THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

VGS Website: www.uvm.org/vtgeologicalsociety/

WINTER 2007	VOLUME 34	NUMBER 1

The Vermont Geological Society
Winter Meeting
March 3, 2007, 9:30 AM
Cabot Science Building, Room 085
Norwich University, Northfield, Vermont

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ABSTRACTS

THE DEVONIAN PLUTONS OF NORTH-CENTRAL VERMONT: A REVIEW

WESTERMAN, David S., Department of Geology, Norwich University, Northfield, VT 05663; westy@norwich.edu

The Siluro-Devonian tectonic history of eastern Vermont was dominated initially by the opening and filling of the Connecticut Valley Trough (CVT) starting ~440-435Ma and ending ~395-390 Ma. Proposed mechanisms for extension call for delamination of subducted lithosphere, accompanied by mafic magma production by decompression melting. This magmatism is most visibly expressed by mantle-derived Standing Pond volcanics that flooded the CVT basin in southern Vermont at the stratigraphic position marked by the close of carbonate sedimentation (~425-420 Ma). In northern Vermont those magmas occur near the same stratigraphic horizon but have very limited expression. The temporal and spatial distribution of these magmas at depth is unconstrained.

Extension and basin filling gave way directly to deformation, regional metamorphism (~395-375 Ma), and magmatism (~390-370 Ma) as the northwest-advancing Acadian orogenic front approached its western limit. Not coincidentally, the plutons barely post-date the regional metamorphism, and their contact aureoles have isograds concentrically arranged within the regional isograds. Middle Devonian magmatic rocks in Vermont occur almost exclusively in the northern half of the state where 6,000 km^2 is underlain by a calc-alkaline magmatic suite ranging from gabbro to granite. Trace element ratios suggest magma production associated with volcanic arc activity, however associated Devonian arc volcanics are not recognized in the region. Models considered to explain the origin of this magmatic suite include: i) hybridization and mingling of anatectic melts and mafic, mantle-derived magmas, ii) contamination by assimilation of carbonate-rich crust, and iii) fractionation of magmas generated by subduction of oceanic lithosphere produced during the extension of the CVT. Ultimately, the plutons locally domed the regional isograd surfaces to produce the pattern of metamorphism now exposed by erosion.

A ROCKFALL HAZARD ASSESSMENT OF HIGHWAYS IN VERMONT

SPRINGSTON, George E.[1], ELIASSEN, Thomas D.[2], BECKER, Laurence R.[3], (1) Department of Geology, Norwich University, 158 Harmon Drive, Northfield, VT 05663, gsprings@norwich.edu; (2) Materials and Research Division, Vermont Agency of Transportation, 1 National Life Drive, Drawer 33, Montpelier, VT 05633; (3) Vermont Geological Survey, 103 S. Main St., Logue Cottage, Waterbury, VT 05671-2420

Highway construction across the rugged topography of Vermont has required the excavation of numerous rock cuts, many of which extend for hundreds of meters and are commonly tens of meters in height. Every year, the combination of steep slopes, adverse geologic structures, and ongoing weathering processes leads to rockfall events. As those reaching the highway pose a hazard to travelers and are very expensive to clean up, a rockfall hazard rating system has been developed to enable the Vermont Agency of Transportation (VTRANS) to prioritize limited maintenance funds. The system is modified from one developed by the Federal Highway Administration (FHWA).

A preliminary field survey of all Interstate, U.S., and State highways in VT identified 3,647 cuts greater than 5 feet high. Based on roadway and geological characteristics and known rockfall history, 77% were ranked as low hazard (rockfall not likely), 8% as moderate (slight chance of rockfall that reaches road), 10% as elevated (rockfall possible and may reach road), 2% as significant (rockfall likely and may reach road), and 4% as high (rockfall expected to occur and to reach road).

Detailed ratings of about 174 high hazard cuts have been completed based on height and length of rock slope, ditch effectiveness, speed limit, traffic count, sight distance, road width, water/ice conditions, known rockfall history, and geologic factors. Geologic factors include rock type, discontinuity characteristics (orientation, length, spacing, openness, roughness, wetness, and infilling of joints and faults), block size, and volume of rockfall. Fieldwork included slope profiles and preliminary remediation estimates.

Data for the high hazard rock slopes was entered into spreadsheets in the field and is being migrated to a database and GIS. A scoring system modified from the FHWA system is being used produce a numerical estimate of the overall hazard posed by each slope. High hazard slopes will be periodically resurveyed by VTRANS to track deterioration and emerging hazards.

MAPPING OF COLLUVIUM TO IDENTIFY ARCHAEOLOGICAL TARGET ZONES AND PRESERVATION POTENTIAL OF ARCHITECTURE AT THE ROMAN ERA ARCHAEOLOGICAL SITE OF KENCHREAI, GREECE

DUNN, Richard and CRAVER, Anastasia, Department of Geology, Norwich University, Northfield, VT 05663; rdunn@norwich.edu

Sediment characterization and detailed mapping of the distribution of colluvium in the area of the Roman cemetery at Kenchreai, Greece, enables us to predict the location of buried structures and assess the preservation potential for architecture across the entire site. The cemetery, consisting of rock cut graves and tombs, is part of the Roman port of Kenchreai, and is located upon a ridge of

Plio-Pleistocene marl, conglomerate, and valley fill. The ridge surface slopes relatively steeply to the sea and terminates in a coastal cliff.

The texture of colluvium at the site is variable and reflects underlying bedrock. In most areas only the upper few decimeters of colluvium appears to have been recently mobilized, with underlying material containing relatively high proportions of pedogenic carbonate and therefore being partially consolidated. Detailed mapping of colluvial thickness was possible due to the 200+ looting holes on the site, as well as profiles exposed at graves and tombs. We postulate that colluvium thickness is in part controlled by buried architectural structures, and we propose two models for the development of areas of abnormally thick colluvium, which we suggest will be target areas for future geophysical and archaeological prospecting.

Detailed mapping, construction of profiles, cross sections and a colluvial isopach map enabled us to identify three primary excavation targets as well as areas of low potential for buried structures. For example, the area of the rock cut tombs is characterized by thin colluvium, suggesting limited potential for finding structures of much significance here. One particularly thick area of colluvium was investigated by geophysical methods, revealing the foundation of a monumental building. Determining the distribution of colluvium can guide geophysical exploration, and combining these two non-destructive techniques can help pinpoint archaeologically rich areas. Our detailed mapping of colluvium highlights areas of both high and low potential for buried remains and serves as a means for helping to direct large-scale excavations beginning in 2007.

PRESIDENT'S LETTER

Hello all,

The Winter Meeting is just around the corner and I'm looking forward to seeing people here at Norwich. Both a Summer and Fall field trip are taking shape, but we are always looking for people to lead trips, so if you have an idea, contact any of the Society officers. If you know of a student conducting research in Vermont, be sure to look into a VGS student research grant.

Global warming – we've heard a lot of this very recently, and awareness of the issue is high while awareness of the science probably is not. If you can, grab a young person and explain some of the realities of the science, and then send them out in hopes they will tell friends. We have to start somewhere, and kids are the best source of knowledge propagation that I know of, so use them to our advantage. Remember, ice cores are cool!

One quick plug: Middlebury, Norwich, UVM, and probably others have geology or general science seminar speakers on a regular basis. For those of you who don't get regular announcements, try websites or contact the programs directly. These are a great resource, and I know that at Norwich, and I'm sure at the other schools as well, we love to see people from outside our campus at our seminars.

Have a good winter and thaw,
Rick Dunn, President

ANNUAL MEETING MINUTES & ELECTIONS

Following a very successful Fall Field Trip examining the glacial geology of northern Vermont in the Waterville, Belvidere, and Eden areas led by Stephen Wright, the Executive Committee met in Johnson, Vermont to conduct its business and certify the election of officers and board members. In attendance were President Rick Dunn and Treasurer Steve Howe, as well as Les Kanat, Jon Kim, John Van Hoesen, and Stephen Wright. I, acting as temporary secretary for Dave West, have summarized below the discussions that took place.

1. Steve Howe reported that the financial condition of the Society was excellent and that it had $4,887.06 in its checking account.

2. Steve Howe reported that the Society had awarded $500 to one student who had applied to the Research Grant Program by the September 30, 2006 deadline. He indicated that the Society would be able to support the Program at a similar or increased level for the next round, the deadline of which is March 31, 2007. In response to a question, Steve described the make-up of the Advancement of Science Committee and the process by which the proposals are reviewed. There was some discussion about the possibility of expanding the number of members on the committee, but it was ultimately decided that the current committee size was sufficient. All present agreed that the Society needs to find additional ways to publicize the Research Grant Program.

3. The Society's Lecturer program was described by Rick Dunn, noting that selection of a new Lecturer was overdue. After much discussion, including whether volunteers should be solicited by e-mail from the Society's membership, Jon Kim agreed to serve as the VGS Lecturer for the 2007 calendar year. Jon will offer the following two talks: "Nitrate Contamination of a Bedrock Aquifer in Central Vermont" and "Application of Tectonics to Groundwater Problems in Vermont." Colleges and high schools wishing to schedule a presentation by Jon should contact him directly [see contact information at the end of this issue of the *Green Mountain Geologist* (GMG)].

4. Upcoming fieldtrips were discussed next. Steve Howe reported that Pete Thompson had volunteered to lead, possibly with Dave DeSimone of the Vermont Geological Survey, a combined bedrock and surficial geology field trip to Woodstock and Quechee Gorge next summer. Steve also reported that Dave West had volunteered to lead a field trip next fall to examine the geology in the vicinity of Middlebury. Details would be discussed further following the Winter Meeting.

5. John Van Hoesen volunteered to look into setting up a ListServ for the Society, probably hosted by Green Mountain College, for the purpose of discussing Vermont geology. A formal announcement of the availability of this ListServ would be made to Society members once it was up-and-running.

6. Steve Howe reported that the new publishing committee that was established earlier in the year to handle the creation, printing, and mailing of the GMG was running very smoothly. He noted that approximately half of the Society's membership has opted to receive the GMG electronically as a pdf file. Steve recommended that the Executive Committee continue to urge as many members as possible to choose this method of newsletter receipt.

7. Steve Howe recommended that Saturday, March 3, 2007 be set as the date for the upcoming Winter Meeting to be held at Norwich University, which would move it away from Presidents' Day weekend and the usual Vermont school break week, yet still precede the Northeastern Section meeting of the Geological Society of America. It was agreed that the meeting would have no defined theme this year.

8. Steve Howe reported that Char Mehrtens had expressed interest earlier in the year in having the University of Vermont host the Society's Spring 2007 Meeting and said that he would confirm this early next year.

9. The entire slate of Officers and Board of Directors proposed for 2007 was voted for unanimously by a combination of verbal affirmation by the members present at the meeting and absentee ballots sent in previously to the Secretary by Society members. The Officers and Board of Directors assumed their duties at the close of the Annual Meeting.

Respectfully submitted,
Stephen S. Howe

TREASURER'S REPORT

The financial condition of the Society continues to be very strong. As of February 11, 2007, the Society's checking account balance was $6,041.09. As indicated in the Advancement of Science Committee report below, one Research Grant totaling $500 was awarded during the latest round of review. I expect to be able to support the Research Grant Program at a similar level for the foreseeable future, given the relatively stable income derived from membership dues, additional research grant contributions, and publications sales. To my knowledge, there are no outstanding bills.

The following members have been approved for membership in the Society since the last report: Bruce Douglas, Jeffersonville, Vermont; Richard Geisler, Andover, Vermont; and Christopher Kinnick, Colchester, Vermont.

The 2007 membership renewal and directory information form was mailed to all members before December 31, 2006. The deadline for renewal was January 31, 2007. Many members have already returned their forms with their payments, including a number with additional contributions to the Research Grant Program, but there are still quite a few members who have not yet returned their forms. Please help the Society keep expenses to a minimum by renewing your membership promptly.

