



QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

VGS Website: <http://www.uvm.org/vtgeologicalsociety/>

**WINTER 2013**

**VOLUME 40**

**NUMBER 1**

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## **PRESIDENT'S LETTER**

As I near my 17<sup>th</sup> anniversary of moving to Vermont, through your votes, I will now take a pull as President. So how did I get here? At the 1996 NEGSA in Buffalo, Rolfe Stanley and Marjie Gale said they had "an area" for me to map and convinced State Geologist Larry Becker to hire me as a contractor straight out of graduate school at SUNY at Buffalo. On Memorial Day weekend of 1996, with all possessions in/on a 1982 Toyota Camry, I moved to Vermont from Buffalo, N.Y. to start work in a field area that encompassed parts of Albany, Eden, and Lowell. Having signed the contract before visiting northern Vermont, I overcommitted a bit to the amount of real estate I said I'd map and that first project took me a bit longer than expected to complete. Out of necessity that year, I also landed additional jobs as Adjunct Instructor at Johnson State College (two semesters), and Ski Instructor at Smugglers Notch Resort (still do it). The contractor situation bloomed into a full-time position at the Vermont Geological Survey in the fall of 1997 and I have worked there until the present.

After conversations with the Executive Committee of the Vermont Geological Society (VGS) and the Lake Champlain Research Consortium (LCRC), we will have a joint meeting of the VGS and LCRC on Saturday April 27, 2013 at the University of Vermont. As you know, this is the meeting where current undergraduate and graduate student research is presented. We are currently working on the venue, but it will either be the Aiken Center or the Dept. of Geology. The plan is to run VGS and LCRC talks in separate, but nearby lecture rooms. Some of the students that are funded by LCRC will have to give a talk in each session. The LCRC and VGS will share the food and beverage costs as well as setup and breakdown tasks.

For the Vermont Geological Society summer field trip, Pat and Tom Manley of the Geology Dept. at Middlebury College have offered to run a cruise on Lake Champlain in their research vessel. The goals of the trip will be to demonstrate the use of their survey equipment and discuss their research. The vessel has a capacity of 10-15 visitors, so if more members than this sign up, more than one cruise will be run. The cruise will run a maximum of two hours and will leave from the docks on Thompson's Point in Charlotte on Saturday August 24, 2013. Early this summer, I will establish a sign-up sheet so you can contact me for cruise(s) reservations. We anticipate that Stephen Wright from UVM will lead a surficial geology trip to the Killington area in the near future (fall?).

We will not have a traditional winter meeting this year. I received mixed responses from the VGS Executive Committee whether we should pursue a winter meeting this year or the future. I welcome responses from other VGS members regarding this issue. As a substitute, we are jointly pursuing, with the New Hampshire Geological Society, a guest lecture by Doug Howard from the U.S. Geological Survey in Reston, VA. Although Doug is currently the Director of the STATEMAP Program, which funds mapping by state geological surveys, he formerly did research associated with the exploration of Mars. While on a field visit to the Vermont Geological Survey this past summer, we talked to him a good deal about his fascinating former work, which would be the focus of his talk.

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Last fall, I attended a memorial celebration for John Carmola at the top of a mountain in Belvidere. John is the VGS member who died last summer in a swimming accident in North Carolina. The site of the memorial service was in and around the high elevation glacial potholes that John, friends Paul Madden and J.D. Thoren, recently worked on with Stephen Wright of UVM. There were dozens of family, friends, and colleagues of John there for this event and it was truly a celebration.

Respectfully submitted,  
Jon Kim



John Carmola and Friends, Field Trip, 2011

## ANNUAL MEETING MINUTES & ELECTION RESULTS

Elections were conducted using Survey Monkey. The following officers were elected for the 2013-2014 year:

President	Jon Kim
Vice-President	Keith Klepeis
Secretary	Dave West
Treasurer	David Westerman

## TREASURER'S REPORT

The Vermont Geological Society finds itself in a healthy financial position, thanks entirely to the generous support from its members. Cash on hand as of December 2012 remained steady with a balance of \$6,316. Since then we have received \$728 in membership renewals and new membership dues, and \$460 as contributions to the Society's Research Grant Program. Paper-copy of dues renewal notices are being sent to the remaining 56 members in good standing who

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did not respond to the electronic solicitation.

Research awards of \$700 each were recently made to:

Natashia Pierce, Master's Degree candidate at the University of Cincinnati  
*Geochemical analysis of meta-volcanics in the Rowe-Hawley Zone of northern Vermont: Testing tectonic models*

Juliet Ryan-Davis, undergraduate student at Middlebury College  
*Origin of the Moretown Formation, Vermont: A detrital zircon study*

Eric Weber, undergraduate student at the University of Vermont  
*Analysis of microstructures near the southern terminus of the Hinesburg Thrust Fault*

Please join me in welcoming the following new and returning members (M), associate members (A) and student members (S):

Gretchen Gotlieb (M), Cardno ENTRIX, Houston, TX

Vera Lawson (S), Moss Landing Marine Labs, California State University - Monterey Bay, CA

Virginia Irvine (M), ECS, Inc., Brimfield, MA

Joseph Schmidl (M), Stone Environmental, Inc., Montpelier, VT

Tom Eliassen (M), Vermont Agency of Transportation, Montpelier, VT

Andrew Fraser (M), AEF Consulting LLC, Johnson, VT

No expenses have been incurred since the last Treasurer's report.

Respectfully submitted,

David S. Westerman, Treasurer

## **ADVANCEMENT OF SCIENCE COMMITTEE REPORT**

Congratulations to recipients of the VGS Research Grants: Natashia Pierce, Juliet Ryan-Davis, and Eric Weber. Their proposals were submitted to the Vermont Geological Society Research Grant Program by the October 1, 2012 deadline and judged to merit full funding. The awards are announced in the Treasurer's Report above.

The next deadline for proposals to the Vermont Geological Society Research Grant Program is April 1, 2013. Applications should be sent to our new address (as of Feb. 25): Jon Kim, Vermont Geological Survey, 1 National Life Drive, Davis 2, Montpelier, VT 05620-3902. All proposals must be postmarked by the deadline. For details, see the following link:

<http://www.uvm.org/vtgeologicalsociety/grantpolicy.html>

Respectfully submitted,

Jon Kim, Chair

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## CALL FOR STUDENT ABSTRACTS SPRING MEETING OF THE VERMONT GEOLOGICAL SOCIETY

The Spring 2013 meeting will be held on Saturday, April 27<sup>th</sup> at the University of 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 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 encourage speakers to send their abstracts electronically as a Word file with a doc or docx extension attached to an e-mail message to Marjie Gale ([Marjorie.gale@state.vt.us](mailto:Marjorie.gale@state.vt.us))

Oral presentations will be limited to 12 minutes with 3 additional minutes for questions. A computer projection system is available for PowerPoint presentations.

**Deadline for abstracts: Friday, April 5, 2013 at 5:00 pm**



2012 SUMMER FIELD TRIP, CRAFTSBURY, VT

## VERMONT STATE GEOLOGIST'S REPORT

### Geologic Map Advisory Committee Meeting – October, 2012

The STATEMAP Geologic Map Advisory Committee, chaired by Kristen Underwood, met to help the Vermont Geological Survey (VGS) set mapping priorities for the 2013 Field Season. The Town of Bristol attended the meeting for a second year to make a compelling case to continue the mapping into the north half of the adjacent quadrangle to Bristol known as South Mountain. Jon Kim and George Springston are mapping in the Bristol Quad with planned completion in May 2013. However, the boundaries of the Town are within the Bristol and South Mountain quads. The Town sees geologic maps as integral to Town planning in relation to review of proposed developments including the Act 250 process, groundwater source protection, siting of wastewater treatment, gravel extraction, and hazard mitigation review. They see the need for maps showing depth to bedrock, potential high yielding aquifers, groundwater flow directions, landslide potential and location of aggregate deposits. Bristol also fits with our long range interest in geologic mapping and groundwater quality concerns related to radionuclides and arsenic. A new developing concept for comprehensive groundwater characterization of targeted watershed was added to the long range mapping plan - another aspect of water related studies. As a secondary priority surficial geologic studies in the Joes Pond quadrangle will be considered as part of the USGS Sleeper's River Research Watershed (SREE). Additional data and understanding can apply from the SSRE to a watershed initiative that the VGS is proposing for the Department of Environmental Conservation Strategic Plan.

### Planned partnership with State Climatologist

Leslie-Ann Dupigny-Giroux, the State Climatologist at the UVM Geography Dept. and the VT State Geologist plan to partner to provide information to a NOAA drought planning web site. Through a NOAA grant application, Dr. Dupigny-Giroux will provide student interns to help bring existing groundwater information that the Vermont Geological Survey has developed into the necessary formats for access by NOAA. Students will also be able to help develop new VGS data sets. The groundwater resource is a safeguard in times of meteorologic and hydrologic drought. Water is stored in a natural condition and accessed through wells and springs. Groundwater discharge helps to sustain surface water flows in summer and early fall. As groundwater seeps into rivers and streams, water at mean annual temperature lowers surface water temperature supporting aquatic life during the heat of summer.



*Bascom Fm., St. George*

### USGS National STATEMAP Program Visitor from Reston

Doug Howard, USGS National Coordinator for the STATEMAP Program, visited State Surveys in New England reaching the Vermont Geological Survey on Sept. 20 and 21. We explained our geologic mapping program, showed maps, and then conducted a field visit to view examples of Vermont bedrock and surficial geology.

### Post-Fukushima Seismic Review Documents for Nuclear Power Plants

The State Geologist has been reviewing four interrelated Electric Power Research Institute and Nuclear Regulatory Commission documents that bear on seismic evaluation requirements. In *Central and Eastern U.S. Seismic Characterization for Nuclear Power Plants*, he is concerned that a historic earthquake recently projected to a higher magnitude in Central NH has not been considered in the characterization. This could affect calculations for the projected shaking at the Vernon nuclear facility. In the *Screening, Prioritization and Implementation Detail* document, he is concerned that new information is needed to have a defensible understanding of what kind of shaking could occur beneath the cooling tower safety cell. Applicants are only required to use existing information from the original license to follow the screening requirements but the material that underlies the cooling tower can be complex based on its glacial origin. In the mid 2000's, new detailed boring information was needed to fully understand seismic safety in the materials underneath the dry fuel storage pad proposal.

