of known SGD shows the values for nitrate and ammonium near the bottom to be elevated with respect to the water column. This is significant to the understanding of the annual eutrophication of the waters in Quahog Bay.

[Oral Presentation]

LATE ACADIAN D4 SHORTENING, CHANDLER RIDGE, MOUNT WASHINGTON, NEW HAMPSHIRE

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Late Acadian D4 deformation is ubiquitous in the alpine zone of Mt. Washington and other peaks of the Presidential Range, New Hampshire. D4 is characterized by mesoscopic, asymmetric, moderately inclined, flexural slip folds that deform bedding (S0) and S1 schistosity. A weakly to strongly developed S4 crenulation is also typical of D4 deformation. F4 fold shortening was evaluated within the context of the lithologic setting and the structural setting of macroscopic D4 folding.

D4 fold wavelength, amplitude and stratigraphic viscosity (based upon the amount of schist to total rock ratio) was measured on 350 mesoscopic F4 folds along a transect of Mt. Washington down the Chandler Ridge. This transect has near continuous exposures of the folded Devonian Littleton Formation. An accurate cross-section has been constructed and used to determine mesoscopic and macroscopic shortening during D4.

The Chandler Ridge Dome, which was previously believed to be an F3 structure (Eusden et al., 1996), has now classifieded as an F4 structure due to its surrounding mesoscopic folding and shortening patterns. On the Chandler Ridge Dome the mesoscale F4 folds have axial planes dipping in the opposite direction than those of the macroscopic scale D4 limb that they are located on. Due to the axial plane dip direction, which is opposite from that of expected ZMS folds, the Chandler Ridge Dome is believed to be a diapiric fold structure or a product of shortening difference between scales and buckle folding.

Mesoscale shortening varies spatially down the transect with the higher values located on the apex of Chandler Ridge Dome and the shortening values systematically decreasing on either side of the dome. A small percentage, 9%, of mesoscale folding can be directly explained by the amount of schist at the site. In the field area the largest amount of shortening, larger double amplitude:wavelength ratios, and smaller interlimb angles are all centered on the Chandler Ridge Dome where the shortening is greatest.

F4 meso- and macroscales of late Acadian shortening were calculated. The mean Late Acadian mesoscopic F4 shortening for the Chandler Ridge has been calculated as 14.2%

shortening. The mean macroscopic Late Acadian F4 shortening is 10.3%. The combined Late Acadian shortening for both meso- and macroscale is 22.2% for Chandler Ridge or 919.9 meters shortened on a transect of 3228.4 meters. All of the shortening amounts calculated above are minimum estimates because crenulation folding was not included in shortening estimates.

[Poster Presentation]

ALTERNATE Z-VALUE SURFACE ANALYSIS OF FABRIC ORIENTATION IN REGIONAL TRANSPRESSION RELATED TO DEXTRAL NORUMBEGA SHEARING, MID-COAST MAINE

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Field measurements of strike and dip for metamorphic layering on a scanned and georeferenced Bath 1:100,000 geologic map were digitized as points in ArcGIS to create a data table of strike, dip and strike-angle relative to the NE trend of the main Norumbega shear zone. Regional strain accommodation adjacent to the Norumbega is reflected in tight upright folds oblique to the trace of the shear zone where continued strain led to clockwise fold rotation and layer-parallel shear concentrated in the steep planar limbs. The orientation of this regional layered fabric was studied to predict the likely location of discrete shear zones within the coastal block that flanks the Norumbega on the SE side. Selection of "alternate z-values" from an attribute database allowed surface modeling thru the generation of rastered images illustrating the spatial distributions of particular orientation characteristics that can be highlighted with color and interval selections. Applying map algebra using the raster calculator allowed the combination of two orientation characteristics to show areas throughout the flanking coastal block with the most favorable orientation for shear according to the oblique fold model for regional strain accommodation during Norumbega shearing. This optimal orientation function selected the steepest dips 70-90^0 and strike alignments closest to the 35-42^0 oblique angle to the main shear. The optimal areas for shear appear as elongate zones that flank a wide mid-coast block of less favorable orientations. Fabric orientations with a high potential for shear on the west are coincident with the previously proposed Phippsburg dextral shear zone and on the east with sinistral shearing observed in the Pemaquid Point-Muscongus Bay area. This pattern of favorable orientation for shear coupled with field observations of kinematic indicators support a lateral (southerly) escape model for the mid-coast block during regional strain accommodation adjacent to the Norumbega fault zone.