Despite the impending increase in postal service rates, I will recommend that dues remain at the same level as last year. I urge as many members as possible to consider receiving the *Green Mountain Geologist* electronically as a pdf file to help keep the Society's publication and mailing costs low, which will, in turn, allow us to keep membership in the VGS the bargain that it already is.

Respectfully submitted,
Stephen S. Howe, Treasurer

ADVANCEMENT OF SCIENCE COMMITTEE REPORT

The Committee has been busy with two projects since its last report, reviewing applications to the Research Grant Program and soliciting abstracts for the Winter Meeting.

One application to the Research Grant Program was received by the September 30, 2006 deadline from a student at Middlebury College. The Committee was impressed with the quality and timeliness of Colleen Sullivan's proposal, entitled "Evaluation of Potential Ultramafic Source of Arsenic in Private Bedrock Wells of Central VT."

The Executive Committee decided at its last meeting not to emphasize a particular theme for the Winter Meeting this year.

Respectfully submitted,
Stephen S. Howe, Chair

VERMONT STATE GEOLOGIST'S REPORT

Radioactivity, Naturally-Occurring
In certain places in Vermont, rocks and groundwater contain naturally occurring radionuclides in higher concentrations. Geologic information can assist well-water users when making decisions related to health risks and the need to test groundwater supplies. On February 5th, the Vermont Geological Survey and Professor Peter Ryan of the Geology Department of Middlebury College made a presentation to the Hinesburg Selectboard on the elevated naturally-occurring radioactivity levels found in groundwater from Hinesburg wells. We reported on radioactivity tests conducted by Middlebury College in 2005 and on other wells tested by the Vermont Department of Health over the years. The majority of wells with elevated radioactivity levels occur in the Fairfield Pond and Pinnacle Formations in the eastern half of Hinesburg (Hinesburg Quadrangle mapped by Peter and Thelma Thompson and Barry Doolan). The Selectboard members actively questioned us about the basic geology, health implications, and action they should take. We agreed to provide them with geologic and hydrogeologic data and maps that will help the town inform citizens about testing and filtration to mitigate against the risk to public health. Thanks to Rob Farley, Hinesburg resident, for making arrangements for our visit to the Selectboard.

The Town of Colchester is requesting "uranium bedrock geography" maps through the Regional Planning Commission. The Division, in cooperation with the Health Department, made a geologic map of the Colchester Quadrangle (most of Colchester and southernmost part of Milton, mapped by Jon Kim and Peter Thompson) to address the radioactivity-in-groundwater issue a few years ago. The bedrock geologic map shows the patterns of all the rock formations in the area (the Clarendon Springs Formation had all but one of the wells with elevated radioactivity). The Vermont Survey also made a derivative hazard map showing wells with elevated radioactivity, airborne Geiger counter survey data from 1975, etc. All the map layers are in GIS format. The Vermont Survey gave paper copies of the bedrock geologic map to the Town Health Officers a few years ago and now will supply digital GIS coverages and accompanying text explaining the maps to the Chittenden County Regional Planning Commission.

"Groundwater Mapping" Bill Introduced – H.192
In law, the Secretary of the Agency of Natural Resources is to identify and map groundwater currently used as public water supply sources and groundwater determined by the Secretary as potential future public water supply sources. This bill proposes to establish a "groundwater mapping" program in the "Office of the State Geologist" to accomplish the above. A schedule is proposed to map by county. The "Office of the State Geologist" may adopt rules to implement and funds are proposed to accomplish the work. The text will soon be posted at *www.leg.state.vt.us*

Respectfully submitted,
Laurence R. Becker, State Geologist

GOODSELL RIDGE FOSSIL PRESERVE

[The following article is modified somewhat from an article written by Stephen S. Howe that appeared originally in the November/December 2006 newsletter of the Burlington Gem and Mineral Club.]

The Goodsell Ridge Fossil Preserve was formally opened to the public during a ceremony held on Saturday, September 16, 2006, Isle La Motte's "Teddy Roosevelt Day." Over 150 people were in attendance, including former Vermont State Geologist Chuck Ratté; present State Geologist Larry Becker; Char Mehrtens, Chair of the Geology Department at the University of Vermont; and Roger Cuffey, Professor of Geology at Penn State.

The Isle La Motte Preservation Trust and the Lake Champlain Land Trust have been working for several years to acquire this geologically highly significant parcel of land, to accompany the previously protected Fisk Quarry a short distance to the southwest of the Goodsell Ridge.

Together, these two preserves contain the most complete fossil record of the world's oldest reef dating back to the Ordovician Period, early in the Paleozoic Era. The reef formed in warm, shallow waters at the latitude of present-day Zimbabwe. A diverse succession of reef-building organisms is found at Goodsell Ridge, with the primary reef-builders, stromatoporoids and bryozoans, predating corals by about 30 million years. Gastropods, such as *Maclurites*, and straight cephalopods are abundant, and trilobites have been identified as well. Because of the dip of the Ordovician strata, successively younger portions of the reef are exposed to the north. Walking over the ridge yields a view similar to how the reef would appear if one snorkeled over it 480 million years ago, according to Char Mehrtens.

The Goodsell Ridge and the Fisk Quarry share some of the same fauna as those found in the nearly contemporaneous limestones at the Hatch Quarry in Panton, Vermont.

Although fossil collecting is not permitted at the Preserve, the Goodsell Ridge continues to be the focus of active paleoecological research. In addition to Char Mehrtens and Roger Cuffey, David Griffing of Hartwick College in Oneonta, New York has recently introduced his students to the Goodsell Ridge.

Sign at the entrance to the Goodsell Ridge Preserve
© 2006 Kathleen D. Howe

Students from Hartwick College survey the area
© 2006 Stephen S. Howe

Stromatoporoids, cephalopods, and gastropods are well exposed at several of the scattered exposures of the Goodsell Ridge.

(Top, left) Cabbage-like stromatoporoids were the primary reef-builders; (top, right) locally abundant cephalopods; (bottom, middle) *Maclurites* gastropods are very similar to those found at the Hatch Quarry in Panton, Vermont
© 2006 Stephen S. Howe

A visitor center and museum sits on the 81-acre preserve and contains educational materials describing not only the geology of the Goodsell Ridge, but also its flora and fauna.

For additional information and news stories about the Fisk Quarry and Goodsell Ridge Preserves and the dedication ceremony on September 16th, see the following website links:

www.ilmpt.org/preserves.html

www.foxnews.com/story/0,2933,224000,00.html

www.sevendaysvt.com/features/2006/fossil-fueled.html

CALL FOR STUDENT ABSTRACTS

SPRING MEETING OF THE VERMONT GEOLOGICAL SOCIETY
SATURDAY, APRIL 28, 2007

The Vermont Geological Society will hold its Spring 2007 Meeting in Delehanty Hall at the University of Vermont in Burlington, Vermont. The meeting is dedicated to students conducting research in the geological sciences. Undergraduate and graduate students are encouraged to submit abstracts outlining the results of their research. Abstracts covering all aspects of the geological sciences are welcome and will be published in the Spring issue of the *Green Mountain Geologist*. The Charles Doll Award for the outstanding undergraduate paper will be presented. Cash awards for the top three papers will also be presented based on quality of the research, the abstract, and the presentation of the paper.

Abstracts should be prepared using the style employed for abstracts submitted to Geological Society of America meetings (maximum of 2,000 characters without spaces). We strongly encourage speakers to send their abstracts electronically as a Word file attachment to an e-mail message sent to Kathleen Howe at khowe@uvm.edu

If electronic submission is not possible, please mail your abstract well in advance of the deadline to:

Kathleen Howe
University of Vermont
Office of Health Promotion Research
1 South Prospect Street, Room 4428A
Burlington, VT 05401

Oral presentations will be limited to 15 minutes with 5 additional minutes for questions. A computer projection system for PowerPoint presentations will be available as well as slide and overhead projectors.

Deadline for abstracts: Monday, April 9, 2006 at noon ELT

For additional information regarding capabilities for presentations at the meeting, contact Stephen Wright at (802) 656-4479 or stephen.wright@uvm.edu

ANNOUNCEMENTS

STUDENT RESEARCH GRANT APPLICATIONS
DUE MARCH 31, 2007

Students and secondary school teachers are encouraged to apply to the VGS Research Grant Program by March 31, 2007. Downloadable Research Grant Program Applications are available from the Society's website at www.uvm.org/vtgeologicalsociety/. For those without Internet access, forms may be obtained by writing to Stephen Howe at the Dept. of Earth and Atmospheric Sciences, University at Albany, ES-351, 1400 Washington Avenue, Albany, NY 12222-0001. Tel: (518) 442-5053; e-mail: showe@albany.edu

VERMONT GEOLOGICAL SOCIETY CALENDAR

March 31: Student Research Grant Program applications due

April 9: Student abstracts for Spring Meeting due

April 10: Executive Committee reports due

April 28: Spring Meeting, Delehany Hall, University of Vermont

The ***GREEN MOUNTAIN GEOLOGIST*** is published quarterly
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Vermont Geological Society
Winter Meeting
March 3, 2007, 9:30 AM
Cabot Science Building, Room 085
Norwich University, Northfield, Vermont

Directions to Norwich University:

Norwich University is located on Vermont Route 12, one mile south of the center of Northfield. It can be reached from I-89 by taking Exit 5 and following Vermont Route 64 west to Route 12, and then north to the University. The Geology Department is located in Cabot Science Building, the southeastern most brick building on campus, just west of Route 12. The entrance is near the northeast corner of the very large white Kreitzburg Library, which can't be missed. The easiest parking for the meeting will be in the commuter lot opposite the Science/Engineering complex on the east side of Route 12.

Vermont Geological Society
P.O. Box 1224
Saint Albans, VT 05478-1224

ADDRESS CHANGE?
Please send it to the Treasurer at the above address

THE GREEN MOUNTAIN GEOLOGIST

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The Vermont Geological Society
Spring Meeting
April 28, 2007, 8:30 AM
Delehanty Hall, Room 219
University of Vermont, Burlington, Vermont

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12:45 PM	EXECUTIVE COMMITTEE MEETING

ABSTRACTS

TECTONIC EVOLUTION OF AN EXPOSED SECTION OF LOWER CRUST, WESTERN FIORDLAND, NEW ZEALAND

Robert Zimmermann, Department of Geology, University of Vermont, Burlington, VT 05405

Continental extension is a fundamental tectonic process. Metamorphic core complexes, which represent one mode of extension, provide valuable information on the behavior of different crustal layers during deformation in extensional tectonic regimes. The lower crust is one of these layers that are rarely exposed. This project presents a bedrock map and cross section of the 350 square-kilometer area surrounding Wet Jacket Arm, New Zealand, with structural data on a newly discovered ductile shear zone in the lower crust. The region records deformation associated with the breakup of Gondwana (110-102 Ma) and also the current oblique collision between the Australian and Pacific plates. Microstructural and outcrop analyses provide the basis for the interpretation of the deformation history of this exposed section of lower middle crust. The rocks composing the hanging wall of the recently named Resolution Island Shear Zone are interpreted to be the lower-crustal analog to the mid-upper crustal Paparoa metamorphic core complex in nearby Westland, New Zealand. The structures depict a symmetric core complex in the lower crust, bounded by ductile shear zones antithetic to several major detachment faults. The geometry of the upper plate in this ductile extensional regime is similar to a system of brittle conjugate faults, which is markedly different from core complex models from the western margin of North America and elsewhere. These models involve asymmetric structures defined by large, folded detachment faults controlled by the process of simple shear. In contrast, the core complex in western Fiordland appears to be a symmetric structure bounded by conjugate ductile shear zones. By restoring the displacement across the strike-slip Alpine Fault, the Paparoa core complex can be brought to coincide with these lower crustal rocks. This project presents a new variety of core complex, dominated by the mechanics of pure shear rather than simple shear.