### Central Vermont Public Service and Geothermal

The Vermont Geological Survey received a supplemental Department of Energy geothermal grant. The supplemental award is to collect water temperature data in wells and obtain rock samples to test for thermal conductivity and geochemical parameters. Central Vermont Public Service (CVPS) in a Sept 28, 2010 letter supported the application and agreed to provide seed money if the grant is approved. In 2011, an internal CVPS renewable resource committee approved the proposal. The original request was for \$5,000 but the committee approved \$15,000. In October, the administration approved the signed grant releasing funds to be spent on the project. On Oct 12, 2012, the VGS reported on study progress to CVPS now owned by Green Mountain Power.

### Geothermal Geologic Studies

21 plugs from rock outcrops collected by Marjorie Gale and Abigail Ruksznis were sent to Southern Methodist University (SMU) in Texas. SMU ran density and thermal conductivity analyses of the samples at elevated pressure (to close small fractures and mimic rocks at depth). Running multiple orientations of the same sample will allow us to better understand thermal conductivity differences in rocks. We will also have chemical analyses run on these samples. Data may be used to model temperatures at depths of up to 15,000 feet in Vermont. Jon Kim has begun collecting water well temperature data in deeper water wells in cooperation with Ed Romanowicz of Plattsburgh State.

### Data Delivery to U.S Department of Energy (DOE):

The Agency of Natural Resources GIS group (Peter Telep) worked with Marjorie Gale to deliver the new bedrock map, the surficial map GIS data, and water well data as a web map service as part of the DOE National Geothermal Data System (<http://www.stategeothermaldata.org/>). We delivered a series of georectified map images of radioactivity data (Kim, Jonathan, Compiler, 2002, *Compilation and Assessment of Radioactivity Data in Vermont: Vermont Geological Survey General Interest Publication*) as it relates to heat production in deep rocks.

### Heat Pumps

As part of this year's deliverable on the Geothermal Technologies grant, Marjorie Gale coordinated with Scott Sawyer of the Vermont State Jobs Fund and Renewable Energy Atlas of

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**NATURAL RESOURCES**

**ATLAS** - The Vermont Agency of Natural Resources (ANR) recently launched a new Natural Resources Atlas web application posted at <http://anrmaps.vermont.gov/websites/anra/>. The atlas provides geographic information about environmental features and sites that the ANR manages, monitors, or regulates. In addition to standard map navigation tools, this site allows you to generate reports, export search results, import data, search, measure, mark-up, query map features, and print PDF maps.

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**ERIE PROGRAM** - The University at Buffalo's Ecosystem Restoration through Interdisciplinary Exchange (ERIE) Program is excited to announce our 2013 Summer Stream Ecosystem Restoration Workshops and Professional Certificate Program. Registration is now open! Topics include fluvial geomorphology, stream ecology, invasive species, stream assessment, restoration design, and more. Visit the website for more information: <http://www.erie.buffalo.edu/training/SummerCoursemainpage.php>

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Vermont to obtain information about installed heat pumps. Data is scarce but Scott is emailing people in hopes of obtaining more data about their heat pump systems. She also contacted Cindy Parks with VT DEC about permits issued for underground injection wells, some of which are geothermal systems. Most of the permit materials were lost in the flood but we were able to connect with operators of several larger systems in state buildings and obtain some data about the number of supply wells, depth, yield, and the type of system.

Respectfully submitted,  
Laurence R. Becker, State Geologist

**ANNOUNCEMENTS**

**MAP EXHIBIT COMING SOON TO PERKINS MUSEUM** - The 2011 Bedrock Geologic Map of Vermont will be on permanent display in the Perkins Museum later this spring. MajaDesign worked with Char Mehrtens and Marjie Gale to create a 4 panel full size map exhibit funded by a generous contribution from the Lintilhac Foundation. More details TBA.

**STUDENT RESEARCH GRANT APPLICATIONS** - Students and secondary school teachers are encouraged to apply to the VGS Research Grant Program by April 1, 2013. Downloadable Research Grant Program applications are available from the Society's website at <http://www.uvm.org/vtgeologicalsociety/>. For those without Internet access, forms may be obtained by writing to Jon Kim at the Vermont Geological Survey, 1 National Life Dr., Davis 2, Montpelier, VT 05620-3902, e-mail: [jon.kim@state.vt.us](mailto:jon.kim@state.vt.us), or by calling (802) 522-5401.

**SUMMER FIELD TRIP** - Preliminary announcement: Tom and Pat Manley (Middlebury College) expect to take us in small groups for 2 hour excursions on board their research vessel on Lake Champlain on August 24. Details will be announced as summer approaches.

**ON THE MOVE** - At the end of February, the Vermont Geological Survey will be moving to their new home at 1 National Life Drive, Davis 2, Montpelier, VT 05602-3902.

**FIND MAPS** - Find maps in paper, as electronic images or as digital data through the National Geologic Map database (NGMDB) at: [http://ngmdb.usgs.gov/ngmdb/ngmdb\\_home.html](http://ngmdb.usgs.gov/ngmdb/ngmdb_home.html)

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**WHERE'S IT, WHAT'S IT?**

Send me an e-mail ([marjorie.gale@state.vt.us](mailto:marjorie.gale@state.vt.us)) with the Vermont town name and a brief description of what is in the picture. All correct entries will be entered in a drawing for a copy of the 2011 Bedrock Geologic Map of Vermont. Look for the answers in the GMG Spring Issue along with another puzzler. Feel free to contribute your own Vermont puzzlers too.

**CALENDAR**

- February 11: Geology Lecture, UVM, Delehanty, Rm 219, Trinity Campus, 4:15 pm  
Andrew Schroth presents "The Evolution of Riverine Metal Fluxes to the Gulf of Alaska: Variability in Provenance, Speciation, Time and Space"
- February 21: Geology Lecture, UVM, Delehanty, Rm 219, Trinity Campus, 4:15 pm  
Julia Perdal presents "How Does Carbon in the Critical Zone Respond to Changes in Climatic Forcings?"
- March 11: Geology Lecture, UVM, Delehanty, Rm 219, Trinity Campus, 4:15 pm  
Chris Gerbi presents "4D lithospheric strength: causes and consequences"
- March 18-20: Northeastern Section Meeting, Geological Society of America, Bretton Woods, NH
- March 25: Geology Lecture, UVM, Delehanty, Rm 219, Trinity Campus, 4:15 pm

(Calendar, continued)

	Juliet Crider presents "What follows a 'failed eruption?' Inferring the presence of magma beneath Mount Baker volcano, Washington"
April 1:	Student Research Grant Program applications due
April 5:	Student abstracts for Spring Meeting due
April 5:	Executive Committee reports due
April 27:	Spring Student Research Meeting, University of Vermont
August 24:	Summer Field Trip on Lake Champlain
Sept. 23-24:	National Ground Water Association Conference on Groundwater in Fractured Rock and Sediment, Hilton Burlington, Burlington, VT

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	Jon Kim	(802) 522-5401	jon.kim@state.vt.us
Vice President	Keith Klepeis	(802) 287-8387	keith.klepeis@uvm.edu
Secretary	David West	(802) 443-3476	dwest@middlebury.edu
Treasurer	David Westerman	(802) 485-2337	westy@norwich.edu

#### Board of Directors

Les Kanat	(802) 635-1327	les.kanat@jsc.edu
George Springston	(802) 485-2734	gsprings@norwich.edu
Kristen Underwood	(802) 453-3076	southmountain@gmavt.net

#### Chairs of the Permanent Committees

Advancement of Science	Jon Kim	jon.kim@state.vt.us
Membership	David Westerman	westy@norwich.edu
Public Issues	Laurence Becker	laurence.becker@state.vt.us
Publishing	Marjorie Gale	marjorie.gale@state.vt.us

**Vermont Geological Society  
Norwich University, Dept. of Geology  
158 Harmon Drive  
Northfield, Vermont 05663**

***ADDRESS CHANGE?***

*Please send it to the Treasurer at the above address*



QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

VGS Website: <http://www.uvm.org/vtgeologicalsociety/>

SPRING 2013

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*The Vermont Geological Society's  
Spring Meeting*

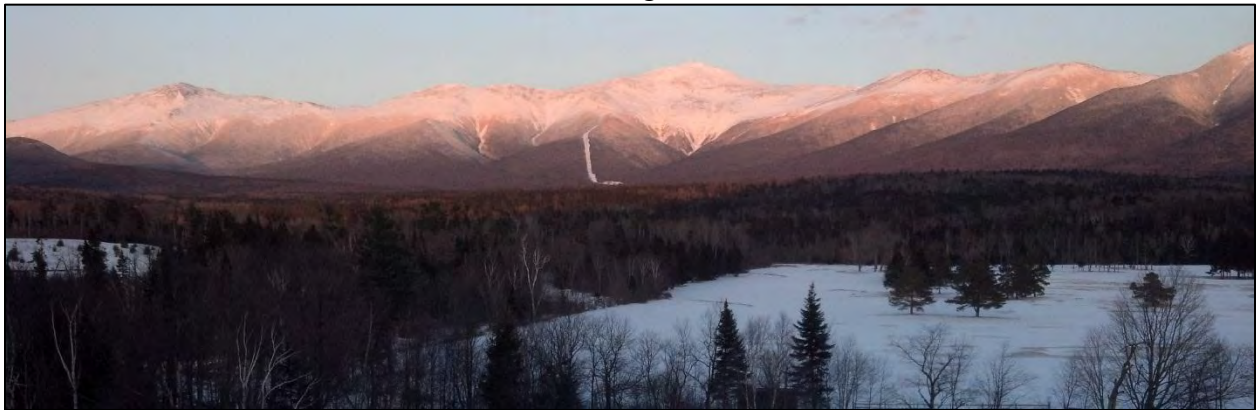
*April 27, 2013, 8:00 AM  
Room 110, Aiken Center  
University of Vermont, Burlington, VT*

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**PRESIDENT'S LETTER**

Mt. Washington, NH



The 2013 Geological Society of America- Northeastern Section Meeting (NEGSA) was held at the Mt. Washington Hotel in Bretton Woods, New Hampshire from March 18-20. I heard that the attendance for the meeting was ~1200, which was the second highest ever for this section meeting. For the first time that I can remember, there were so many abstracts for talks submitted, that a 15 minute time limit was implemented, rather than the usual 20 minutes. The view from the back porch of the hotel was absolutely spectacular, particularly around sunset (above) and sunrise. Congratulations to Brian Fowler (Mt. Washington Observatory), Dyk Eusden (Bates College), Thom Davis (Bentley College), and Mark Van Baalen (Harvard University) for organizing such a superb meeting. NEGSA 2014 is in Lancaster, Pennsylvania.