[Poster Presentation]

A COLD-WATER CARBONATE-RICH SAND BEACH: CAPE FREELS, NORTHEAST NEWFOUNDLAND

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Carbonate-rich deposits are used as paleo-climate indicators of tropical settings. However, carbonate beaches are found at higher latitudes such as on the coast of Maine. Samples collected on a barrier beach at Cape Freels, Newfoundland (49.3°N 53.5°W) in June of 2003, were analyzed to document carbonate variability in relation to distance from source and grain size. Both sieved and bulk representative samples were tested by using 20% acetic acid to leach each sample. Point counts were done using a binocular microscope to identify carbonate species. Point counts show high percentages of echinoderm fragments (dominant species) and unidentifiable shell hash. Sieved samples larger then 2φ located closest to the swash zone contained the most $CaCO_3$. Samples smaller then 2.5φ show an increase of $CaCO_3$ from the high tide swash zone to the dune scarp. Carbonate percentages of bulk samples along the transect range from 18% at the water's edge to 7% at the dune scarp. Results suggest that chemical dissolution is aided by physically reducing grain size, which increases surface area for rapid destruction of $CaCO_3$, particularly at mid beach. Grain size correlations are irregular, showing high percentages of $CaCO_3$ at the waters edge and dune scarp, with a drop at mid beach. Ocean water creates a buffer from dissolution at points lower on the beach resulting in high $CaCO_3$ levels. Grain size trends indicate that wind plays an important role in bringing smaller particles of $CaCO_3$ to higher points on the beach.

[Oral Presentation]

SEDIMENTOLOGICAL AND GEOCHEMICAL CHARACTERIZATION OF EAST POND, BELGRADE LAKES WATERSHED, CENTRAL MAINE

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An interdisciplinary research program (Geology and Chemistry) at Colby College, Waterville, Maine, is developing a model for surface and groundwater interactions over spatial and temporal scales in the Belgrade Lakes watershed. The watershed is a system of seven glacially formed, interconnected lakes in central Maine. Surface and groundwater discharge from the area to the Kennebec River, which empties into the Gulf of Maine.

The present study focuses on East Pond, the head of the lake-chain system. East Pond is roughly oval in shape with several coves along the margins; it has a surface area of ~4500 hectares, a maximum depth of 7.5 m, and an estimated total volume of 33.68 x 10^6 m^3. The lake is surrounded by North temperate hardwood forest and there is a marshy outlet to the other lakes in the northwest corner. This project will develop a baseline for the geological, geo-chemical and hydro-chemical parameters to better understand the lake's dynamics. Analyses include: characterization of the sedimentology, measurement of the Total Organic Carbon (TOC) and Total Organic Nitrogen

(TON) loads, and measurement of the reactive phosphorous on a real-time basis throughout the ice-free months. The lake is characterized by a grain-size of predominantly medium silt (mean = 4.51 φ) with a range of 1.0 to 6.15 φ. No clay-sized particles (>8 φ) have been detected in lake-bottom sediment samples. Medium-grained sand occurs at the outlet and very fine sand is restricted to the margins. TOC values range from 0.47% to 30.64% (mean = 5.42%) and the mean TOC:TON ratio is 10.92, indicating a mixed algal and terrestrial origin for organic matter. Phosphorous concentrations from sediment pore waters and water column samples are expected to be high, because the lake has sustained yearly algal blooms. All data will be integrated to evaluate the processes operating within this lake, and a model will be proposed to describe its seasonal dynamics.