CRUST–MANTLE INTERACTIONS DURING EXTENSION IN THE LOWER CONTINENTAL CRUST

Paul M. Betka, Department of Geology, University of Vermont, Burlington, VT 05405

The recent discovery of deep (~20kb, ~60km) granulite and ecologite exposures within Fiordland, New Zealand provide evidence of interactions between the lower crust and lithospheric mantle during continental extension. New data suggest that processes controlling extension in this setting are similar to those in oceanic core complexes. Strain in oceanic core complexes is accommodated by localized shear zones controlled by the metamorphic hydration of mantle dunite, peridotite and harzburgite at the upper amphibolite and greenschist facies rocks. In Fiordland, preliminary results indicate that metasomatism of granulite and eclogite material representative of the mantle and lower crust resulted in zones of weakening that accommodated strain during continental extension. These observations pose two fundamental questions about the behavior of the lower crust and lithospheric mantle during continental extension: 1) Does retrograde metamorphism of mantle rocks cause rheologic heterogeneities in the lower crust that control strain partitioning during deformation? and 2) Do the lower

continental crust and upper mantle behave similarly to processes documented in other settings, including oceanic core complexes?

Mapping of outcrop-scale (~10m^2) exposures of this shear zone indicate that shear strain is localized in an anastomosing array of high-strain amphibolite facies shear fabrics that envelope low-strain, eclogite and granulite facies rocks. Amphibolite facies shear fabrics envelope meter scale pod-shaped lenses of eclogite, and garnet granulite. Eclogite and granulite display cross-cutting clinozoisite- and hornblende-bearing veins, indicating they experienced brittle deformation during extension under high-pressure amphibolite-facies conditions. Amphibolite facies fabrics contain very strongly aligned hornblende and plagioclase stretching lineations that plunge strongly toward both ~25° and ~205°. Foliations in amphibolite shear fabrics wrap the pod-shaped lenses of eclogite and granulite, forming dome-and-basin structures. Initial results suggest that metasomatism of granulite and eclogite weakened the lower crust sufficiently to allow it to accommodate strain during continental extension, resembling strain localization mechanisms recently documented in oceanic core complexes.

COMPARISON OF HOLOCENE AGE MARINE SEDIMENT RECORDS: FOUR BAYS ON THE ANTARCTIC PENINSULA

Anne Christopher, Geology Department, Middlebury College, Middlebury, VT 05753

The bays along the Antarctic Peninsula (AP) experience differing climates based on slight variations in temperature and precipitation rates in relation to the bays' geographical position (latitude/longitude). These varying climatic conditions in turn affect the local glacial characteristic of each bay, which ultimately determines the sedimentology of the bays. This study focuses on four Holocene Kasten cores of marine sediment from the AP, specifically from Maxwell Bay and Lapeyréré Bay on the western side of the AP and Herbert Sound and the Firth of Tay on the eastern side of the AP.

Sedimentological records for each bay were constructed using physical properties (grain size, magnetic susceptibility, electrical resistivity, and porosity), clay mineral analysis, ice-rafted debris counts, and radiocarbon dating. The physical properties indicate where local climate swings are located within the cores; the clay mineral analysis clarifies whether the sediment is terrigenous (land origin) or oceanic (ocean origin); the ice-rafted debris counts display evidence for advance and retreat of the ice fronts within the bays; and the radiocarbon dating determines sedimentation rates. In addition, the distance of the core site to the coastline of the bays was taken into consideration. With these high-resolution sediment records, comparisons between the bays were made to observe if geographic locations (east versus west side of the AP) or glacial settings of the bays significantly impact the observed sediment characteristics. This information will enhance other Holocene sedimentological records of the Antarctic Peninsula.

A MULTI-PROXY CLIMATE RECONSTRUCTION ON LAKE SEDIMENT FROM THE UINTA MOUNTAINS, UTAH

Lee Corbett, Geology Department, Middlebury College, Middlebury VT 05753

Reader Lake and Elbow Lake, two high altitude lakes in the Uinta Mountains of Utah, are located about 2 km apart from each other in the same drainage basin. Despite their proximity, however, loss-on-ignition (LOI) curves on sediment cores retrieved from both lakes suggest that

they have had surprisingly dissimilar post-glacial histories. The goal of this study is to perform a multi-proxy climate reconstruction on both cores to clarify how each lake responded to climate changes, to elucidate how the various proxies are related, and to understand why the two lakes have behaved so differently.

LOI, biogenic silica (BSi), carbon to nitrogen ratios (C/N), and grain size distribution were analyzed at 1- or 2-cm intervals throughout both cores. AMS radiocarbon dating of terrestrial macrofossils indicates that the cores contain sediment starting ca. 14,000 years ago, and continuing through ca. 2,000 years ago (the uppermost, youngest, sediment in each lake was not retrieved). Overall, the Reader Lake record features high variability in LOI and BSi, while the Elbow lake record features a prolonged interval of elevated LOI and C/N ratios. Both lakes exhibit a major event centered on 4,000 years ago, possibly synchronous with the 4200 drought that has been widely identified throughout the western United States. In Reader Lake, this event is characterized by unusually high LOI and low BSi, suggesting a profound change in the character of sediment accumulating in the lake at this time. In Elbow Lake, this event marks the end of a 6,000-year period of heightened C/N ratios.

Because the lakes are located so close together, they have likely experienced the same climatic forcing during the post-glacial period. Therefore, the differences between the two records may lie in the geomorphology of the lakes themselves. Reader Lake currently has no inlet and therefore may have operated as a closed basin for most or all of its history. Elbow Lake, however, has an active inlet that feeds a large delta. This indicates that inwashing of terrestrial material, both organic and clastic, is an important contribution to sedimentation in the lake basin. The results of this study suggest that geomorphology has the potential to control each lake's response to climate changes.

POST-GLACIAL LAKE SEDIMENT RECORDS FROM NORTHEASTERN VERMONT, USA

Christopher M. Rodgers and Jeffrey S. Munroe, Geology Department, Middlebury College, Middlebury, VT 05753

Continuous sediment cores were retrieved from two ponds in Brighton, Vermont in order to reconstruct the post-glacial climate of this area. Both of these ponds, Beecher (373 m asl) and Nulhegan (352 m asl), are located within the Nulhegan Basin, a prominent topographic lowland underlain by a quartz monzonite pluton. The ponds are located less than 4 km apart, and both feature simple bathymetry, maximum depths of ~4 m, minor inflow and outflow, and shorelines densely vegetated by bog and boreal forest vegetation. Sediment was retrieved with a 2-inch diameter Livingstone corer operated from the ice surface; overall, more than 15 m of sediment were collected from the two ponds. Based on AMS radiocarbon dating of terrestrial macrofossils, the record for Beecher Pond extends from ~11,200 cal yrs BP to ~770 cal yrs BP, with a sedimentation rate of 0.44 mm/yr. A wood fragment from a depth of 40 cm in the Nulhegan Pond core returned a date of 1,100 cal yrs BP. Most %LOI values for the two lakes range from 35 to 45%, with a general increase over time. Both records also feature dramatic transient departures to higher and lower %LOI values. The fluctuations consist of steadily rising or falling values that abruptly shift to trend in the opposite direction. This characteristic, and the sedimentation rate determined for Beecher Pond, suggest that the %LOI fluctuations track changes in the amount of organic matter accumulating in the lakes over centennial timescales. If

%LOI is considered a proxy for aquatic productivity, then these records reveal notable variability in the post-glacial period. Future work will investigate the possible synchrony of these changes between the two lakes, and with climatic variability noted in previous paleoclimate studies from the region.

A GEOMORPHIC ASSESSMENT OF THE 'WHITE ROCKS SLIDE', WALLINGFORD, VERMONT

Desiree M. Violette and John G. Van Hoesen, Green Mountain College, One College Circle, Poultney, VT 05764

White Rocks Slide (WRS) is located on a west-facing slope in the Wallingford Quadrangle of east-central Vermont. WRS is composed of block talus ranging from ~0.5 meters to ~4.0 meters and lacks evidence for a finer-grained supporting matrix. The cliff-forming unit in this area is the Cheshire Quartzite and is also the dominant lithology of the blocky talus observed covering the length of the slide.

We analyzed the fabric of surface clasts on four distinct regions of the WRS to test for a preferred orientation. In addition, we used ArcGIS to characterize the slope, aspect, potential solar insulation, variations in regional lithology, and develop a geomorphic map of the slide. Solar insulation was modeled using Solar Analyst 9.2 within the ArcGIS framework (Fu and Rich, 1999).

Fabric data suggests a preferred orientation for all regions of the slide. In addition, modeled solar radiation levels on both the ridge and slide are relatively low compared with the surrounding landscape. We suggest that these low insulation values would increase the likelihood of snow surviving into the early summer months and provide a low-friction transport surface with the debris fed through freeze-thaw of the strongly fractured Cheshire Quartzite (Lee, 1989).

URANIUM-ENRICHED GROUND WATER, KNOX MOUNTAIN PLUTON, VERMONT: OCCURRENCE AND LITHOLOGIC CONTROLS

Michael Gleason, Geology Department, Middlebury College, Middlebury, VT 05753

Since 2003, seven ground water wells in Marshfield and Peacham, VT have demonstrated uranium (U) concentrations exceeding EPA and VT Department of Health maximum contaminant levels (MCLs). Due to the prevalence of unregulated private wells in the area, the extent of U contamination is unknown, posing the potential for a major public health concern. The contaminated wells tap deep fractured-bedrock aquifers of the Knox Mountain Pluton, implicating lithologies within this Devonian intrusion as likely sources. This study combines ground water and bulk-rock geochemistry to assess, respectively, (1) the distribution of U-enriched ground water in the study area; and (2) the potential of differing lithologies within the pluton as sources of U and associated radioactivity in the ground water.

Of 19 private wells sampled in the study area, three contain U in concentrations above the VT Dept. of Health MCL of 20 ppb. Two of these three also contain gross alpha (GA) in levels exceeding the EPA MCL of 15 pCi/L. U and GA demonstrate a significant positive correlation for the wells sampled ($P<0.001$, $n=19$), suggesting that U is the predominant radionuclide

occurring in the ground water. While U and GA levels do not vary systematically with well depth, they do show generally higher levels in wells within the central part of the northern pluton.

Bulk-rock geochemistry confirms the significant heterogeneity of rock types within the pluton identified by previous work. Lithologies sampled in the northern pluton can be divided into four significant groups based on mineralogy and rare-earth element chemistry: (1) biotite-rich pluton, (2) biotite-poor pluton, (3) late-stage pegmatites, and (4) late-stage aplites and veins. Neither major element nor radionuclide content suggests that the geochemistry of the four lithologies varies systematically throughout the pluton.

Although U levels are generally highest in wells tapping biotite-poor pluton, bulk-rock analysis reveals relatively low U (2.6-5.7 ppm) in this lithology. High concentrations of U (23.2-28.7 ppm) in late-stage dikes suggest their potential role as a source; however, ongoing analyses of U solubility in the various lithologies should help clarify the significance of each to U ground water contamination.

POTENTIAL ULTRAMAFIC-DERIVED ARSENIC CONTAMINATION IN BEDROCK WATER WELLS IN NORTH-CENTRAL VERMONT

Colleen Sullivan, Geology Department, Middlebury College, Middlebury, VT 05753

Analysis of 30 bedrock ground water wells in the vicinity of Stowe, Vermont reveals three wells with arsenic concentrations that exceed the EPA MCL of 10 ppb, with two of the wells producing water containing 86 and 275 ppb As. Seven additional wells contained between 1.5 and 7.0 ppb As. The wells are located in the Stowe, Ottaquechee, Moretown, and Hazens Notch Formations, and possibly penetrate isolated serpentinites.