I just figured out that I have attended 20 out of the last 21 NEGSA meetings, missing only the 1997 meeting, and this does makes me feel like a veteran (old). At this meeting, it was particularly nice to see all the familiar faces, great research, and large numbers of students. After the formal programming concluded each day, I always looked forward to the interaction with other geologists. Impromptu discussion sessions were easily initiated at the Mt. Washington Hotel, because of the long corridor on the lobby level, which was lined with couches, tables, and chairs on either side.



Mt. Washington Hotel; Alain Tremblay and Jon Kim discussing VT-Quebec connections.

The Vermont Geological Society (VGS) and the Lake Champlain Research Consortium (LCRC) will have joint meetings on Saturday April 27, 2013 at the Aiken Center of University of Vermont. The VGS symposium will be in room 110 of the Aiken Center whereas the LCRC

symposium will be in room 102. Both symposia will run concurrently and will have a break at 10:00 am in a common area where LCRC posters will be displayed. A light breakfast of coffee, juices, and pastries will run from 8:00 – 8:30 am and during the 10:00 am break in Room 103. LCRC and VGS will share the food and beverage costs.

Respectfully submitted,  
Jon Kim, President

## ADVANCEMENT OF SCIENCE COMMITTEE REPORT

No proposals were submitted to the Vermont Geological Society Research Grant Program by the April 1, 2013 deadline. The next round of proposals are due on October 1, 2013. Students and secondary school teachers are encouraged to apply to the VGS Research Grant Program. Downloadable Research Grant Program applications are available from the Society's website at <http://www.uvm.org/vtgeologicalsociety/>. Applications and questions should be addressed to: Jon Kim, Vermont Geological Survey, 1 National Life Drive, Davis 2, Montpelier, VT 05620-3920; e-mail: [jon.kim@state.vt.us](mailto:jon.kim@state.vt.us), phone: (802) 522-5401.

The following 2012 VGS grant recipients presented their work at the NEGSA in Bretton Woods:

Natashia Pierce, Master's Degree candidate at the University of Cincinnati

“Compilation of Geochemical Data of Meta-Volcanics from the Rowe-Hawley Zone of Western New England are Consistent with Backarc, Arc, and Forearc Regions of One Composite Arc” (Talk).

Juliet Ryan-Davis, Undergraduate Student at Middlebury College

“Origins of the Moretown Formation, Vermont: A Detrital Zircon Study” (poster).  
Award- \$700.00

Eric Weber, Undergraduate Student at the University of Vermont

“Comparison of Ductile Structures from the Southern Terminus of the Hinesburg Thrust Fault with those from Central Flap, West-Central Vermont (poster).

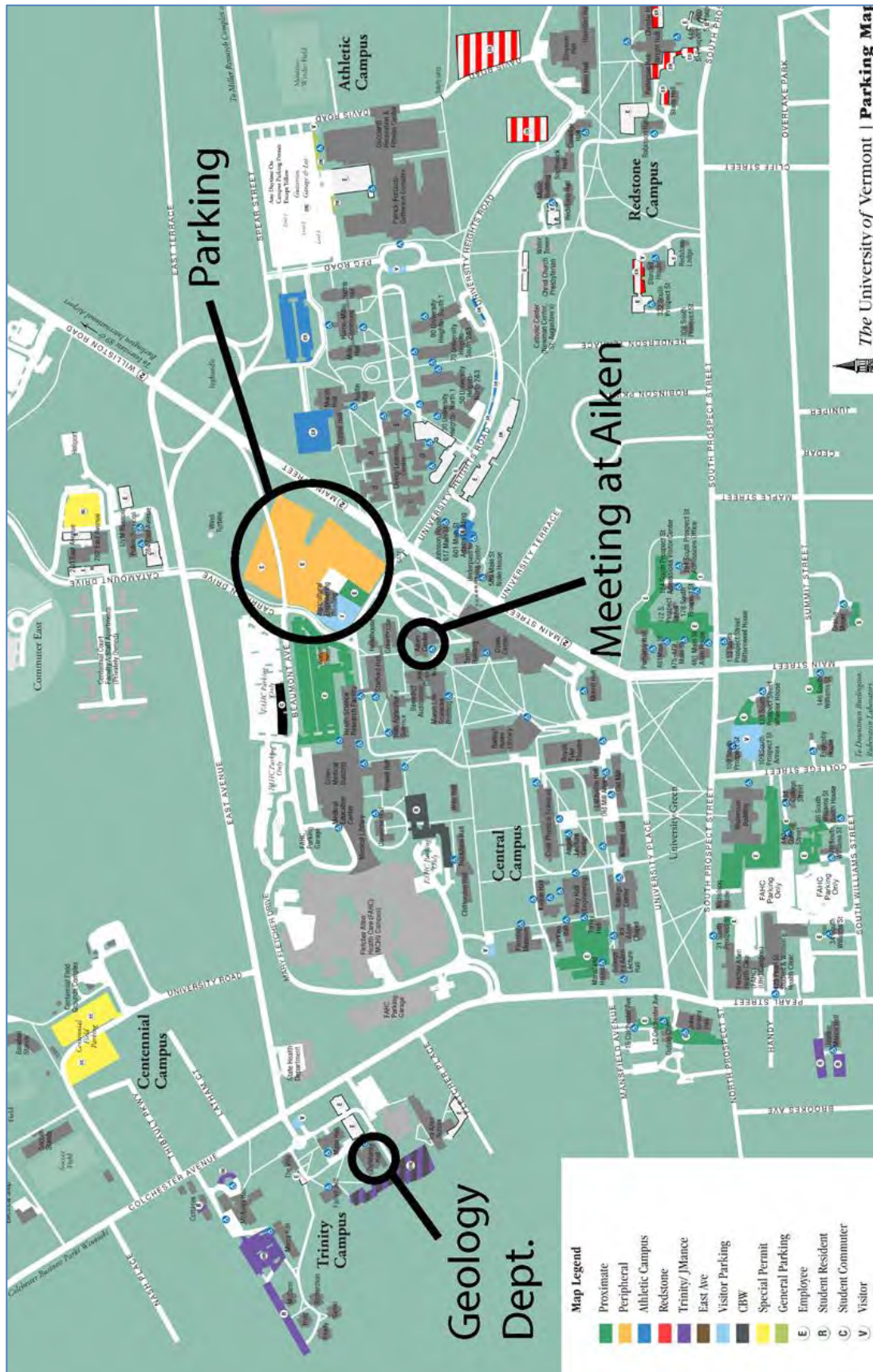
We will hear talks by Juliet and Eric at the VGS Spring Meeting on Saturday April 27.

Respectfully submitted,  
Jon Kim, Chair

**ANNOUNCEMENT: JUDGES NEEDED FOR MEETING:** We need three people to judge the student presentations at the VGS portion of the meeting. Please contact Jon Kim at 802-522-5401 or [jon.kim@state.vt.us](mailto:jon.kim@state.vt.us) if you are willing to serve.

Also, we will be having an Executive Committee meeting after the presentations. This meeting is open to all members. Larry Becker, State Geologist, will be there to discuss geologist licensure (see Public Issues, p. 18).

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## 2013 SPRING MEETING PROGRAM

- 8:00 AM COFFEE & REFRESHMENTS
- 8:30 AM Juliet Ryan-Davis: ORIGINS OF THE MORETOWN FORMATION, VERMONT: A DETRITAL ZIRCON STUDY
- 8:45 AM Emily Wei: SUMMERTIME HYDRODYNAMICS AND SEDIMENT DYNAMICS OF MISSISQUOI BAY, LAKE CHAMPLAIN
- 9:00 AM Sarah Studwell, Peter Ryan, and David West: ARSENIC CONCENTRATION WITHIN VARIABLY METAMORPHOSED SHALES OF THE TACONIC SEQUENCE, VERMONT AND NEW YORK
- 9:15 AM Parker Richmond: GROUND PENETRATING RADAR AS A METHOD FOR DISTINGUISHING FRACTURES AND HIGH ANGLE FAULTS
- 9:30 AM Patrick Dyess and Laura Webb: THE QUARTZ WASHING MACHINE: INSIGHTS INTO THE USES AND EFFECTIVENESS OF THE TITANIUM IN QUARTZ THERMOBAROMETER
- 9:45 AM Joshua Johnson: THE SPANISH CREEK MYLONITE: A NEWLY IDENTIFIED REGION OF HIGH STRAIN WITHIN THE NORTHERN MADISON RANGE, SW MONTANA
- 10:00 AM BREAK, COFFEE & REFRESHMENTS
- 10:30 AM Steven Gohlke, Barbara Tewksbury, and Charlotte Mehrrens: EVIDENCE FOR AN EARLY CENOZOIC TECTONIC EVENT IN SOUTHERN EGYPT AND THE SIGNIFICANCE OF DEFORMATION BANDS ON THE SEIYAL FAULT, WESTERN DESERT, EGYPT
- 10:45 AM Lisa Luna, Will Amidon, Burch Fisher, and Doug Burbank: U-PB ZIRCON AGES FROM TUFFS AND DETRITAL SEDIMENT: A NEW EVOLUTIONARY MODEL FOR THE RÍO IRUYA CANYON, NORTHWESTERN ARGENTINE ANDES
- 11:00 AM Annika Silverman: MULTI-PROXY RECONSTRUCTION OF POST-GLACIAL ENVIRONMENTAL CHANGE FROM A CORE OF SOLDIER LAKE, NEVADA
- 11:15 AM Clara St. Germain: NATURAL PROCESSES IN AN INDUSTRIAL SETTING: SEDIMENTARY AND HYDRO-DYNAMICS OF THE BUFFALO RIVER, N.Y.
- 11:30 AM Daniel Hobbs: DEVELOPING GEOCHRONOMETERS: DIFFUSION OF
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**HELIUM IN CALCITE, ARAGONITE, AND DOLOMITE**

