

# THE GREEN MOUNTAIN GEOLOGIST



QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

VGS Website: [www.uvm.org/vtgeologicalsociety/](http://www.uvm.org/vtgeologicalsociety/)

WINTER 2007

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*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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**WINTER MEETING PROGRAM**

- 9:30AM COFFEE & REFRESHMENTS
- 10:00AM David S. Westerman: THE DEVONIAN PLUTONS OF NORTH-CENTRAL VERMONT: A REVIEW
- 10:20AM George E. Springston, Thomas D. Eliassen, and Laurence R. Becker: A ROCKFALL HAZARD ASSESSMENT OF HIGHWAYS IN VERMONT
- 10:40AM Richard Dunn and Anastasia Craver: MAPPING OF COLLUVIUM TO IDENTIFY ARCHAEOLOGICAL TARGET ZONES AND PRESERVATION POTENTIAL OF ARCHITECTURE AT THE ROMAN ERA ARCHAEOLOGICAL SITE OF KENCHREALI, GREECE
- 11:10AM EXECUTIVE COMMITTEE MEETING

**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<sup>2</sup> 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.

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**A ROCKFALL HAZARD ASSESSMENT OF HIGHWAYS IN VERMONT**

SPRINGSTON, George E.<sup>1</sup>, ELIASSEN, Thomas D.<sup>2</sup>, BECKER, Laurence R.<sup>3</sup>, (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

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**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.
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8. Steve Howe reported that Char Mehrstens 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."

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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 5<sup>th</sup>, 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](http://www.leg.state.vt.us)

Respectfully submitted,  
Laurence R. Becker, State Geologist

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## 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 16<sup>th</sup>, see the following website links:

[www.ilmpt.org/preserves.html](http://www.ilmpt.org/preserves.html)

[www.foxnews.com/story/0,2933,224000,00.html](http://www.foxnews.com/story/0,2933,224000,00.html)

[www.sevendaysvt.com/features/2006/fossil-fueled.html](http://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](mailto: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](mailto: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/](http://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](mailto:showe@albany.edu)

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**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  
by the Vermont Geological Society, a non-profit educational corporation.

**Executive Committee**

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

**Committees**

Advancement of Science	Stephen Howe
Education	Christine Massey
Membership	Stephen Wright
Public Issues	Laurence Becker
Publishing	Kathleen Howe, Stephen Howe, and David West

**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*