Geochemical analysis of the Stowe, Ottaquechee, Moretown, and Hazens Notch Formations from the present cooperative research with Jon Kim of the Vermont Geological Society and previous theses (Bright, 2006; Anderson, 2006; Morris, 2006) are combined to form a suite of 99 samples. Complete geochemical analyses have been performed on 76 of the samples, which document low concentrations of arsenic in schists and quartzites (mean = 8.6 ppm; SD = 15.3; N = 20) and greenstones (mean = 4.1 ppm; SD = 13.9; N = 33) compared to ultramafic rocks which contain high arsenic concentrations between 9.5 and 449 ppm (mean = 63.7 ppm; SD = 94.1; N = 23).

Metasedimentary rocks show low to moderate correlations between arsenic and elements expected of a sulfide source (e.g., Fe, Cu, Ni; e.g., R^2 for Ni and As = 0.42) which suggests a potential mixture of sulfide and non-sulfide sources of arsenic. Scanning electron microscopy-energy dispersive spectrometry (SEM-EDS) analysis of thin sections from the Barnes Hill ultramafic body have not identified a particular trace mineral that contains arsenic; instead, it appears that the arsenic is disseminated throughout the serpentine, possibly substituted into tetrahedral layers in serpentine. Such speculation is supported by recent work by Hattori et al. (2005), who indicate that arsenic becomes incorporated into serpentine during hydration and metamorphism of ultramafic rocks associated with orogenic events.

The elevated concentrations of arsenic within the rocks from the Barnes Hill and other regional ultramafic rocks along a transect from Waterbury to Lowell, and the general lack of elevated arsenic in regional metasedimentary rocks and greenstones, suggest that the ultramafic rocks are

the source of the high arsenic concentrations in the ground water. Further work includes additional SEM element maps, and geochemical and age-dating analysis of groundwater samples that produce from serpentinites north of Stowe.

FATE OF ORCHARD-DERIVED ARSENICAL PESTICIDES IN NEW ENGLAND STREAMS

Elizabeth J. Barclay, Carl Renshaw, Benjamin Bostick, W. Brian Dade, and Francis Magilligan, Department of Earth Sciences, Dartmouth College, Hanover, NH 03755

While flume studies suggest that flow interactions between a stream and its bed can potentially impact the transport and fate of dissolved and suspended contaminants, these impacts are less well documented in the field. Of particular interest in New England is the transport and fate of arsenic in alluvial hyporheic sediments derived from orchards where arsenic-based pesticides were widely used in the early 1900's. We are investigating the distribution of arsenic contamination in hyporheic sediments not only longitudinally downstream from their presumed source, but also vertically in the stream bed. We have identified two field sites in southern New England that drain disturbed orchard lands, as well as one control site where no agricultural influence has occurred. At the two sites below orchards we have taken, at downstream intervals of several hundred meters, vertical profiles in 5-cm increments down to 25 cm. In a companion study we are also investigating the temporal variation in the vertical distribution of an atmospherically derived short-lived radioisotope ^{7}Be. We have found relatively little variation in vertical distribution of contaminants, possibly suggesting significant penetration and more or less uniform mixing of contaminant loads to depths of several tens of centimeters and more. The ^{7}Be activity in the stream is closely correlated to samples adjacent to the streambed indicating that sediment washed into the stream is infiltrating into the bed down to 8 cm relatively quickly. We have also found that the longitudinal decrease in sediment contaminant concentration with distance from the source cannot be explained by dilution alone, suggesting some of the contamination entering the streams is being sequestered. The significant penetration of the contamination into the stream bed suggests that stream bed storage may be partially responsible for the rapid attenuation downstream. These results demonstrate that hyporheic sediments can filter and store potentially large amounts of contaminants for long periods of time and thus stream bed interactions have a significant impact on the transport and fate of suspended contaminants.

A FLUVIAL RECORD OF LAND-USE CHANGE IN THE OTTER CREEK BASIN, VERMONT

Carrie Childs, Geology Department, Middlebury College, Middlebury, VT 05753

Significant land-use changes have occurred throughout North America as a result of human habitation. Native American and European settlers both made significant alterations to the natural landscape for survival, resulting in a disruption of otherwise "natural" ecological, biological, and geologic cycles. As populations increased dramatically over the last two centuries, these alterations became more prevalent and pronounced.

As part of the Otter Creek Integrated Watershed Study this study aims to bridge the gap between historical geographic information concerning industry and land-use changes in the Otter Creek

Basin and the geologic sediment record. Two cores extracted from the Otter Creek Delta underwent ICAP spectral analysis, grain size analysis, magnetic susceptibility determination, x-ray diffraction, and x-ray and digital photography in order to determine if changes in historical industry or known large events have physical proxies in the cores.

Significant wood-chip layers were observed occurring randomly down the length of a 3-meter core taken from the modern delta (OCD-2). These layers include potentially not-naturally occurring wood chips and shavings and pieces of charcoal, possibly indicators of extensive wood-based industries up-stream. Initial ^{210}Pb dating of the upper 10 cm revealed significant bioturbation, requiring further dating analysis. Trace metal analysis in the core revealed increasing contamination in the upper layers of sediment, particularly concerning Pb and P concentrations. This may be a result of the introduction and subsequent use of tetraethyl lead as an anti-knock agent in leaded gasoline from 1920 to 1950, and introduce the possibility of fertilizer contamination. Further testing is being done to determine arsenic and mineralogy of specific silica-rich zones in the cores.

SULFUR OXIDIZING BACTERIA IN THE FRASASSI CAVE SYSTEM, ITALY

Danielle Eastman, Gregory Druschel, Jenn Macalady, Dan Jones, and Lindsey Albertson, Department of Geology, University of Vermont, Burlington, VT 05405

The Frasassi Cave System, located in the Marche Region of central Italy, is forming in Jurassic-aged Calcare Massiccio limestone of the Apennine Mountains. Research on this karst system focuses on its sulfur chemistry and on the microbes that inhabit its aqueous subterranean environments. Microbial communities of sulfur-reducing and sulfur-oxidizing organisms in the aqueous regions of the Frasassi caves, as well as on the walls and ceilings, are catalysts for the majority of the oxidation-reduction reactions involved in sulfur cycling through the caves. These reactions fuel sulfuric acid production and represent a biological feedback to sulfuric acid speleogenesis. Using electrochemical techniques, specifically voltammetry, we were able to identify the chemical differences that may relate to the selection of different microbial communities. The comparison of a number of cave sites and ecosystems provides unique information to better understand the pathways through which sulfur is oxidized, the rate at which this happens, and the chemical parameters specific to each microbial niche. The understanding of chemical cycling through these simple aqueous environments can be applied to the investigation of sulfuric acid speleogenesis as well as to more complex environments.

GEOCHEMICAL SULFUR CYCLING AND ORGANIC INTERACTIONS ASSOCIATED WITH MICROBIAL COMMUNITIES AT GREEN LAKE, NEW YORK

Lydia G. Smith and Gregory K. Druschel, Department of Geology, University of Vermont, Burlington, VT 05405

Green Lake, located in Fayetteville, NY, is a mermocitic lake with significant geochemically influenced microbial activity. The permanently stratified water column is characterized by the presence of an oxic/anoxic chemocline in which an abrupt chemical contrast provides potential energy for the microbial coupling of reduced/oxidized forms of sulfur intermediates (S, HS^-, polysulfides, etc.), as well as C, N, and P. Two vertical profiles of *in situ* electrochemical data were compiled in the fall of 2006. A solid-state electrode system, consisting of PEEK working,

reference, and counter electrodes, was weighted and lowered at 1 meter increments. Several cyclic and square wave voltammetry scans were run at each increment and recorded on the computer. The oxic/anoxic interface was determined to be at 21 meters below the surface based on increasing anoxic conditions with depth (oxygen became depleted with increasing sulfide), and this water was pink because of abundant purple sulfur bacteria. Water samples from this depth were obtained with a Niskin bottle and kept for lab experimentation. Distinct sulfide peaks were observed on the voltammograms as well as other unknown peaks of sulfur intermediates. Polysulfide salts, NaS_4 and NaS_5 (S_4^{2-} and S_5^{2-}) were synthesized through the procedure published by Rosen and Tegman (1971) to characterize these signals. Lab experiments involved voltammetric analysis of hydrogen sulfide additions to the Green Lake water, in hopes of building a calibration curve for the determination of sulfide and polysulfide concentrations through the profile. Sulfide additions to fresh Green Lake water samples resulted in a reaction that consumed sulfide and formed a precipitate, likely elemental sulfur. This reaction only occurred in scans run with fresh Green Lake water, before less recalcitrant organic molecules broke down. This is indicative of a reaction between sulfide and dissolved organic matter which has been linked to sulfur colloid precipitation by Heitmann and Blodau (2006) and illustrates the important link between organic chemistry and sulfur cycling in these types of systems.

PRESIDENT'S LETTER

Hello all,

The Society has field trips lined up, a VGS Lecturer in Jon Kim, and the Spring VGS Meeting coming up soon (see details for all of these in this issue). The VGS is healthy and active, as witnessed by the nice turn out at the Winter Meeting at Norwich, where several people traveled in bad weather to attend—and thanks to all of you.

Marjie Gale of the Vermont Geological Survey recently sent out a reminder of Earth Science Week, October 14-20, and I encourage each of you to find a way to use that event to generate interest and awareness of our discipline. The theme this year is "The Pulse of Earth Science", focusing on geoscience research and earth science in education and society. See that? Education and society. While people are more and more aware of science (especially through 'global warming'), science leadership in our society is eroding. Erosion—we know something about that, and we know it is hard to stop, so we all have to get creative and help promote education and awareness of geoscience.

The Spring Meeting is on April 28th, at the University of Vermont, so please attend and enjoy the student scholarship. See you at the meeting or in the field.

Best wishes,
Rick Dunn, President

WINTER MEETING MINUTES

Following the presentations associated with the Winter Meeting held at Norwich University, a quorum was declared and President Rick Dunn called the Executive Committee Meeting to order. Treasurer Steve Howe indicated that the financial condition of the Society remains sound. The total VGS membership (individuals + institutions) is holding steady at about 120.

Steve Howe also reported for the Advancement of Science Committee and indicated that one new research grant had been awarded to Colleen Sullivan from Middlebury College. In an effort to encourage new membership, it was agreed that research grant awardees would now receive a one-year cost-free VGS membership, including electronic receipt of the *Green Mountain Geologist*, in the hopes that they will retain a long-term affiliation with the Society. It was also reiterated that research grant awardees must present their results at a professional conference (e.g., Spring VGS meeting, NEGSA).

The Committee briefly discussed the status of upcoming VGS field trips. Peter Thompson of the University of New Hampshire has tentatively agreed to lead the summer field trip to the Woodstock–Quechee area and Dave West of Middlebury College has tentatively agreed to lead the fall field trip to the Middlebury area. Details of these trips will be forthcoming.

The Committee noted that the Society's new Lecturer, Jon Kim of the Vermont Geological Survey, is offering two separate talks on groundwater problems and will be speaking at Alfred University in April. The Committee approved a motion that the VGS Lecturer would be reimbursed for mileage, and if necessary, per diem meals and lodging expenses, at the standard federal rates.

Steve Howe reported that John Van Hoesen was working on setting up in the next few months a ListServ for the Society, hosted by Green Mountain College, for the purpose of discussing all aspects of Vermont Geology. Rick Dunn agreed to contact Stephen Wright to come up with ways, including the design of a poster, to promote VGS membership, particularly among students. He also noted that he would be stepping down after his two-year term as President is up following the Annual Meeting in the fall. Vice President George Springston agreed to his nomination as a candidate for President to succeed Rick, and both Dave West and Steve Howe indicated they would also agree to be candidates for their respective positions. The Committee will be looking into nominating a candidate for Vice President to succeed George.

Finally, in an effort to increase participation at the Winter Meetings, the Committee agreed to reinstitute a "general theme" for future Winter Meetings. The theme for the 2008 Winter Meeting will be "Holocene Climate Change." It was reiterated that all presentations need not be associated with the meeting theme, however, efforts would be made to attract speakers who fit into the theme. The meeting was adjourned.