- 11:45 AM Eric Weber, COMPARISON OF DUCTILE STRUCTURES FROM THE SOUTHERN TERMINUS OF THE HINESBURG THRUST FAULT WITH THOSE FROM THE CENTRAL FLAP, WEST-CENTRAL VERMONT
- 12:00 PM Abigail Ruksznis, Keith Klepeis, and Marjorie Gale: VARIATION IN TWO STYLES OF ACADIAN THRUST FAULTING IN THE PINNACLE FORMATION, RICHMOND, VT
- 12:15 PM JUDGING AND AWARDS PRESENTATION
- 12:30 PM EXECUTIVE COMMITTEE TO FOLLOW CONCLUSION OF STUDENT MEETING

**LAKE CHAMPLAIN RESEARCH CONSORTIUM PROGRAM (RM. 102)**

- 8:25 AM Opening remarks – Jason Stockwell
- 8:30 AM Suzanne Ball: CHANGES IN MYSIS DILUVIANA POPULATION DEMOGRAPHICS IN LAKE CHAMPLAIN BETWEEN 1975 AND 2012
- 08:45 AM Chelsea Mitchell: DIVERGENT DIEL VERTICAL MIGRATION IN MYSIS DILUVIANA: IS IT A PLASTIC OR FIXED BEHAVIOR?
- 09:00 AM Peter Euclide: ASSESSING TEMPERATURE SENSITIVITY OF PELAGIC VS. BENTHIC-CAUGHT MYSIS DILUVIANA
- 09:15 AM Janet Bering, Abigail Borah, Charlie Koch, Avery Shawler: REGIONAL AQUATIC INVASIVE SPECIES PREVENTION IN THE LAKE CHAMPLAIN BASIN
- 09:30 AM Michelle Trimper: EXPLORING THE SUSTAINABILITY OF THE FUNDING NETWORK FOR AQUATIC INVASIVE SPECIES IN THE LAKE CHAMPLAIN BASIN
- 09:45 AM Kali Blankenship: VARIATION IN LITTER DECOMPOSITION BETWEEN NATIVE SPECKLED ALDER AND NON-NATIVE EUROPEAN BUCKTHORN: AN EXPERIMENTAL STUDY IN PLATTSBURGH, NY
- 10:00 AM Break and Poster Session
- 11:00 AM Justin Geibel: INFLUENCE OF DRAINAGE WATER MANAGEMENT ON PHOSPHORUS LOSS FROM A TILE-DRAINED FIELD IN NORTHERN NEW YORK
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(Lake Champlain Research Consortium, Rm 102, continued)

- 11:15 AM Patrick Bousquet: THE EFFECTS OF URBANIZATION ON STREAM BED SEDIMENT SIZE AND BENTHIC MACROINVERTEBRATE COMMUNITIES
- 11:30 AM Emily Wei: SUMMERTIME HYDRODYNAMICS AND SEDIMENT DYNAMICS OF MISSISQUOI BAY, LAKE CHAMPLAIN
- 11:45 AM Peter Isles: HIGH TEMPORAL RESOLUTION MONITORING OF CYANOBACTERIAL BLOOM DYNAMICS AND NUTRIENT LIMITATION IN MISSISQUOI BAY
- 12:00 AM Rebecca Gorney: DIETS AND DIET OVERLAP OF INVASIVE WHITE PERCH AND ALEWIFE IN MISSISQUOI BAY, LAKE CHAMPLAIN, AND IMPLICATIONS FOR THE ZOOPLANKTON COMMUNITY
- 12:15 AM Trevor Gearhart: AN EVALUATION OF FATTY ACID PROPAGATION THROUGH MULTIPLE TROPHIC LEVELS AND ITS APPLICATION TO QUANTIFYING ECOSYSTEM CHANGE IN LAKE CHAMPLAIN
- 12:30 PM Katherine Ritchie: CYANOBACTERIA BLOOMS AND ESSENTIAL FATTY ACID TRANSFER THROUGH THE FOOD WEB OF LAKE CHAMPLAIN

### **LCRC POSTER SESSION, 10 AM - 11 AM**

- Justin Andrews: Establishing a DNA Database for the Genus *Rana* in the New York Lake Champlain Basin
- Siobhan Levere: DNA Barcoding in Fungi (Mushrooms); Establishment of a Genetic Database within the Lake Champlain Basin as well as the Adirondack Park
- Maxwell Marsh: Finding Biodiversity and Searching for Invasive Species in the Lake Champlain Basin Using Environmental DNA (eDNA)
- Sean McNamara and Clare Abercrombie: Testing for Coyote-Wolf Hybrids in a Vermont Population of Eastern Coyotes
- Bich (Alex) Nguyen: Effect of Biochar on Lettuce (*Lactuca sativa*) and Basil (*Ocimum basilicum*) Germination
- Beth Rutila: Seasonal Changes in the Phosphorus Composition of Missisquoi Bay Sediments
- Sarah Studwell: Arsenic Concentration within Variably Metamorphosed Shales of the Taconic Sequence, Vermont and New York
- Kerry Monahan: Observing Abnormal Bat Behavior at Aeolus Cave
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## 2013 ABSTRACTS

### ORIGINS OF THE MORETOWN FORMATION, VERMONT: A DETRITAL ZIRCON STUDY

Juliet Ryan-Davis, Geology Department, Middlebury College, Middlebury, VT 05753

The tectonic history of the Vermont Appalachians can be refined with the aid of geochronological data. The Moretown Formation of Vermont has been interpreted as sediments deposited in the fore-arc basin of the Cambrian-Ordovician Shelburne Falls arc. This study uses detrital zircons to provide new information on the provenance of the Moretown sediments. Zircons have been separated from ten samples taken from the Moretown Formation of northern Vermont. U-Pb ages were determined on 75 to 100 zircons per sample using the LA-ICP-MS at Rensselaer Polytechnic Institute. Age distributions represent a signature of the range of ages of zircons from sources that contributed to the sediment. The age signatures of the Moretown, and some rift related sediments of Vermont, are compared to age signatures of potential source regions to determine the sedimentary provenance. The Late Proterozoic, rift-related Hazens Notch Formation shows, as expected, a dominant Laurentian (Grenville) signature. Ages from Moretown samples have a strong peak at 600 Ma, suggesting a peri-Gondwanan source component, likely mixed with a Laurentian Grenville component. This result indicates more provenance sources than the exclusively Laurentian signature postulated by previous work on the Moretown in southern Vermont and northern Massachusetts. Such a distinction could indicate that the Moretown is not the same along strike and that there is variation in local sources of zircons, or that tectonic models that explain the origin of the Moretown sediments need to be revised to incorporate the peri-Gondwanan signature.

### SUMMERTIME HYDRODYNAMICS AND SEDIMENT DYNAMICS OF MISSISQUOI BAY, LAKE CHAMPLAIN

Emily Wei, Geology Department, Middlebury College, Middlebury, VT 05753

The relationship between circulation currents, suspended sediment concentration, and sedimentation rates were investigated as part of a larger 5-year project studying the causes of eutrophication in Missisquoi Bay, a shallow bay (4 m) in Lake Champlain (Vermont and Quebec). Previous studies collected hydrodynamic modeling was based on a single month of ADCP data in the western arm of Missisquoi Bay and cores were taken from only the southeastern area. This study looks at the first 2 months of currents, wind forcing, and water level variations at five sites to better understand sediment resuspension and deposition. North-south and east-west centimeter-scale diurnal oscillations of lake level were observed and were not linked to the calculated ~30 minute surface seiche. Currents were obtained from Acoustic Doppler Current Profilers (ADCPs) indicate that after consistent wind forcing, both cyclonic and anticyclonic circulation patterns were set up. Unique to this very shallow bay was the degree of directional shear (in depth) as high as 180 degrees that occurs during periods of thermal stratification and neutral lake levels. Sediment properties and magnetic susceptibility measurements of five push cores vary, indicating that sedimentation rate is not constant throughout the bay. Implications of our results will provide other investigators insight into how phosphorus and nitrogen are being moved throughout the bay.

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**ARSENIC CONCENTRATION WITHIN VARIABLY METAMORPHOSED SHALES OF THE TACONIC SEQUENCE, VERMONT AND NEW YORK**

Sarah Studwell, Peter Ryan, and David West, Geology Department, Middlebury College, Middlebury, VT 05753

Elevated levels of naturally occurring arsenic have been found in bedrock wells throughout the Taconic region of southwestern Vermont. Previous studies have shown arsenic concentrations in groundwater are generally higher in the lower grade Giddings Brook slice than in the higher-grade Bird Mountain slice. This study aims to examine the role of metamorphic grade on arsenic concentration in black, pyritiferous shales, slates, and phyllites, which are common rock types in bedrock aquifers of this region. Two equal sample groups were established based on metamorphic grade. The lower-grade sample set is composed of rocks from the autochthon or Giddings Brook slice, and the higher-grade sub-set is composed of rocks from the Bird Mountain slice. In total, 30 samples were collected and analyzed for whole rock major and trace element geochemical analysis, and XRD and SEM-EDS analysis of mineral compositions.