[Oral Presentation]

RECENT SEDIMENTATION OF A TRANSECT OF HIGH ARCTIC ISOLATION BASINS, SOUTHERN QUEEN ELIZABETH ISLANDS ARCHIPELAGO, NUNAVUT, CANADA

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An observed 20th Century warming trend has spurred controversy concerning anthropogenic influence. To understand current trends in climate, researchers have looked to the past to reconstruct natural variability to understand the degree to which elevated greenhouse gas emissions are related to 20th Century warming. Annually laminated sediments preserved in high Arctic coastal lakes provide a high-resolution proxy for paleoenvironmental and paleoclimatic change, and may provide valuable information concerning this debate.

This study examines the recent sedimentation of five Arctic coastal lakes located on an east-west transect through Devon, Cornwallis, and Bathurst Island in the Queen Elizabeth Islands Archipelago (Q.E.I.), Nunavut, Canada. All studied lakes are coastal inlets termed 'isolation basins' that have been isolated from the sea due to post-glacial uplift. Water-column density stratification and anoxic conditions in bottom-waters contribute to the preservation of undisturbed annually laminated sediments (varves). Varves used together with radiometric dating provide information about sedimentation rates, allowing paleoenvironmental and paleoclimatic interpretation.

Surface cores recovered from each lake basin, sampling the most recent deposition, were analyzed for varve thickness, percent grain size >63 mm, percent loss-on-ignition (% LOI), and percent biogenic silica (%BSi). Thin sections from cores were analyzed for varve structure and thickness. Results show changes in lamination thickness and structure with changes in sedimentation source and process due to post-glacial isostatic uplift. Varve thickness anomalies in nival-fed lakes suggest a possible paleo-precipitation signal showing increased rain events and storminess during the end of the Little Ice Age. Varve thickness anomalies from basins currently exchanging with the sea and receiving glacial runoff suggest a possible paleo-temperature signal. Comparison to ice-core proxies, total reconstructed solar irradiance, and various analogues developed from historical records suggest a correlation between varve thickness and summer temperature indicating the Little Ice Age, the Franklin Era, and the 20th Century Warming trend.

[Poster Presentation]

WAGNERITE, APATITE AND BIOTITE IN GRANULITE FACIES ROCKS OF THE NAPIER COMPLEX, ENDERBY LAND, ANTARCTICA; THE ROLE OF HALOGENS

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Wagnerite, $(Mg,Fe)_2PO_4(F,OH)$, has been discovered in Late Archean pegmatite pods and veinlets at four localities in the ultrahigh-temperature Napier complex, and in a phlogopite-enstatite-sapphirine-cordierite granulite reworked in the Early Cambrian ("Rayner" Complex), all in coastal exposures around Amundsen and Casey Bays, western Enderby Land, Antarctica. Associated minerals in the pegmatites include biotite, apatite, sillimanite, quartz, garnet, perthite, beryllian sapphirine-khmaralite, surinamite, cordierite, ilmenite-hematite intergrowths, and rutile. Textural relationships suggest that wagnerite is a primary phase that formed at temperatures of ~900°C (granulite) and possibly ~1000°C (pegmatite) at ~1GPa. Apatite shows complex textures, in most cases it armors or rims the wagnerite grains. Three generations of apatite are evident (1) a primary chlorapatite-Cl-rich fluorapatite that appears to be coeval with wagnerite ("Christmas Point" only), (2) rims of chlor-fluorapatite that surround wagnerite in most samples and (3) late F-rich apatite (possibly carbonato-apatite) that has partially replaced the apatite rims. Electron microprobe analysis shows wagnerite Fe/(Fe+Mg) ratio ranging from 0.026 to 0.073, which is roughly correlated with Fe/(Fe+Mg) ratio in contiguous biotite grains. F and Fe contents in the biotite vary inversely; which is attributed to F-Fe avoidance. Biotite F/(F+Cl) ratios do not vary systematically with apatite F/(F+Cl) ratios, instead there is an increase of apatite F+Cl with increasing wagnerite F amounts. Since OH is assumed to be (1-F) in wagnerite and (1-F-Cl) in apatite, this suggests a possible regular distribution of OH between the two minerals. Overall, the distribution of the halogens and Mg-Fe among biotite, apatite and wagnerite is not particularly regular, and so there is little evidence for chemical equilibrium, possibly as result of multiple events. This disequilibrium is also reflected in the complex apatite textures and variable chemical compositions of biotite. The presence of significant Cl in pegmatitic apatite and biotite, and the near absence of Cl in these minerals within the granulite supports evidence obtained from bulk analyses of other Napier complex pegmatites for Cl enrichment in the pegmatites relative to their host rocks.