Respectfully submitted,
David West, Secretary

TREASURER'S REPORT

The financial condition of the Society continues to be very strong. As of April 9, 2007, the Society's checking account balance was $ 6,343.14. To my knowledge, there are no outstanding bills.

The following members have been approved for membership in the Society since the last report: Jason Clere, Portland, Maine; Carey Hengstenberg, Burlington, Vermont; James Nizamoff, Proctor, Vermont; and Matt Trieber, Bellows Falls, Vermont.

Respectfully submitted,
Stephen S. Howe, Treasurer

ADVANCEMENT OF SCIENCE COMMITTEE REPORT

This year, the Society's Winter Meeting in March was designed purposely without a theme. Dave Westerman kicked the meeting off with his review of Devonian plutons in Vermont, followed by George Springston's discussion of a rockfall hazard assessment of Vermont highways, and concluding with Rick Dunn's description of mapping colluvium near potential archeological sites in Greece. As always, members are encouraged to contact me with any suggestions they may have for topics or presenters for next year's meeting.

The Committee received no applications to the Society's Research Grant Program by the deadline of March 31, 2007. Applications for the second round are due October 1, 2007. Please see the Society's website for details.

The Committee gratefully acknowledges the contributions to the Society's Research Grant Program by the following members:

Laurence R. Becker
E. Stanley Corneille, Jr.
Jeanne C. Detenbeck
Barry Doolan
Albert W. Gilbert, Jr.
Timothy W. Grover
Barbara L. Hennig
Jefferson P. Hoffer
Jon Kim
Carl Koteff
Frederick D. Larsen
John A. Malter
Helen Mango
J. Gregory and Nancy W. McHone
Alexis P. Nason
William D. Norland
George Springston
Sharon Strassner
Roger and Terry Thompson
David West

Respectfully submitted,
Stephen S. Howe, Chair

VERMONT STATE GEOLOGIST'S REPORT

A bill related to groundwater mapping was passed by the Vermont Senate in March 2007. This bill will still need to be considered by the Vermont House. The following is the text from the bill:

S.92 AN ACT RELATING TO GROUNDWATER MAPPING
It is hereby enacted by the General Assembly of the State of Vermont:
Sec. 1. 10 V.S.A. § 1416 is added to read:
§ 1416. GROUNDWATER MAPPING

(a) In accordance with the requirements of subdivision 1392(a)(4) of this title to identify and map the groundwater resources of the state, the secretary of natural resources shall establish a groundwater mapping program within the office of the state geologist. The groundwater mapping program shall identify public water supply sources and groundwater sources that may serve as future public water supply sources. The office of the state geologist shall also identify areas of interest that require additional mapping, including location of water wells, mapping of surficial geology and bedrock, and, if funds are available, geophysical studies.

(b) Prior to October 15, 2007, the secretary of natural resources shall develop a schedule for mapping the groundwater resources of the state. In developing the schedule for mapping the groundwater resources of the state, the secretary shall give priority to municipalities, watersheds, and other areas subject to development pressure, groundwater supply shortages, groundwater quality issues, or commercial groundwater withdrawal. The secretary shall submit the schedule required by this section to the legislative study committee on groundwater regulation and funding, the senate committee on natural resources and energy, and the house committee on fish, wildlife and water resources.

(c) The secretary of natural resources may adopt rules implementing the requirements of this section.

Sec. 2. AGENCY OF NATURAL RESOURCES GROUNDWATER FUNDING REPORT

(a) On or before October 15, 2007, the agency of natural resources shall report to the senate committee on natural resources and energy and the house committee on fish, wildlife and water resources with a recommendation for funding the groundwater resources of the state as required under sections 1392 and 1416 of Title 10. The report shall include:

(1) A summary of the current groundwater mapping conducted or completed by the agency of natural resources, including use of compiled groundwater data, well driller reports, and other groundwater data.

(2) A summary of the appropriations and personnel currently available to the agency of natural resources for groundwater mapping.

(3) An estimate of the appropriations and personnel necessary to fund the mapping of the groundwater resources of the state as required by sections 1392 and 1416 of Title 10 and a proposal for incorporating such appropriations into the agency of natural resources' annual budget.

(b) Upon completion of the report required by this section, the agency of natural resources shall submit the report to the legislative study committee on groundwater regulation and funding.

Respectfully submitted,
Laurence R. Becker, State Geologist

ANNOUNCEMENTS

VERMONT GEOLOGICAL SOCIETY LECTURER PROGRAM

The goal of the Vermont Geological Society Lecturer Program is to offer local colleges, universities, and high schools the opportunity to invite a member of the VGS to speak at their institution on timely topics within the broad realm of earth and environmental sciences. The program is primarily intended to reach those departments which either do not hold a regularly scheduled seminar series or whose finances do not permit them to invite external speakers to present talks on a regular basis. Any costs associated with the Lecturer's travel, lodging, and meals are borne entirely by the Vermont Geological Society.

Jon Kim, Ph.D., Geologist/Environmental Scientist, at the Vermont Geological Survey in Waterbury, Vermont, is our 2007 Lecturer. Jon is offering the following two lecture topics: "Nitrate Contamination of a Bedrock Aquifer in Central Vermont" and "Application of Tectonics to Groundwater Problems in Vermont." For scheduling information, see the Society's website at *www.uvm.org/vtgeologicalsociety/lecturer_program.html*

VGS SUMMER FIELD TRIP: FROM WOODSTOCK TO QUECHEE GORGE

The summer field trip will be held on Saturday, August 11, 2007. We will meet at 9 AM in the parking lot *west* of Quechee Gorge, on the north side of Route 4. Rest rooms are available at the Visitor Center *east* of the gorge.

Pete Thompson and Dave DeSimone will show us the results of their recent project to characterize aquifers in the town of Woodstock. We will look at well logs and cross sections that show evidence for a confined sand and gravel aquifer in the valleys, and discuss models for recharge to that important resource. Outcrops will be selected to illustrate both the jointing characteristics of the bedrock and the significance of a zone of steeply dipping layers to the geohydrology. Peter will also present evidence for refolded nappes and topping directions across the Standing Pond Volcanics.

The trip will end up at Quechee Gorge in the town of Hartford. If you are interested in camping at Quechee Gorge State Park either Friday or Saturday nights, please e-mail Peter so he can reserve a group area, if there's enough interest. Greg McHone hopes to join the trip to show us a mafic dike in the gorge, and others will be on hand to discuss hypotheses regarding the gorge formation.

STUDENT RESEARCH GRANT APPLICATIONS

Students and secondary school teachers are encouraged to apply to the VGS Research Grant Program by October 1, 2007. Downloadable Research Grant Program applications are available from the Society's website at *www.uvm.org/vtgeologicalsociety/grantpolicy.html*. For those without Internet access, forms may be obtained by writing to Stephen Howe at the Dept. of Earth and Atmospheric Sciences, University at Albany, ES-351, 1400 Washington Avenue, Albany, NY 12222-0001. Tel: (518) 442-5053; e-mail: showe@albany.edu

VERMONT GEOLOGICAL SOCIETY CALENDAR

April 28, 2007:	Spring Meeting, University of Vermont
August 11-12, 2007:	Summer Field Trip
October 14-20, 2007:	Earth Science Week
October 28-31, 2007:	Geological Society of America Annual Meeting

The ***GREEN MOUNTAIN GEOLOGIST*** is published quarterly
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Vermont Geological Society
P.O. Box 1224
Saint Albans, VT 05478-1224

ADDRESS CHANGE?
Please send it to the Treasurer at the above address

Vermont Geological Society
Spring Meeting
April 28, 2007, 8:30 AM
Delehanty Hall, Room 219
University of Vermont, Burlington, Vermont

Directions to University of Vermont:

Delehanty Hall is located on the old Trinity College Campus adjacent to the University of Vermont. From I-89, take exit 14 (Main Street–Route 2 exit), and go west (towards the lake) to East Avenue. Turn right on East Avenue and go to the end of East Avenue and proceed straight across Colchester Avenue and into the driveway. Delehanty Hall has a slate exterior and large granite blocks in front of it. Once on the driveway, bear around to the left and the parking lot is in the rear.

THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

VGS Website: www.uvm.org/vtgeologicalsociety/

SUMMER 2007	VOLUME 34	NUMBER 3

The Vermont Geological Society's
Summer Field Trip

Aquifers of Woodstock, Vermont
Mesozoic Dike in Quechee Gorge, Vermont

August 11, 2007

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SUMMER FIELD TRIP DESCRIPTION AND ROAD LOG

Saturday, August 11, 2007

TITLE: Aquifers of Woodstock, Vermont and Mesozoic Dike in Quechee Gorge, Vermont

TIME: 9:00 AM – afternoon

MEETING POINT INFORMATION: Assemble to leave around 9:00 AM from the Quechee Gorge State Park Visitor's Center, Route 4 east of Gorge. (Travel west on Route 4 from I-89 exit #1.) Those arriving from the north, east and south should meet at the Gorge. Members driving from the west (Rutland direction) may meet us at the Bridgewater Mill Mall, east end of the parking lot, around 9:30 AM. Those doing so, however, should be aware that the final stop is close to the Quechee Gorge Visitor's Center—not the Mall. WE WILL CAR POOL AS MUCH AS POSSIBLE.

LEADERS: Peter J. Thompson and David DeSimone (Woodstock area)
J. Gregory McHone (Quechee Gorge area)

FIELD TRIP DESCRIPTION: The main purpose of this trip is to visit key sites that demonstrate findings of our recent project to characterize aquifers in the town of Woodstock. Theoretical considerations of bedrock geology will logically lead to two stops in the Quechee quadrangle to the east. We will end at Quechee Gorge, where a Mesozoic dike may have played a role in the formation of the Gorge. Research supported in part by the Vermont Geological Survey and the USGS National Cooperative Mapping Program.

Bring water and lunch, although we will be near a country store (with a restroom) around noon. Wear shoes you don't mind getting wet and muddy.

If you wish to join us to stay at the Quechee Gorge State Park campground Saturday night, make reservations soon, as weekends are busy at the campground. For reservations visit the Vermont State Parks website www.vtstateparks.com or call 802-295-2990 (Quechee State Park, in season).

FIELD TRIP ROAD LOG: (See above for information on departure location)

0.0 Leave Visitor's Center, drive west across the Gorge.

0.2 Pull into parking lot west of Gorge to further consolidate vehicles.
- Follow Route 4 through Woodstock village (there may be some detour signs).

13.8 Turn left into Bridgewater Mill Mall, proceed along river to bridge.
- Left across Ottauquechee River, left onto Curtis Hollow Road.
- Keep straight onto Larry Curtis Road.

14.6 TURN AROUND BEYOND ONE-WAY BRIDGE AND PARK OFF THE TRAVELED WAY. OUTCROPS IN THE RIVER.

Stop 1 Barnard Gneiss: Ordovician metavolcanics, less strongly jointed than most other rock units in Woodstock, but several wells in Curtis Hollow have high yields.

• Retrace route and proceed east on Route 4.

16.4 Note outcrops along the south bank of the river—these are garnet schist of the Silurian "Northfield Slate."

17.0 After Ottauquechee Motel turn left on Meadow Way. Drive up past till exposures (dug wells at the sand/till interface provided water to the farm which formerly stood here).

17.2 PARK ALONG RIGHT OF THE GRAVEL ROAD; DO NOT BLOCK DRIVES.

Stop 2 Kame Terraces: Sand and gravel deposits on the north side of the valley overlie thick till, which in turn overlies a buried sand and gravel aquifer. Dave will present an overview of the surficial geology at this stop.

17.4 Continue east on Route 4.

~18.8 Turn right across covered bridge, turn left downstream. *(Lincoln Bridge, 1877, is unique in that the builders modified the Pratt arch by using both wood and iron in the truss. Pratt's bridges were entirely of steel.)*

~19.5 Bear right and right again onto Fletcher Hill Road.