ICP-MS data show that arsenic concentrations in the lower-grade samples range from 5.6 to 51.7 ppm, with an average of 26.9 ppm. In the higher-grade samples, arsenic concentrations range from 1.1 to 30.3 ppm, with an average of 13.8 ppm. Certain fluid-mobile elements (e.g., Pb, Ni, Zn) are also depleted in the higher-grade rocks. SEM-EDS analysis of pyrite-rich, high-arsenic samples revealed the presence of distinct Zn-bearing (sphalerite), and Cu- (chalcopyrite) minerals, but no distinct As-bearing minerals (e.g., arsenopyrite) were found. This suggests that arsenic may be disseminated as a trace element in other sulfide minerals such as pyrite, instead of forming its own distinct minerals. Analysis of REE distributions between the two sample sets suggest similar bulk rock compositions prior to metamorphism, allowing the lower-grade samples to act as a proxy for the protolith compositions of higher-grade samples. Therefore, the observed 48 % depletion in arsenic, and similar depletion in other trace minerals from the lower- to the higher-grade sample set may be attributable to mobilization during prograding metamorphism. This data is consistent with data from other depositional basins, including the Connecticut Valley-Gaspe belt, where biotite and garnet zone phyllites and schists contain 85 % less As and Pb than unmetamorphosed shale equivalents.

**GROUND PENETRATING RADAR AS A METHOD FOR DISTINGUISHING FRACTURES AND HIGH ANGLE FAULTS**

Parker Richmond, Geology Department, University of Vermont, Burlington, VT, 05401

This paper investigates the application of ground penetrating radar (GPR) to mapping folds and fractures in the hanging wall of the Champlain Thrust at Mt. Philo State Park, Charlotte, Vt. This location offers a unique opportunity to compare GPR profiles taken on an ideal flat surface to a vertical outcrop face that parallels the transect. East-West GPR transects were conducted in the upper parking area using a high frequency 200 MHz antenna. Target features such as fractures and folds were documented in geologic transects conducted along cliff faces directly below the parking area and above the Devil's Chair Trail, approximately 40m from the GPR transects. There, outcrops primarily consist of Lower Cambrian regularly bedded Monkton Quartzite and structural data were collected to allow projection of the cliff face structures into the GPR

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profiles. Where fractures project into the GPR profiles discontinuities associated with offset of reflectors are observed. Fold hinges of the observed synclines and anticlines project above the GPR profiles, but fold limbs can be identified from dipping layers. High angle faulting documented by previous work at Mt. Philo may be responsible for offset of target features. This paper offers insight on characterizing high angle faults previously mapped as fractures.

#### THE QUARTZ WASHING MACHINE: INSIGHTS INTO THE USES AND EFFECTIVENESS OF THE TITANIUM IN QUARTZ THERMOBAROMETER

Patrick Dyess and Laura Webb, Geology Department, University of Vermont, Burlington, Vermont, 05405

Investigations into the applications of the Titanium in Quartz, “TitaniQ”, thermobarometer have provided insight into the P-T-D cycle, from basin deposition through Acadian metamorphism, of the central Rowe Hawley Belt. In addition, evidence shows the importance that both structural and metamorphic processes play in the recycling of inherited quartz in metapelites.

Sampling was conducted along a structural transect from Rochester to Bethel, Vermont; incorporating a sequence of interbedded phyllites, quartzites, and calcic schists that have been exposed to both Taconic and Acadian conditions. Cathodoluminescence (CL) imaging on quartz was conducted to qualitatively assess [Ti] zoning within grains. Microprobe spot analyses and X-ray mapping of garnet porphyroblasts was performed to estimate peak P-T conditions. Secondary ion mass spectrometry (SIMS) analyses were conducted to determine [Ti] for TitaniQ calculations.

Petrology and microstructures record two major prograde events resulting from the Taconic and Acadian orogenies. CL imaging of quartz grains reveal zoning of darker cores and brighter rims as well as some uniform grains. A positive relationship between intensity at  $\lambda = 415$  nm and [Ti] is known, indicating that zoning represents an increase in [Ti] from core to rim. SIMS analyses of quartz grains indicate a spread of [Ti] from 0.4 – 157 ppm. 5% of these analyses have [Ti] signatures above the peak metamorphism evidenced by garnet P-T-X diagrams and stability fields.

High [Ti] samples can only be described as inherited grains with titanium contents similar to those of high grade origins. Lack of dynamic recrystallization textures, low peak P-T conditions during garnet growth, and slow volume diffusion rates of Ti into quartz requires alternative mechanisms for quartz equilibration. Solution transfer during fabric development produces new quartz growth at lower P-T conditions and consequently equilibrates with lower [Ti]. Additional quartz is introduced during quartz producing metamorphism.

Integration of structural, petrologic, geochemical and thermodynamic models suggest that while most quartz experienced reworking during the development of Taconic schistosity, and during Acadian metamorphism and fabric development, some quartz grains retained their relict signature.

#### THE SPANISH CREEK MYLONITE: A NEWLY IDENTIFIED REGION OF HIGH STRAIN WITHIN THE NORTHERN MADISON RANGE, SW MONTANA

Joshua Johnson, Geology Department, Middlebury College, Middlebury, VT 05753

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Recent fieldwork in Archean rocks of the Northern Madison Range in southwestern Montana has revealed a zone of high strain approximately 2 km long and at least 1 km wide. A multipronged structural approach incorporating fieldwork, microstructural analysis, and geochronology have been applied to studies of this mylonite. The dominant rock type in this area is multiply deformed granitic orthogneiss with variable porphyroclastic character. Thin section petrography reveals the presence of high-temperature microstructures such as quartz ribbons and polygonal, recrystallized feldspar grains in certain samples while others have distinctly lower grade microstructural assemblages characterized by weak to no shape preferred orientation and strong undulose extinction in quartz. Microstructural differences therefore confirm field observations of strong strain gradients within this zone and delineate three distinct structural realms. Strong quartz crystallographic preferred orientations in mylonitic samples indicates prism  $\langle a \rangle$  slip and deformation conditions of  $\sim 500$  °C. Zircon U-Pb ages indicate an igneous protolith age of  $\sim 2800$  Ma and suggest a Pb-loss event at  $\sim 1790$  Ma. These ages do not link this episode of mylonitization to the Early Proterozoic Big Sky Orogeny, but they do not preclude such a connection either.

#### EVIDENCE FOR AN EARLY CENOZOIC TECTONIC EVENT IN SOUTHERN EGYPT AND THE SIGNIFICANCE OF DEFORMATION BANDS ON THE SEIYAL FAULT, WESTERN DESERT, EGYPT

Steven Gohlke, Geology Department, University of Vermont, Burlington, VT, 05405,  
Barbara Tewksbury, Geosciences Department, Hamilton College, Clinton N.Y. 13323, and  
Charlotte Mehrtens, Geology Department, University of Vermont, Burlington, VT, 05405

This study seeks to determine the relative timing of events that contributed to the formation of an enigmatic structural feature in Egypt's Western Desert known as a Desert Eye. This Desert Eye is a structural dome (500 m by 1,000 m) consisting of shallowly dipping bedding, and is cut by the Seiyal Fault, part of a regional E-W basement trend. The primary goal of this research is to constrain the timing of deformation band formation on the Seiyal Fault. Cataclastic deformation bands are associated with faulting in porous rocks, such as the field area's Taref Member of the Nubian Sandstone.

Field data on the abundance and orientation of deformation bands and calcite veins were collected where the Seiyal Fault outcrops 70 km SW of Aswan in January 2012. The complete slip history of this fault is unknown, but it may be possible to determine if the motion recorded by the deformation bands matches its modern, dextral strike-slip movement.

At the thin section scale, grain attributes were measured in order to quantify differences between the poorly sorted, quartz arenite host rock and the deformation bands within it. SEM images show a decrease in mean grain size within the deformation bands ranging from 37-75% relative to the host rock. Measurement of the long axis orientation of grains shows a preferred alignment exists within the deformation bands. There are also many examples of calcite veins overprinting deformation bands indicating extremely high pore fluid pressure.

Field-scale cross-cutting relationships show that folding occurred prior to deformation band formation. The presence of soft sediment deformation (seismites) suggests seismicity during the Late Cretaceous deposition of the Taref Member. A strong subsidence signal from the burial history model indicates tectonic instability in the Early Paleocene. This likely caused movement along basement faults, resulting in deformation band formation at shallow (300-800 m) depths. CL imaging shows no authigenic quartz cement fragments within deformation bands, meaning they formed in unlithified sediment. Thin sections stained with Alizarine Red (ARS) show later pore-filling calcite cement haloes are coeval with calcite veins of Late Eocene age or younger. This research supports the presence of a previously unrecognized Early Paleocene tectonic event in southern Egypt.

#### U-PB ZIRCON AGES FROM TUFFS AND DETRITAL SEDIMENT: A NEW EVOLUTIONARY MODEL FOR THE RÍO IRUYA CANYON, NORTHWESTERN ARGENTINE ANDES

Lisa V. Luna, William H. Amidon, Geology Department, Middlebury College, Middlebury, VT 05753, and George B. Fisher, Douglas W. Burbank, Department of Earth Sciences, University of California-Santa Barbara, Santa Barbara, CA 93106-9630

The relationship between climate, tectonics, and erosion rates in mountainous terrain remains poorly understood over long timescales. Although studies of modern systems allow comparison across modern climatic and tectonic gradients, long-term records are required to test the importance of disequilibrium landscape conditions created by global climate cycles and long-term climate trends. To address the question of erosion rate response to changes in tectonic activity and climate cycling, we are developing a 9 Ma record of temporal variations in paleo-erosion rates from cosmogenic nuclides in the Río Iruya watershed of the northwestern Argentine Andes. The 100 m deep Río Iruya canyon is an extraordinary section of ~7500 m of sedimentary rock deposited in the Andean foreland basin during growth of the sub-Andean fold and thrust belt and only recently re-exposed when the river overwhelmed a flood control canal in 1898. Minimal post-burial cosmogenic production, along with published paleomagnetic stratigraphy data, makes the Río Iruya canyon an exceptional location to develop a long-term record of erosion rates. However, understanding the ages of the exposed sediments and the evolution of the watershed over time is a critical prerequisite to estimating and interpreting cosmogenic erosion rates. To refine the current stratigraphic framework, this study presents LA-ICPMS U-Pb zircon dates from three new interbedded ashes at  $7.01 \pm 0.10/-0.04$  Ma,  $4.07 \pm 0.07/-0.03$  Ma, and  $2.77 \pm 0.05/-0.06$  Ma. We additionally constrain sedimentary provenance and interpret watershed evolution through kernel density estimation plots from two modern and four paleo-detrital zircon samples.