[Oral Presentation]

A NEW INTERPRETATION OF THE WAGENDRIFT SECTION NEAR ESTCOURT, KWAZULU NATAL PROVINCE, SOUTH AFRICA

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The South African Karoo Basin preserves a continuous continental record across the Permian/Triassic Boundary in which both plant and vertebrate fossil assemblages co-occur. The Upper Permian Beaufort Group spans this boundary, and the Estcourt Formation in this sequence has been interpreted to represent levee infill of a bay, with sedimentation occurring as a product of overbank deposits. This interpretation implies sedimentation occurred along the margins of a large, Late Permian intracontinental lake. Recent work in a series of outcrops at Wagendrift Dam, near the town of Estcourt requires a reinterpretation of this setting.

The three outcrops in this area consist of several different facies that can be grouped genetically into lithotypes. The basalmost lithotype consists of mm scale, fining upwards sequences of siltstone to mudstone that has been interpreted as background deposition in a lake. Bedding is undisturbed and bioturbation is limited, indicating deposition within a low oxygen zone. The second consists of a rippled/ball-and-pillow coarse sediment, overlain by a finer, massive siltstone. This has been interpreted as turbidite deposition, which is further supported by the presence of large, localized slump blocks, with internal bedding planes preserved. The third lithotype consists of mm-to-cm scale fining upwards sequences of planar/(small, isolated) ripple beds of coarse (fine sand, coarse silt) sediment overlain by finer siltstone. This again represents background deposition, although under shallower conditions than found in Lithofacies 1. The last lithotype consists of thick, ripple-bedded sandstone representing a major change in depositional setting. This suite of sedimentological features is consistent with deposition in a deep, intracontinental lake regime, rather than a shallow, marginal lake setting.

[Poster presentation]

DIGITAL MAGNETIC, GRAVITY, AND HEAT FLOW DATA FOR MAINE AND CANADA INTEGRATED WITH OTHER DIGITAL DATA IN AN OBJECT- ORIENTED GEOGRAPHICAL INFORMATION SYSTEM

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Digital data for the Earth's magnetic field, gravity field and heat flow of the region straddling the St. Lawrence River valley for all of Maine and adjacent Quebec and Ottawa in Canada have been assembled into an Object-Oriented Geographical Information System (GIS). These data have been combined with a previously acquired a) Digital Elevation Model, b) the Canadian and Maine digital geologic maps, c) seismicity data, d) World Stress Map (WSM) stress vectors, and e) Global Positioning System (GPS) data. A mosaic of four digital images derived from Landsat 5-TM satellite data (source: NASA-Earth Science Applications Directorate) of western Maine and adjacent Canada was used as a base for considering regional geology and tectonics in an intra-plate locale.

For the geophysical data analyzed we found that earthquake epicenters are generally correlated with zones of high aeromagnetic anomalies, zones of low Bouguer gravity anomalies, and with values of low to intermediate heat flow. Magnetic values showed the highest correlation with bedrock geology. As expected, earthquakes are highly correlated with fault patterns in the St. Lawrence River valley. The influence of recent regional de-glaciation complicates the interpretation of crustal dynamics in the region.

The result of this investigation produced a new and integrated view of the region for the purpose of geologic interpretation.

Keywords: Maine, Canada, Tectonics, Heat flow, Gravity, Magnetism, Remote Sensing

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