19.8 PARK ON RIGHT OF ROAD, BUT AVOID DITCH. LANDOWNER PERMISSION REQUIRED. *(Note stone house made of Waits River Fm.)*

Stop 3 Glacial till: Tall brook exposure of till and possibly lacustrine clay.

• Continue up Fletcher Hill to height of land.

~22.2 Turn left into second blind driveway on left—DANGEROUS TURN!

Stop 4 Silurian Waits River Formation in South Woodstock syncline: Garnet schist interlayered with sandy, punky brown-weathering limestone. Round, open hilltops are typical of this formation all through eastern Vermont—hilltop farms have continued because of the rich limey soils. Strongly jointed and often deeply weathered, this unit is the most permeable in Woodstock. Peter will present an overview of the bedrock geology at this stop.

• Return to Fletcher Hill Road, turn left (NOTE MIRROR ON TREE TO AID IN WATCHING FOR TRAFFIC)

22.7 Bear left at triangle.

23.8 Right at next triangle (view of pond).

23.9 Left at next triangle (Kendall Road in South Woodstock), and immediately left onto Randall Road.
(You may wish to visit the country store in South Woodstock before lunch at Stop 5.)

• Follow Randall Road north to dead end.

24.8 PARK BEYOND STONE HOUSE. DO NOT BLOCK ROAD SOUTH OF STONE HOUSE. LANDOWNER PERMISSION REQUIRED. *(Where did the builders find stone for houses such as this? I have found no old quarries in the Waits River Fm.)*

Stop 5 Waits River Formation in steeply dipping zone, with important implications for water availability**:** This zone is noted for either high-yield wells or dry wells. Lunch on outcrops in the abandoned road. Glacial striae on woods road to east.

• Retrace road to South Woodstock.

25.6 Turn left onto Route 106 north. Pass first golf course parking area, turn right into second country club parking lot (includes restaurant).
30.2 Walk west up driveway to steep slope. LANDOWNER PERMISSION REQUIRED.

Stop 6 Mt. Tom member of Waits River graded beds: The Mt. Tom member lacks significant punky brown layers. Here bedding is overturned and tops face east. The implication is that the Standing Pond and Gile Mountain Formations lie stratigraphically above the Waits River Formation, a matter of debate among geologists for decades.

• Continue north to Woodstock village, turn right at the Green, then left onto Route 12 north.

• Turn right onto Pleasant Street and watch for Free Parking sign on left—at old mill site on Kedron Brook. Walk back to Elm Street to the north side of the steel bridge.

Stop 7 Standing Pond Volcanics under bridge: Garbenschiefer with 1- and 2-cm garnets and large amphibole fascicles, interlayered with various rocks. This is the most heterogeneous unit in town.

• Continue north on Route 12.

32.1 Turn right at Y onto Pomfret Road.

32.5 Turn left onto Stimets Road.
• Park along right side of Stimets Road.

Stop 8 Woodstock well field: These wells tap the buried aquifer.

• Continue west on Stimets Road, turn left onto Route 12.

• Turn left before the Billings Farm Museum and follow the River Road to Taftsville, cross the Ottauquechee *(Taftsville Bridge, 1836, third oldest in state, "mongrel" style)*.

• Rejoin Route 4 (left at dangerous intersection), continue east more than two miles.

• Turn right on Gilson Avenue, then right again onto Marsh Family Road, go up hill to Frost Lane.

Stop 9 Devonian Gile Mountain Formation: Feldspathic quartzites and garnet schist. Similar rocks in the Hartland quadrangle on strike to the south were mapped by Walsh (1998) as a member of the Waits River Formation. *(I disagree for reasons that will be explained on the trip.)*

• Return to Route 4, proceed east to Quechee Gorge.

Stop 10 Mesozoic dike in Gile Mountain Formation: Follow trail from parking lot on northwest side towards the dam and down to the river. Discussion about how the Gorge formed. Also note that the country rocks here contain calcareous layers—we can speculate as to whether they represent a facies of the Gile Mountain Formation, or structural infolds of Waits River Formation.

PRESIDENT'S LETTER

Greetings,

First, I want to remind everyone that the VGS Summer Field Trip to the Woodstock-Quechee Gorge area is August 11th, the general topic being hydrogeology. I understand that at some point the weather might dry out this summer and so I hope everyone will make it to the trip.

The Society is financially strong, and on that note I encourage you to help students submit applications to our Research Grant Program. An intriguing development for the Society is the implementation of the VGS ListServ, which should be up and running soon, thanks very much to John Van Hoesen and a server at Green Mountain College. Once running this can serve as a clearinghouse for information about the Society and a place for anybody who has questions to ask them of the membership.

We had a wonderful set of student papers at the Spring Meeting, hosted by UVM (thank you to Char Mehrtens, especially).

Jon Kim, of the Vermont Geological Survey, is the current VGS Lecturer and he is available, free of charge, to your school to give a talk. See the VGS website or the "Announcements" section of this *Green Mountain Geologist* for his topics and contact information.

And one last reminder, the Fall Field Trip will probably be in October in the Middlebury vicinity. Looking forward to seeing people on August 11th. Enjoy your summer!

Best regards,
Rick Dunn, President

SPRING MEETING MINUTES

The Executive Committee of the Vermont Geological Society met following the student presentations during the very successful Spring Meeting held at the University of Vermont on April 28, 2007. All of the officers, except for Dave West, and all of the Board of Directors, were present. Steve Howe took the minutes for Dave.

1. The Treasurer's report was given by Steve Howe, who indicated that the Society had a balance of $6,036.64 in its checking account, and that Char Mehrtens' bills for the refreshments at the Spring Meeting were the only bills outstanding.

2. Steve reported that no Research Grant Program applications were received by the March 31, 2007 deadline. The deadline for the next round of applications is October 1, 2007.

3. Jon Kim, the Society's 2007 Lecturer, reported that he had presented talks at Alfred University and Mt. Abraham High School. Other talks would be scheduled in the fall.

4. The VGS Summer Field Trip is scheduled for Saturday, August 11, 2007. Pete Thompson and Dave DeSimone will lead a trip concentrating on the hydrogeology of the Woodstock–Quechee Gorge area. Steve reported that Dave West had agreed to lead the VGS Fall Field Trip to the Middlebury area in October.

5. John Van Hoesen reported that a single server at Green Mountain College would be dedicated to the VGS ListServ, once it is up and running.

6. The succession of officers and directors in the fall was discussed, with Rick Dunn to be appointed to a one-year term on the Board of Directors, as Immediate Past President, per Society By-laws, replacing John Van Hoesen, who would vacate his elected position on the Board to stand as a candidate for Vice President of the Society.

7. The officers and directors discussed the scheduling of the Society's meetings, noting that the Spring Meeting had been scheduled to avoid conflicting with the Lake Champlain Research Consortium held the previous week at St. Michael's College. It was agreed that every effort would continue to be made to avoid scheduling future Winter, Spring, and Fall Meetings on dates that would conflict with other meetings of interest to the Society's members.

Respectfully submitted,
Stephen S. Howe

TREASURER'S REPORT

The financial condition of the Society continues to be very strong. As of July 20, 2007, the Society's checking account balance was $6,035.50. To my knowledge, there are no outstanding bills.

Respectfully submitted,
Stephen S. Howe, Treasurer

ADVANCEMENT OF SCIENCE COMMITTEE REPORT

The Society's Spring Meeting was a showcase for the excellent research carried out by 12 undergraduate and graduate students from Dartmouth College, Green Mountain College, Middlebury College, and the University of Vermont. The following students received awards for their presentations:

1st Place Award ($100): Paul Betka, University of Vermont
2nd Place Award and Doll Award ($75): Danielle Eastman, University of Vermont
3rd Place Award ($50): Lee Corbett, Middlebury College
3rd Place Award ($50): Michael Gleason, Middlebury College

The Charles G. Doll Award, given for the top undergraduate student presentation, is a plaque with the student's name and school engraved on it that is kept at the student's school until the following year's Spring Meeting.

The Committee received no applications to the Society's Research Grant Program by the deadline of March 31, 2007. Applications for the second round are due October 1, 2007. Please see the Society's website or the "Announcements" section of this *Green Mountain Geologist* for details.

The theme of the Society's upcoming Winter 2008 Meeting will be "Holocene Climate Change." Members are encouraged to contact me with any suggestions they may have for speakers.

Respectfully submitted,
Stephen S. Howe, Chair

VERMONT STATE GEOLOGIST'S REPORT

Northern Vermont Cross-Sections submitted for New State Bedrock Map

The Vermont Geological Survey (VGS), the U.S. Geological Survey (USGS), the University of Vermont (UVM) and contractors have participated since the early 1980's in a cooperative venture (COGEOMAP and STATEMAP) to produce the new bedrock geological map of Vermont. The map, at a scale of 1:100,000, incorporates field studies conducted over 30 years by more than 60 geologists. Editors for the Vermont map are Nicholas Ratcliffe (USGS), Rolfe Stanley (posthumous), Marjorie Gale (VGS), and Peter Thompson (UNH). The one-degree sheets were compiled by Rolfe Stanley, Barry Doolan, and Charlotte Mehrtens of UVM; Marjorie Gale, Jonathan Kim, and Peter Thompson (contractor) of VGS; and Nicholas Ratcliffe, Norman Hatch, Douglas Rankin, and Greg Walsh of USGS. Vermont State Geologists involved in the project include Laurence Becker, Diane Conrad, and Charles Ratté. Many other geologists have also made significant contributions to the new map.

The map was recently produced for review in Adobe Illustrator. The correlation of units chart (CMU) and unit descriptions (DMU) have also been digitized for scientific review. M. Gale and P. Thompson delivered four cross-sections for northern Vermont this week to the USGS. The cross-sections are interpretive and portray the geology at depths to 5 km. The sections are key for understanding the geology as shown on the map and represent a milestone in the overall project. The map and cross-sections, once through scientific review and publication, will be used for all land-based analyses of environmental issues in Vermont including groundwater, biodiversity and habitat, land management and hazard assessment, and mineral resources.

Education

In April, the State Geologist spoke about "Groundwater Mapping and Opportunities for Town Planning" to the Town Officers Education Conference held in Lyndonville, Colchester, Fairlee, and Rutland. Municipal officials in Vermont are requesting maps that identify groundwater resources to provide a base for planning and protection. The talk covered how the mapping is conducted, how the maps are used, and how a town can become a mapping partner.

On April 10th Jon Kim of the Vermont Geological Survey gave a presentation to an Environmental Science class of juniors and seniors at Mt. Abraham Union High School in Bristol on nitrate contamination of a bedrock aquifer in the vicinity of a large dairy farm in central Vermont.

On April 23rd Jon Kim led a field trip to the North Branch of the Winooski River in Putnamville for a Structural Geology class from Norwich University. The field trip area was mapped by the Geology Division in 2003.

Northeast Geological Society of America Meeting

Vermont Geological Survey (Division of Geology) geologists and project collaborators were authors on nine papers presented at the 42nd Annual Meeting of the Northeastern Section of the Geological Society of America in Durham, New Hampshire. Papers covered a variety of topics including an overview of recent Survey activities and applied studies, groundwater resources and contaminants projects, rockfall hazards, tectonics, and glacial geology. Collaborators from Middlebury College, the Vermont Department of Agriculture, University of New Hampshire, the Vermont Department of Transportation, and Norwich University were co-authors on the presentations. Geologists from the Division also attended a full-day USGS–State Geologists cluster meeting which fostered discussions for future cooperative work. The outcome is that projects have been developed with base science so when applied to the protection of health, safety, and the general welfare the underlying science is known to be defensible. The public wants to know that the base science is sound but focuses on the societal outcome.