#### MULTI-PROXY RECONSTRUCTION OF POST-GLACIAL ENVIRONMENTAL CHANGE FROM A CORE OF SOLDIER LAKE, NEVADA

Annika Silverman, Geology Department, Middlebury College, Middlebury, VT 05753

A core was retrieved from Soldier Lake, a glacial pond at 2775 m asl in the Ruby Mountains of northeastern Nevada, to reconstruct a record of post-glacial environmental change. The core

penetrated to a depth of 415 cm below the sediment-water interface. Four AMS radiocarbon analyses, one on terrestrial plant material, one on charcoal, and the deepest two from concentrated pollen indicate that the core extends to 26.1 cal ka BP. A layer of tephra encountered at a depth of 190 cm was correlated with the Mt. Mazama eruption by geochemical fingerprinting. These four radiocarbon dates and the tephra date supported the construction of a depth-age model which aided the comparison of Soldier Lake with other paleoclimate records from the region. Multi-proxy laboratory analysis of the Soldier Lake core included measurements of magnetic susceptibility (MS), water content, loss on ignition (LOI), grain size distribution (GS), and carbon to nitrogen ratio (C/N). MS values are high in the bottom quarter of the core ( $70 \times 10^{-5}$  SI units), reflecting higher levels of inwashing of iron-bearing minerals, and probably indicates a glacial flour source. After  $\sim 13.9$  cal ka BP MS values fall to zero and remain there with the exception of a slight peak ( $20 \times 10^{-5}$  SI units) centered around the Mazama tephra layer. Before  $\sim 13.9$  cal ka BP, LOI and C/N values remain close to zero, but a significant rise in LOI and C/N corresponds to the MS decrease  $\sim 13.9$  cal ka BP, indicating a period of decreasing glacial runoff and increasing ecosystem productivity. LOI and C/N decrease around the tephra layer and then increase until  $\sim 3$  cal ka BP when they both exhibit a slight trough. After  $\sim 3$  cal ka BP, LOI increases continuously and then rapidly in the past  $\sim 400$  cal yr BP, whereas C/N stays close to the Holocene mean and then decreases rapidly  $\sim 400$  cal yr BP. Mean grain size exhibits cyclic variability throughout the record, with values oscillating between 7 and 70  $\mu\text{m}$ . The overall trend in GS distribution indicates there is a higher concentration of fine GS (mostly silt) and small mean GS before  $\sim 17$  cal ka BP. After this time, fine GS concentrations and silt percentages decrease, giving rise to an increase in sand percentages and an overall increase in mean GS. An exception to this trend is the fine GS associated with the Mazama tephra layer. Soldier Lake data overlap with trends observed in other records from the region, namely the early Holocene period of productivity found in the Overland Lake record from the southern Ruby Mountains, and the most recent warm periods observed in the Blue Lake (Louderback and Rhode, 2009) and Stella Lake (Reinemann et al., 2009) records from eastern Nevada.

#### NATURAL PROCESSES IN AN INDUSTRIAL SETTING: SEDIMENTARY AND HYDRO-DYNAMICS OF THE BUFFALO RIVER, N.Y.

Clara St. Germain, Geology Department, Middlebury College, Middlebury, VT 05753

The lower 9 km of the Buffalo River, which flows from the east along the southern border of Buffalo, NY before discharging at its mouth into the eastern end of Lake Erie, has been designated as a Great Lakes area of concern (AoC) due to poor water quality, degraded riparian and river habitat, and sediment contamination. Over a century of rapid industrial growth and subsequent deterioration in the area directly surrounding the river has caused its natural state to become extremely altered as it has been and continues to be manipulated to fit into a man-made setting. The current Remedial Action Plan (RAP) for this AoC centers on sediment remediation and therefore understanding the hydrodynamics and subsequent sediment transport processes within the river is key. The current understanding of the river's dynamics has been interpreted primarily from sediment movement and deposition trends via Sediment Trend Analysis (STA), side scan imaging, and three-dimensional modeling. These studies have revealed that a highly dynamic transport system within the river including both downstream and upstream flow regimes has developed due to the impact of seiche events. The development of a standing wave, known



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as a seiche, along the long axis of Lake Erie, initiates rapid changes in lake level causing water to be forcibly driven up into the Buffalo River channel at its mouth resulting in the creation of this unique bidirectional flow regime within the river. As the hydrodynamics of the river have primarily been reverse modeled from sediment trends, an examination of data collected by Acoustic Doppler Radar Profilers (ADCPs) greatly enhances this database of knowledge by sampling the vertical water column and horizontal cross-section velocities of the river in multiple strategic locations at short time intervals of 30 minutes or less over an extended period of time. This hydrologic data, in collaboration with other databases including the aforementioned studies as well as concurrently collected measurements of temperature, meteorological, lake level, and updated side-scan survey imaging data, reveals new trends and creates a more comprehensive image of this dynamic setting which may enhance our ability to efficiently remediate this AoC as well as other similarly affected areas in the future.

#### DEVELOPING GEOCHRONOMETERS: DIFFUSION OF HELIUM IN CALCITE, ARAGONITE, AND DOLOMITE

Daniel Hobbs, Geology Department, Middlebury College, Middlebury, VT 05753

Many modern geochronology techniques suffer from highly time-consuming and labor intensive mineral separation procedures which are required to ensure reliable and repeatable age determinations.  $^3\text{He}$  cosmogenic dating and  $^4\text{He}$  thermochronology of calcite, aragonite, and dolomite have the potential to provide relatively fast and simple dating techniques that are widely applicable to a range of fields and study environments. However, the primary limitation to applying such geochronometers is the poor helium retention observed in many natural carbonates and the lack of understanding regarding helium diffusion behavior in these minerals. More knowledge of what controls He retention in calcite is required to identify types of calcite which are reliably retentive and therefore useful for geochronology. One of the first steps to improving our understanding of helium diffusion in calcite is to identify basic trends in diffusion behavior, such as anisotropic diffusion. Nuclear Reaction Analysis (NRA) and Elastic Recoil Detection (ERD) were used to produce direction-specific diffusion coefficients for the major crystallographic axes of calcite, aragonite, and dolomite. This data highlights anisotropic  $^3\text{He}$  diffusion in calcite and relatively low  $^3\text{He}$  diffusion rates in aragonite and dolomite. Interionic porosity and minimum aperture size have previously been correlated with anisotropy in apatite, titanite, rutile, and zircon and are thus compared to the recently collected  $^3\text{He}$  diffusion rates of calcite, aragonite, and dolomite.

#### COMPARISON OF DUCTILE STRUCTURES FROM THE SOUTHERN TERMINUS OF THE HINESBURG THRUST FAULT WITH THOSE FROM THE CENTRAL FLAP, WEST-CENTRAL VERMONT

Eric Weber, Geology Department, University of Vermont, Burlington, VT 05405, Jon Kim, Vermont Geological Survey, Montpelier, Vermont 05620, and Keith Klepeis, Geology Department, University of Vermont, Burlington, VT 05405

In west-central Vermont, the Hinesburg Thrust (HT) emplaced Neoproterozoic-Cambrian rift clastic and early drift stage metamorphic rocks of the hanging wall onto Cambrian-Ordovician carbonate and clastic sedimentary rocks of the footwall, during the Ordovician Taconian

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Orogeny. The HT extends for ~75 km along-strike and terminates at both its northern and southern ends in map-scale, west-verging, overturned, tight folds. The fault is comprised of conspicuous promontories (“flaps”) and recesses along its length. Relative displacement along the HT is greatest in the central flaps and least along the ends.

In the field area, that lies at the southern terminus of the HT, lithologies in the hanging wall consist of phyllitic quartzites, massive metagraywackes, quartz pebble conglomerates, and marbles of the Pinnacle Fm; phyllites and phyllitic quartzites of the Fairfield Pond Fm; and phyllitic quartzites of the Cheshire Fm. Since the HT “ends” in the Cheshire Fm, other Cheshire lithologies, including stratigraphically higher massive quartzites, are also found in the footwall, as well as massive dolostones of the Dunham Fm.

In the hanging wall of the HT in the field area, two major foliations are present: 1) an older composite bedding-parallel fabric ( $S_1$ - $S_2$ ) defined by alternating quartz and mica domains and rootless reclined isoclinal folds with fold axes that plunge down dip (and collinear stretching lineations), and 2) a well-developed crenulation cleavage ( $S_3$ ) that is axial planar to tight, west-verging, gently-plunging folds, with strong crenulation lineations. Although footwall structures are similar to those of the hanging wall near the thrust zone, the intensity of the older structures diminishes to the west and large-scale  $F_3$  folds become dominant. Based on regional correlation,  $S_1$ - $S_2$  is Taconian and  $S_3$  is Acadian (Devonian).

We defined meso and micro scale structures at the southern terminus of the HT, which is a segment of minimum relative displacement. We compared these structures with those described by Strehle and Stanley (1986) in the central flap of the HT, a segment of maximum relative displacement. We investigated kinematics, grain distortions, and textures to infer conditions of deformation and metamorphism at both segments.