Respectfully submitted,
Laurence R. Becker, State Geologist

ANNOUNCEMENTS

VERMONT GEOLOGICAL SOCIETY LECTURER PROGRAM

The goal of the Vermont Geological Society Lecturer Program is to offer local colleges, universities, and high schools the opportunity to invite a member of the VGS to speak at their institution on timely topics within the broad realm of earth and environmental sciences. The program is primarily intended to reach those departments which either do not hold a regularly scheduled seminar series or whose finances do not permit them to invite external speakers to present talks on a regular basis. Any costs associated with the Lecturer's travel, lodging, and meals are borne entirely by the Vermont Geological Society.

Jon Kim, Ph.D., Geologist/Environmental Scientist, at the Vermont Geological Survey in Waterbury, Vermont, is our 2007 Lecturer. Jon is offering the following two lecture topics: "Nitrate Contamination of a Bedrock Aquifer in Central Vermont" and "Application of Tectonics to Groundwater Problems in Vermont." For scheduling information, see the Society's website at *www.uvm.org/vtgeologicalsociety/lecturer_program.html*

STUDENT RESEARCH GRANT APPLICATIONS

Students and secondary school teachers are encouraged to apply to the VGS Research Grant Program by October 1, 2007. Downloadable Research Grant Program applications are available from the Society's website at www.uvm.org/vtgeologicalsociety/grantpolicy.html. For those without Internet access, forms may be obtained by writing to Stephen Howe at the Dept. of Earth and Atmospheric Sciences, University at Albany, ES-351, 1400 Washington Avenue, Albany, NY 12222-0001. Tel: (518) 442-5053; e-mail: showe@albany.edu

VERMONT GEOLOGICAL SOCIETY CALENDAR

8/11/07	VGS Summer Field Trip, Woodstock to Quechee Gorge, Vermont
9/28-30/07	NYSGA Annual Meeting, Cortland, New York
10/1/07	Student Research Grant Program Applications due
10/5-7/07	NEIGC 99th Annual Meeting, Quebec City, Quebec, Canada
10/14-20/07	Earth Science Week
10/28-31/07	GSA Annual Meeting and Exhibition, Denver, Colorado

The ***GREEN MOUNTAIN GEOLOGIST*** is published quarterly
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Vermont Geological Society
P.O. Box 1224
Saint Albans, VT 05478-1224

ADDRESS CHANGE?
Please send it to the Treasurer at the above address

Vermont Geological Society
Summer Field Trip
August 11, 2007, 9:00 AM
Quechee Gorge State Park Visitor's Center

From I-89, take US Route 4 at Exit 1. Go 3 miles west on Route 4. We will meet at the Quechee Gorge Visitor's Center at 9:00 AM. Those arriving from the north, east and south should meet at the Gorge. Members driving from the west (Rutland direction) may meet us at the Bridgewater Mill Mall, east end of the parking lot, around 9:30 AM. Those doing so, however, should be aware that the final stop is close to the Quechee Gorge Visitor's Center—not the Mall. WE WILL CAR POOL AS MUCH AS POSSIBLE.

THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

VGS Website: www.uvm.org/vtgeologicalsociety/

FALL 2007	VOLUME 34	NUMBER 4

The Vermont Geological Society's
Fall Field Trip & Annual Meeting

An Overview of the Bedrock Geology between Middlebury Village and Middlebury Gap, Vermont

October 20, 2007

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FALL FIELD TRIP DESCRIPTION AND ROAD LOG
Saturday, October 20, 2007

TITLE: An Overview of the Bedrock Geology between Middlebury Village and Middlebury Gap, Vermont.

LEADER: David West, Geology Department, Middlebury College

TIME: 9:00 AM to mid-afternoon

MEETING POINT INFORMATION: We will meet at 9:00 AM at the Maplefields Convenience Store (also a Mobil Gas Station) on US Route 7 approximately 4.5 miles north of the traffic circle in Middlebury. Please note there are a couple of Maplefields store locations in and around Middlebury – this one is located ***4.5 miles north of Middlebury*** on Route 7 and is on the ***east*** side of the highway.

FIELD TRIP OVERVIEW: The purpose of this trip is to visit and discuss bedrock exposures along the western flank of the Green Mountains and the eastern side of the Champlain Valley at the approximate latitude of Middlebury, Vermont. We will visit two large quarry exposures in Ordovician carbonate rocks of the Champlain Valley sequence where participants will have opportunities to view spectacular continuous 3-D exposures that illustrate the deformational style of rocks in the Middlebury Synclinorium. The trip will then progress down-section with a visit to a classic exposure of Cambrian quartzites, and culminate with exposures of Middle Proterozoic basement rocks in the Lincoln Massif and surrounding metamorphosed cover rocks of the Hoosac Formation.

Participants should bring water and lunch, although we will be in the vicinity of a country store around noon. Participants should wear sturdy shoes as a moderate hike is planned for later in the day (at the Middlebury College Snowbowl). We will be visiting two active quarries during this trip and thus those following this guide in the future will be responsible for securing permission prior to visiting these sites.

Finally, the field trip leader does not profess to be an expert in the geology of this region as he is not currently mapping or conducting research in the region. Many of the localities we plan to visit are simply used by the leader as teaching sites for students at Middlebury College. The overall plan is to visit and discuss geological relationships at several exposures in the Middlebury area – and to incorporate what we see into discussions of the overall Middle Proterozoic to Early Paleozoic geologic history of the region.

FIELD TRIP ROAD LOG: (See above for information on departure location)

Mileage

0.0 Exit Maplefields Convenience Store parking lot and proceed north on Route 7.

0.8 Turn left (west) onto Campground Road.

1.0 Turn right into the Pike Aggregate Quarry service road. Please note that the distances traveled within the quarry are variable depending activity levels – *so the mileage readings should be reset at this point upon exiting the quarry.*

Stop 1—Weybridge Member of the Chipman Formation (upper part of the Beekmantown Group): Spectacular exposures of upright shallow-plunging folds in well-bedded light gray limestones. In addition, small-scale west-directed thrust faults with associated fault bend folds, and numerous high-angle oblique slip faults are exposed in the quarry walls. This quarry is located near the axis of the Middlebury Synclinorium.

1.0 Return to vehicles and exit via the quarry service road. Turn left on Campground Road at the entrance to the quarry and reset mileage. Drive east on Campground Road towards Route 7.

1.2 Intersection of Campground Road and Route 7. Turn right (south) on to Route 7 and drive towards Middlebury.

2.9 Cross bridge over the New Haven River.

6.2 First stop light in Middlebury. Turn right onto Elm Street.

6.3 Four-way stop sign. Continue straight across intersection.

7.0 Road bears left and Pulp Mill Covered Bridge crosses Otter Creek.

7.1 Immediately upon exiting the Pulp Mill Bridge, bear to the left.

7.5 Intersection with Route 23 (Weybridge Street). Turn left.

7.7 Turn right into Middlebury College Entrance Road (there is a sign for the entrance to the Freeman International Center).

7.8 Road forks – bear to the left towards the Atwater Parking Lot.

7.9 Park in the parking lot and proceed south to blasted outcrops behind the Atwater B Dorm (easternmost building).

Stop 2—Middlebury Limestone (Chazy Group): Freshly blasted exposures of dark gray, slaty, dolomitic limestone. In contrast to many of the more competent units within the Middlebury Synclinorium, rocks of the Middlebury Limestone are well cleaved and multiple cleavage generations are preserved.

7.9 Return to vehicles and retrace route back to Route 23 (Weybridge Street).

8.1 Intersection of College Entrance Road with Route 23. Turn left.

8.4 Turn right onto Morgan Horse Farm Road.

8.8 Stop sign. Bear to the right and cross the Pulp Mill Covered Bridge.

9.4 Stop sign. Continue straight as the road curves to the left.

9.5 4-way stop sign. Continue straight.

9.6 Stop light – intersection with Route 7. Turn right (south) onto Route 7.

9.9 Enter Middlebury traffic circle and continue south on Route 7.

11.0 Last traffic light in Middlebury – McDonalds on the right. Continue south on Route 7.

12.7 Turn left onto OMYA service road (green road sign is labeled "1975 – Private Road"). This road is easy to miss – it is just beyond a large industrial building on the left and before a car dealership.

13.0 Stop sign. Proceed straight across and through the gate to the OMYA quarry. Please note that the distances traveled within the quarry are variable depending activity levels – *so the mileage readings should be reset at this point upon exiting the quarry.*

Stop 3—Shelburne Formation: Expansive exposures of steeply dipping white marble and subordinate beds of light grey dolomitic marble. If time allows, we will examine unconsolidated glacial and post-glacial sediments (till and overlying varve sequence) that unconformably overlie the marbles.

13.0 Return to vehicles and exit the quarry via the service road. Reset mileage at the stop sign just beyond the gate and the entrance to the quarry. Turn left at the stop sign onto dirt road.

13.3 Stop sign – intersection with Cady Road. Turn left (east) onto Cady Road.

14.4 Stop sign – intersection with Route 116. Turn right (south) towards East Middlebury.

15.4 4-way stop sign – intersection with Route 125. Turn left (east).

16.5 Road turns sharply to the right and a bridge crosses over the Middlebury River. Immediately after crossing the bridge, pull over to the right side and park.

Stop 4—Cheshire Formation: Very carefully walk back across the bridge and proceed to outcrops just downstream of the bridge. At this latitude the Cheshire shows considerable

lithologic variability (e.g., phyllites, rusty weathering horizons), however, at this locality the rocks show little variability and consist of relatively pure, well-bedded quartzites.

16.5 Return to vehicles and continue east on Route 125 towards Ripton.

19.1 Approximately 100 meters south of the Ripton Country Store, pull over to the right (just before the guardrail) and park.

Stop 5—Deformed Middle Proterozoic intrusive rocks of the Lincoln Massif: Proceed very carefully down to bedrock exposures just upstream of the bridge. Please be careful, as these exposures are typically wet and slippery. Exposed in the stream are highly sheared, porphyritic (alkali feldspar up to 10 cm in length), muscovite-bearing granitoid gneisses. In places these gneisses are sheared against rusty weathering muscovite schists.

19.1 Return to vehicles and continue east on Route 125.

20.0 Pull over to the right, immediately beyond the sign for Old Town Road (Private).

Stop 6: Middle Proterozoic gneisses of the Lincoln Massif: Proceed very carefully to the small set of outcrops just below the bridge over the stream. This will be a quick stop with the primary purpose being to illustrate the lithologic variability in the Middle Proterozoic gneisses – and to contrast this exposure with what was observed at Stop 5.

20.0 Return to cars and continue east on Route 125.

22.2 Middlebury College's Breadloaf campus. Continue east on Route 125.
24.2 Entrance to the Middlebury College Snowbowl. Continue east on Route 125.

24.9 Pull over to the right and park in the parking lot where the Long Trail crosses Route 125. This is just to the west of the crest of Middlebury Gap.

Stop 7—Hoosac Formation: This stop involves an approximately 1.5 kilometer hike (each way) to the south along the Long Trail. Our ultimate destination will be Lake Pleiad. Along the hike we will see numerous exposures of greenish-gray schist/phyllite of the Hoosac Formation. At Lake Pleiad are extensive exposures of light gray, well-crenulated, albite–white mica schist (+/- chloritoid?). Return to vehicles.

End of Field Trip. Annual Meeting follows (see details below).

ANNUAL MEETING AND ELECTION OF OFFICERS

The Annual Meeting will be at the Waybury Inn in East Middlebury immediately upon the completion of the field trip. It is estimated that the meeting will begin at approximately 4:30 PM. The Waybury Inn is located on the north side of Route 125 – approximately 1.5 miles from

the intersection of Route 125 and Route 7 (this intersection is south of Middlebury). If you are unable to attend the field trip and Annual Meeting, please send the enclosed absentee ballot by October 18, 2007 to David West, Dept. of Geology, Middlebury College, Middlebury, VT 05753. The ballot lists the names of the four officers to be elected.

PRESIDENT'S LETTER

Dear Members,

Our Society remains financially healthy and active. Check your recent e-mail or see the VGS website for student research grant announcements. I hear the Summer Field Trip went very well and I'm sorry I was unable to attend. Thanks to Peter Thompson, David DeSimone, and J. Gregory McHone for running the trip. For those of you looking for a speaker at your college or high school, check out our website and get the information on Jon Kim, the VGS Lecturer. He comes free of charge!

Fall approaches, which for many of us means we will be able to see outcrop again. If you are out in the field, enjoy. October 14-20 is the Tenth Annual Earth Science Week, with the theme "The Pulse of Earth Science," promoting public and professional awareness of the status of earth science in education and society. Locally, OMYA is holding their annual Middlebury Quarry Open House on the 13th. Hope our Society is out in force!

Have an enjoyable fall,
Rick Dunn, President

SUMMER MEETING MINUTES

No Executive Committee Meeting was held following the Society's Summer Field Trip to the Woodstock–Quechee Gorge area on August 11, 2007.

TREASURER'S REPORT

The financial condition of the Society continues to be very strong. As of September 1, 2007, the checking account balance was $6,020.22. To my knowledge, there are no outstanding bills. A financial statement for the period 9/1/06-8/31/07 is indicated below. Income significantly exceeded expenses during this 12-month period as only one Research Grant was awarded to a single applicant. The Green Mountain Geologist was printed this year at no cost to the Society due to the generosity of the Department of Geology of Middlebury College.

The following member has been approved for membership in the Society since the last report: Kim Greenwood, Montpelier, Vermont.

The 2008 membership renewal and directory information form will be mailed out to all members by December 31, 2007. The deadline for renewal will be January 31, 2008.

Respectfully submitted,
Stephen S. Howe, Treasurer

Income and Expenses
9/1/06-8/31/07

INCOME		
Total Dues		$1,595.00
Member	$1,305.00	
Family	$200.00	
Student	$0.00	
Institution	$90.00	
Student Research Grant Contributions		$590.00
Vermont Geology Sales		$0.00
TOTAL INCOME		$2,185.00
EXPENSES		
Green Mountain Geologist Printing		$0.00
Postage		$157.57
Office Supplies		$7.40
Post Office Box Rental (to 8/1/08)		$56.00
Fall Field Trip Handout Printing		$43.01
Fall Meeting Refreshments		$16.57
Winter Meeting Refreshments		$44.55
Spring Meeting Refreshments		$35.14
Awards	$775.00	
Research Grants	$500.00	
Spring Meeting Student Talks	$275.00	
TOTAL EXPENSES		$1,135.24
TOTAL INCOME – TOTAL EXPENSES		$1,049.76

ADVANCEMENT OF SCIENCE COMMITTEE REPORT

The Committee will recommend several dates in early March 2008 for the Society's next Winter Meeting. The theme for this meeting will be "Holocene Climate Change." Members are encouraged to contact me with any suggestions they may have for speakers.

Respectfully submitted
Stephen S. Howe, Chair

STATE GEOLOGIST'S REPORT

Vermont Geological Survey and Reorganization

In the fall of 2005, I reported to you on a sweeping reorganization at the Agency of Natural Resources. In government, such activities take time and changes are about to be implemented. If you think that geology and the earth sciences are important to the State of Vermont, I urge you to comment to the Vermont Way Forward at *www.anr.state.vt.us/site/cfm/TVWF/index.cfm*
The contact is Laura Pelosi, ANR Director of Policy Research and Planning, ANR.ReOrg@state.vt.us

The science function as separate from day-to-day regulation is important and necessary. Regulations certainly employ science and we provide per statute "advice to regulatory programs," but we do not get in the middle of the details of writing permits and the legal questions that surround this function. The constituency for geology, the earth sciences, and science in general should be heard. A "holistic" approach is the intent of the changes that are coming. In this context, earth systems science is a term that some use to describe our interest in integrating the geosciences for a public good. Health, safety and supporting the general welfare are outcomes reached through the use of Vermont Geological Survey studies and the information we provide.

Woodstock

The Town of Woodstock requested surficial and aquifer mapping from the Vermont Geological Survey to aid in groundwater protection and planning, which are priorities in the Woodstock Municipal Plan and the Two Rivers–Ottauquechee Regional Plan. Bedrock mapping was included since many residential wells penetrate bedrock. We are very proud of the results that include Peter Thompson's bedrock map, Dave DeSimone's surficial map, both of their groundwater interpretations, and Marjorie Gale's design and cartography for map presentation. Maps may be viewed and downloaded at *www.anr.state.vt.us/DEC/GEO/WoodstockWater.htm*

Respectively submitted,
Laurence R. Becker, State Geologist

OMYA QUARRY OPEN HOUSE, EAST MIDDLEBURY, VERMONT
Saturday, October 13, 2007

OMYA is once again holding its annual open house at its Middlebury Quarry to commemorate Earth Science Week. This large quarry produces white, high-calcium marble that is processed into fillers and extenders for the paper, plastic, and paint industries. It has also produced some very attractive salmon-colored calcite. This will be a family event that will include quarry tours, viewing quarrying equipment close-up, earth science activities, and refreshments. The event is free and will be held from 10:00 AM to 4:00 PM, with the last tour at 3:00 PM.

The road to the quarry is off the east side of US Route 7, 2.5 miles south of the *Middlebury Inn* (traveling southbound) and 1 mile north of the turnoff to the junction of Routes 125 and 116 (traveling northbound). The quarry road is between *Standard Register* and *Foster Motors*, and the green street sign is labeled *1975 Private Road*. Continue straight on this road at the first stop sign. The second stop sign is at the quarry. Please park where instructed. For further information, call Alice Blount at (802) 770-7267 from 8:00 AM to 5:00 PM, e-mail to marble2@sigmaxi.net, or visit the website at *www.omya-na.com* and click "Enter Site" and then click on "News" at the top of the page.

Members wishing to volunteer may contact Jerilynn Valente at (802) 770-7217. A dinner at Rosie's in Middlebury is planned for volunteers.

ANNOUNCEMENTS

VERMONT GEOLOGICAL SOCIETY LECTURER PROGRAM

The goal of the Vermont Geological Society Lecturer Program is to offer local colleges, universities, and high schools the opportunity to invite a member of the VGS to speak at their institution on timely topics within the broad realm of earth and environmental sciences. The program is primarily intended to reach those departments which either do not hold a regularly scheduled seminar series or whose finances do not permit them to invite external speakers to present talks on a regular basis. Any costs associated with the Lecturer's travel, lodging, and meals are borne entirely by the Vermont Geological Society.

Jon Kim, Ph.D., Geologist/Environmental Scientist, at the Vermont Geological Survey in Waterbury, Vermont, is our 2007 Lecturer. Jon is offering the following two lecture topics: "Nitrate Contamination of a Bedrock Aquifer in Central Vermont" and "Application of Tectonics to Groundwater Problems in Vermont." For scheduling information, see the Society's website at *www.uvm.org/vtgeologicalsociety/lecturer_program.html*

GREEN MOUNTAIN GEOLOGIST ARCHIVES

Kathleen Howe, the Vermont Geological Society's Webmaster, has begun the process of archiving an electronic version of every *Green Mountain Geologist* published since the dawn of the Society. Issues produced prior to 2005 must be scanned, but later issues are being archived from the original Adobe Portable Document Format (PDF). The archived issues are listed together with a brief note indicating each issue's highlights and can be accessed at the Society's website at *www.uvm.org/vtgeologicalsociety/gmgarchive.html*

ELECTRONIC *GREEN MOUNTAIN GEOLOGIST*

The Vermont Geological Society continues to encourage its members to receive the *Green Mountain Geologist* electronically. In fact, the Society is considering the possibility of a completely electronic *Green Mountain Geologist* beginning in 2008. Newsletters would be sent exclusively as PDF attachments to e-mail messages. Members who currently receive the newsletter as a paper copy sent by postal mail would need to provide an e-mail address when they renew their membership.

Adobe PDF is a very common format that is used by both Windows and Macintosh computers. However, you must have the **free** "Adobe Reader" software installed on your computer to open this type of file. Many computers purchased within the last few years come with "Adobe Reader" already pre-installed. If you **do not** have Adobe Reader on your computer, go to the website below to read more about Adobe Reader software. This website also has a link to download the software, again, for free. See *www.adobe.com/products/reader/*

The Society is considering this change in the way its newsletter is distributed because of a combination of factors, especially the significant and increasing expense the Society incurs from postage and the significant workload associated with the production and mailing of the newsletter. An electronic-only newsletter would also reduce the amount of time spent maintaining separate membership databases, one for members receiving an electronic newsletter by e-mail and another for members receiving a paper copy by postal mail.

Another advantage of electronic newsletters is the ability to display graphic material, such as photographs of geological features in the field, in color, enhancing the appeal of the material that

appears in the newsletters. This is crucial to the Society's ability to attract new members, particularly students, many of who are accustomed to browsing colorful websites routinely.

Members wishing to comment on this proposed change should send an e-mail message to any member of the Society's Executive Committee listed below or a written note to the Society's mailing address of P.O. Box 1224, Saint Albans, VT 05478-1224 **prior to October 20, 2007**.

VERMONT GEOLOGICAL SOCIETY CALENDAR

10/5-7/07	NEIGC 99th Annual Meeting, Quebec City, Quebec, Canada
10/13/07	OMYA Middlebury Quarry Open House
10/14-20/07	Earth Science Week
10/20/07	VGS Fall Field Trip, Middlebury Area, Vermont
10/28-31/07	GSA Annual Meeting and Exhibition, Denver, Colorado

The **Vermont Geological Society** is a non-profit educational corporation.
The **Executive Committee** of the Society is comprised of the Officers, the Board of Directors, and the Chairs of the Permanent Committees.

Officers

President	Richard Dunn	(802) 485-2304	rdunn@norwich.edu
Vice President	George Springston	(802) 485-2734	gsprings@norwich.edu
Secretary	David West	(802) 443-3476	dwest@middlebury.edu
Treasurer	Stephen Howe	(518) 442-5053	showe@albany.edu

Board of Directors

Les Kanat	(802) 635-1327	les.kanat@jsc.vsc.edu
Jon Kim	(802) 241-3469	jon.kim@state.vt.us
John Van Hoesen	(802) 287-8387	vanhoesenj@greenmtn.edu

Chairs of the Permanent Committees

Advancement of Science	Stephen Howe
Geological Education	Christine Massey
Membership	Stephen Wright
Public Issues	Laurence Becker
Publications/Editorial	Stephen Howe

VERMONT GEOLOGICAL SOCIETY ANNUAL MEETING
October 20, 2007

ABSENTEE BALLOT

Please enter your name and address here:

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Officers

President	George Springston	_____
Vice-President	John Van Hoesen	_____
Secretary	David West	_____
Treasurer	Stephen Howe	_____

Only Officers will be elected at the Annual Meeting this year. As Immediate Past President, Richard Dunn is appointed to a one-year term on the Board of Directors, per Society Bylaws. Les Kanat and Jon Kim will serve the second year of their two-year terms on the Board of Directors to which they were elected at the 2006 Annual Meeting. Returning Permanent Committee Chairs are:

Advancement of Science: Stephen Howe
Geological Education: Christine Massey
Membership: Stephen Wright
Public Issues: Laurence Becker
Publications/Editorial: Stephen Howe

If you will not be attending the Annual Meeting, please complete the absentee ballot and return it to David West, Dept. of Geology, Middlebury College, Middlebury, VT 05753 **no later than October 18, 2007**.

Vermont Geological Society
P.O. Box 1224
Saint Albans, VT 05478-1224

ADDRESS CHANGE?
Please send it to the Treasurer at the above address

Vermont Geological Society
Fall Field Trip
October 20, 2007, 9:00 AM

We will meet at 9:00 AM at the Maplefields Convenience Store (also a Mobil Gas Station) on US Route 7 approximately 4.5 miles north of the traffic circle in Middlebury. Please note there are a couple of Maplefields store locations in and around Middlebury – this one is located ***4.5 miles north of Middlebury*** on Route 7 and is on the ***east*** side of the highway.