#### VARIATION IN TWO STYLES OF ACADIAN THRUST FAULTING IN THE PINNACLE FORMATION, RICHMOND, VT

Abigail Ruksznis, Keith Klepeis, Geology Department, University of Vermont, Burlington, VT 05446, and Marjorie Gale, Vermont Geological Survey, Montpelier, Vermont 05620

The goal of this study is to investigate the variation in the styles of Acadian thrust faulting in the Pinnacle Fm. (CZp) located on the western flanks of the Green Mountain anticlinorium. This formation forms part of the Proterozoic to Cambrian rift clastic section on the upper plate of the Hinesburg thrust and lies roughly 0.5 km west of the Underhill – Brome thrusts. The unit contains foliated to massive muscovite-chlorite-biotite schist and metawacke and phyllite with beds of pebble to cobble conglomerate. It sits unconformably on Proterozoic basement to the south (Ripton area) and is interbedded with Tibbit Hill metavolcanics to the north. A continuous 50 m roadcut, on which this study is based, exhibits two domains defined by distinctive structural relationships.

The eastern domain is comprised of layers of pebble-bearing metawacke and chlorite schist with quartz-calcite veins. The oldest visible foliation is an early penetrative disjunctive pinstripe cleavage ( $S_2$ ) defined by alternating muscovite-chlorite and quartz-feldspar domains that are

axial planar to Taconian isoclinal. This foliation is deformed by open, asymmetric, west-verging, upright folds ( $F_3$ ). Cross cutting the crenulation cleavage ( $S_3$ ) are a series of discrete ~1m wide ductile thrust zones defined by the truncation of the pinstripe, an intensification in the size of the pressure shadows on the pebbles, and the transposition of  $S_3$  parallel to the thrust surface.

The western domain is composed of muscovite-chlorite schist with fewer metawacke layers. The older pinstripe cleavage is not as prevalent due to the intense overprinting of the penetrative  $S_3$  cleavage. In comparison to the eastern domain, the deformation processes are predominantly mechanical. Unlike the eastern domain, the thrust zones are parallel to  $S_3$  and have a down dip quartz-chlorite +/- pyrite mineral lineation on the  $S_3$  planes.

Outcrop and microstructural observations suggest the two different thrust styles result from the variability in lithology and location of a large-scale  $F_3$  fold. The eastern type formed by faulting along the long limbs of asymmetric  $F_3$  folds of  $S_2$  while the western type formed by faulting parallel to the  $S_3$  cleavage planes. This model is applicable to the southeastern portion of the Essex Junction Quadrangle where the Acadian deformation intensifies.

## VERMONT STATE GEOLOGIST'S REPORT

**Northeastern Geological Society of America Meeting-** March 18-20: Vermont Geological Survey (VGS) personnel were co-conveners of two successful topical sessions:

*Getting the Work Done: State Geological Surveys; Partnering and Progress:* Abstracts highlighted the needs of the citizens of the Northeast. State Geological Surveys assemble resources for projects to provide framework and applied information on a range of geo-science topics. Presentations focused on collaborative research between state surveys and academic geology or contractors on topics such as hydrogeology, groundwater geochemistry, natural hazards, geomorphology, and geothermal issues. Conveners: Robert Marvinney, Maine Geological Survey; Laurence Becker, VGS; Jonathan Kim, VGS; Rick Chormann, New Hampshire Geological Survey.

*The New England- Canadian Bedrock and Tectonic Connections:* Presentations highlighted research that helps to resolve the similarities and differences in the tectonic evolution of the New England and Canadian segments of the northern Appalachians. The session focused on resolving tectonic problems using various approaches, including elements of structural geology, petrology, geochronology. Conveners: Keith Klepeis, Univ. of Vermont; Jon Kim, VGS.

Abstracts, presentations and posters from VGS and our partners are listed below and abstracts are available at <https://gsa.confex.com/gsa/2013NE/webprogram/start.html>:

Improving Seismic Hazard Assessment In New England Through The Use Of Surficial Geologic Maps And Expert Analysis: Becker, Laurence R.<sup>1</sup>, Patriarco, Steven P.<sup>2</sup>, Marvinney, Robert G.<sup>3</sup>, Thomas, Margaret A.<sup>4</sup>, Mabee, Stephen B.<sup>5</sup>, and Fratto, Edward S.<sup>2</sup>, (1) Vermont Geological

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Survey 2) Northeast States Emergency Consortium, (3) Maine Geological Survey (4) Connecticut Geological Survey (5) Massachusetts Geological Survey

Use of Lidar in a Landslide Inventory Protocol in Vermont: Clift, Anne E., Jericho, Springston, George E., Norwich University, and Becker, Laurence, VGS

Magma Without Borders: Coish, Raymond, Middlebury College, Kim, Jonathan, VGS

Pre- and Post- Tropical Storm Irene Comparative Assessment of Channel Geomorphology Along the Dog River, Central Vermont: Hay, Jeffrey K.<sup>1</sup>, Conley, Matthew J.<sup>1</sup>, Waters, Kevin<sup>1</sup>, Koteas, G. Christopher<sup>1</sup>, Dunn, Richard K.<sup>1</sup>, Springston, George E.<sup>1</sup>, and Grigg, Laurie D.<sup>1</sup>, (1) Norwich University

Analysis of Groundwater Resources in the Town of East Montpelier, Central Vermont: Kim, Jonathan J.<sup>1</sup>, Springston, George E.<sup>2</sup>, and Becker, Laurence R.<sup>1</sup>, (1) VGS (2) Norwich University

Comprehensive Logging of Deep Bedrock Wells in Vermont for Geothermal Purposes: Kim, Jonathan J.<sup>1</sup>, VGS, Romanowicz, Ed<sup>2</sup>, (1) VGS (2) SUNY at Plattsburgh

Distribution and Geometry of Acadian Deformation in the Taconian Foreland of West-Central Vermont: Kim, Jonathan J.<sup>1</sup>, Klepeis, Keith<sup>2</sup>, and Gale, Marjorie H.<sup>1</sup>, (1) VGS (2) University of Vermont

Seismic Hazard Assessment of The Burlington and Colchester Quadrangles, Northwestern Vermont: Lens, John E.<sup>1</sup>, Dewoolkar, Mandar M.<sup>1</sup>, Springston, George E.<sup>2</sup>, and Becker, Laurence<sup>3</sup>, (1) Norwich University (2) University of Vermont (3) VGS

Compilation of Geochemical Data of Meta-Volcanics from the Rowe-Hawley Zone of Western New England are Consistent with Backarc, Arc, and Forearc Regions of One Composite Arc: Pierce, Natasha<sup>1</sup>, Dietsch, Craig<sup>1</sup>, Kim, Jonathan<sup>2</sup>, and Coish, Raymond<sup>3</sup>, (1) University of Cincinnati (2) VGS (3) Middlebury College

Examining the Potential Effect of Metamorphism on Arsenic Concentration in Metapelite Bedrock Aquifers: A Case Study of the Taconic Sequence: Studwell, Sarah<sup>1</sup>, Ryan, Peter<sup>1</sup>, West, David P. Jr<sup>1</sup>, and Kim, Jon<sup>2</sup>, (1) Middlebury College (2) Vermont Geological Survey

Source of Arsenic-Bearing Pyrite in Southwestern Vermont: Sulfur Isotope Evidence Mango, Helen<sup>1</sup>, and Ryan, Peter<sup>2</sup>, (1) Castleton State College (2) Middlebury College

Variation in Two Styles of Acadian Thrust Faulting in the Pinnacle Formation, Richmond, Vt: Ruksznis, Abigail<sup>1,2</sup>, Klepeis, Keith<sup>1</sup>, and Gale, Marjorie H.<sup>1</sup>, (1) University of VT (2) VGS

Rainfall, Flood Magnitude, and Geomorphic Impacts of Tropical Storm Irene on the White River Watershed, East-Central Vermont: Springston, George E.<sup>1</sup>, Underwood, Kristen L.<sup>2</sup>, Robinson, Keith<sup>3</sup>, and Swanberg, Ned<sup>4</sup>, (1) Norwich U. (2) South Mountain Research & Consulting,

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Bristol, VT (3) USGS (4) VT Dept. of Environmental Conservation, Watershed Management Division

Leveraging a GIS and the Emerging Geoweb Towards Improving The Communication Of Geologic Mapping Endeavors To Community Stakeholders: Van Hoesen, John, and O'Keefe, Megan, Green Mountain College

Field-Based Undergraduate Curriculum and Research Exploring Geophysical Methods, With Applications to the State of Vermont: Webb, Laura E.<sup>1</sup>, Westerman, David S.<sup>2</sup>, Springston, George E.<sup>2</sup>, Kim, Jonathan<sup>3</sup>, Klepeis, Keith<sup>1</sup>, Koteas, G. Christopher<sup>2</sup>, Ruksznis, Abigail<sup>1,2</sup>, Mehrrens, Charlotte<sup>1</sup>, Becker, Laurence R.<sup>3</sup>, and Gale, Marjorie<sup>3</sup>, (1) University of Vermont (2) Norwich University (3) VGS

Surficial Geology and Land Use in Vermont: Wright, Stephen F., University of Vermont

**Hazards** : State Hazard Mitigation Plan (SHMP) – Landslides and Earthquakes

The VGS submitted the “Protocol for the Identification of Areas Sensitive to Landslide Hazards in Vermont” developed by Anne Clift and George Springston to Vermont Emergency Management and Homeland Security. There are landslide and earthquake narratives in the Vulnerability and Assessment section. The Executive Summary of the Protocol will be referenced and appear in the appendix. A URL link to the VGS web site gains access to the full report and protocol: <http://www.anr.state.vt.us/dec/geo/hazinx.htm>

**Geologist/Hydrogeologist – Discussion of Formal Designation**

(Please see public policy request to the VG Society membership in this issue)

**Move to National Life Building, Montpelier:** The VGS moved to permanent quarters at National Life, February 25, 2013. The Davis 2 space accommodates our light tables, map cabinets and places for temporaries and student interns. We appreciate our new location with thanks to the Agency of Natural Resources administration and staff that worked to accommodate our needs for the future. (address/phones)

Respectfully submitted,  
Laurence R. Becker, State Geologist

## **PUBLIC ISSUE: RESPONSES SOUGHT ON GEOLOGIST LICENSURE OR REGISTRATION**

With recent proposed changes to the engineer’s licensing statute, the geology and hydrogeology community is again discussing the question of licensing or registration for geologists.

A group in the Department of Environmental Conservation met to begin to consider the pros and cons of licensure/registration. Some states have licensing programs, others registration, so please consider the licensing/registration term as a catch all for considering a more formal designation for geologists.

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Three questions are posed:

1. Is licensure/registration appropriate for geologists/hydrogeologists?
2. Is it necessary?
3. Would you support a bill in the Legislature if proposed?

Please respond by emailing Larry Becker, Vermont State Geologist and Chair of the VG Society Public Issues Committee. Email: [laurence.becker@state.vt.us](mailto:laurence.becker@state.vt.us); If you prefer a phone conversation: 802-522-5165.

Looking forward to hearing from you.

## TREASURER'S REPORT

**Finances:** The Society is in excellent financial condition, thanks to all of its members. We are at our annual peak, with deposits in, and prizes and scholarships not yet distributed. Cash on hand as of April 1, 2013 is \$6,741. Recorded dues payments for 2013 stand at \$1,380, down about 6 members from last year; contributions to the Society's Research Grant Program equal \$775 to date, down almost 50% from the year before. We have had no expenses since the last Treasurer's report.

**New Members:** Please join me in welcoming the following new and returning Members:

Alice Blount (M), Omya, Inc., Proctor, VT  
Shannon Foster (M), Omya, Inc., Proctor, VT  
James Nizamoff (M), Omya, Inc., Proctor, VT  
Michelle Nucci, P.G. (M), Wilcox & Barton, Moretown, VT

**Sanborn "Sandy" Partridge (1915-2013):** I would like to take this opportunity to acknowledge that one of our longest-term members, Sanborn "Sandy" Partridge, passed away peacefully in January. I am lucky to have known him these past few decades. He led a rich and productive life, filled with service, always delivered with a smile. He never let me forget that he was related to the founder of Norwich University, Capt. Alden Partridge. Several news articles can be found with minimal searching, but here's one from the Rutland Herald.

<http://www.legacy.com/obituaries/rutlandherald/obituary.aspx?pid=162378465#fbLoggedOut>

**Mystery Check:** Following separation of an envelope and an unidentified renewal form, and after making deposits before entering all the renewal data, I have no idea who wrote us check #4234 for \$20 dues plus \$10 donation. Step up and claim your prize!

Respectfully submitted,  
David S. Westerman, Treasurer



**Where's It, What's It?** Send me an e-mail ([marjorie.gale@state.vt.us](mailto:marjorie.gale@state.vt.us)) with the Vermont town name and a brief description of what is in the picture below. All correct entries will be entered in a drawing for a copy of the 2011 Bedrock Geologic Map of Vermont. Look for the answers in the GMG Summer Issue along with another puzzler. Feel free to contribute your own Vermont puzzlers too.

*Tom Eliassen is the winner of the last issue's contest. See the correct answer below*

## ANNOUNCEMENTS

**MAP EXHIBIT COMING SOON TO PERKINS MUSEUM** - The 2011 Bedrock Geologic Map of Vermont will be on permanent display in the Perkins Museum later this spring. More details TBA.

**SUMMER FIELD TRIP** - Tom and Pat Manley (Middlebury College) expect to take us in small groups for 2 hour excursions on board their research vessel on Lake Champlain on August 24. Details will be announced as summer approaches.

**ERIE PROGRAM** - The University at Buffalo's Ecosystem Restoration through Interdisciplinary Exchange (ERIE) Program offers 2013 Summer Stream Ecosystem Restoration Workshops and Professional Certificate Program. Registration is now open. Visit their website for more information: <http://www.erie.buffalo.edu/trainingSummerCoursemainpage.php>

## ANSWER TO WHERE'S IT, WHAT'S IT?



The picture is of the Yandow exploratory oil/gas well which was drilled to a depth of 4,500 feet in 1957. The well was drilled by the Henderson Company using a cable tool rig (center picture). Wooden blocks at the base of the derrick rotted and the derrick "settled" onto the well head, thus tipping it about 30 degrees (far right picture). The picture was taken from County Line Rd., St. Albans.

**CALENDAR**

- April 27: Spring Student Research Meeting, University of Vermont
- August 24: Summer Field Trip on Lake Champlain
- Sept. 9-12: 2013 Highway Geology Symposium, North Conway Grand Hotel, North Conway, NH: <http://www.highwaygeologysymposium.org/default.asp>
- Sept. 23-24: National Ground Water Association Conference on Groundwater in Fractured Rock and Sediment, Hilton Burlington, Burlington, VT
- October 11-13: New England Intercollegiate Geologic Conference, Millinocket Lake, ME
- October 27-30: Geological Society of America Annual Meeting, Denver, CO

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	Jon Kim	(802) 522-5401	jon.kim@state.vt.us
Vice President	Keith Klepeis	(802) 287-8387	keith.klepeis@uvm.edu
Secretary	David West	(802) 443-3476	dwest@middlebury.edu
Treasurer	David Westerman	(802) 485-2337	westy@norwich.edu

**Board of Directors**

Les Kanat	(802) 635-1327	les.kanat@jsc.edu
George Springston	(802) 485-2734	gsprings@norwich.edu
Kristen Underwood	(802) 453-3076	southmountain@gmavt.net

**Chairs of the Permanent Committees**

Advancement of Science	Jon Kim	jon.kim@state.vt.us
Membership	David Westerman	westy@norwich.edu
Public Issues	Laurence Becker	laurence.becker@state.vt.us
Publishing	Marjorie Gale	marjorie.gale@state.vt.us



**Vermont Geological Society  
Norwich University, Dept. of Geology  
158 Harmon Drive  
Northfield, Vermont 05663**

***ADDRESS CHANGE?***

*Please send it to the Treasurer at the above address*



# THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

VGS Website: <http://www.uvm.org/vtgeologicalsociety/>

**SUMMER 2013**

**VOLUME 40**

**NUMBER 3**

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## PRESIDENT'S LETTER



*"The Anticline" at the Watershed Center in Bristol*



*Massive Cheshire Quartzite near the top of Hogback Mountain in Bristol (above) and folds in the Forestdale Marble (below)*



**Field Work Update:** After mapping the Bristol Quadrangle last field season, the Vermont Geological Survey will shift southward into the adjacent South Mountain Quadrangle. In both quadrangles, metamorphic rocks of the hanging wall of the Hinesburg Thrust are generally found east of Route 116 and sedimentary rocks of the footwall, with kilometer scale folds, to the west. The recent rains have greatly bolstered the mosquito population, which may temporarily exceed what I experienced 25 years ago in Texas and Louisiana, during a hitch in the oil industry.

**Cool Geology:** Over the past decade, the Vermont Geological Survey and partners from Middlebury College and the Vermont Agency of Agriculture have conducted reconnaissance age dating of groundwater in the Waits River Formation and in lithologies from the hanging wall and footwall of the Hinesburg Thrust. We obtained ages that ranged from 20-50 years using Chlorinated Fluorocarbon (CFC) and Helium techniques. These ages are considered modern.

A fabulous recently-published study on the age of "groundwater" from a deep gold mine in Timmins, Ontario revealed ages in excess of 1500 million years, using Xenon isotopic methods. This water presumably evolved in Neoproterozoic oceans and was trapped in the surrounding rocks as fluid inclusions or along fractures. See the links below:

<http://www.npr.org/2013/05/16/183950854/water-trapped-for-1-5-billion-years-could-hold-ancient-life>

<http://www.nature.com/nature/journal/v497/n7449/full/nature12127.html>

**Spring meeting:** On Saturday April 27, 2013 the Vermont Geological Society (VGS) and the Lake Champlain Research Consortium (LCRC) held a joint meeting in the Aiken Center at the University of Vermont to present student research. The VGS and LCRC each held coordinated symposiums in separate lecture halls that flanked a central atrium, where a continental breakfast buffet of pastries, juices, and coffee were served. Total attendance was ~80. All the feedback I received about the meeting was positive.

There were 13 talks in the VGS symposium and the following awards were presented:

- 1st Place Award and Doll Award (\$100): Sarah Studwell, Undergraduate Student at Middlebury College

Talk Title Arsenic Concentration within Variably Metamorphosed Shales of the Taconic Sequence, Vermont and New York

- 2nd Place Award (\$75): Juliet Ryan-Davis, Middlebury College

Talk Title Origins of the Moretown Formation, Vermont: A Detrital Zircon Study”

- 3rd Place Award (\$50): Daniel Hobbs, Middlebury College

Talk Title Developing Geochronometers: Diffusion of Helium in Calcite, Aragonite, and Dolomite



Award winners: Daniel Hobbs- 3<sup>rd</sup> Place (2<sup>nd</sup> from left) and Sarah Studwell- 1<sup>st</sup> place (2<sup>nd</sup> from right). Judges: Shelley Snyder, Dave Westerman, and Les Kanat (left, center, and right, respectively).

Respectfully submitted,  
Jon Kim, President

## ADVANCEMENT OF SCIENCE COMMITTEE REPORT

Although I may be preaching to the choir, the student talks at the VGS Spring Meeting were *absolutely superb*. I have mused year after year with VGS geologists from across the spectrum that these talks would hold their own any place in the country. In addition to the winning talks, you could hear about Lake Champlain hydrodynamics, arsenic and metamorphism, Montana mylonites, Egyptian tectonics, stratigraphy of a Nevada lake, ground penetrating radar at Mt. Philo State Park..... If you have never attended one of these meetings, I strongly encourage you to make plans to do so. I learn so much every year.

By the way, some of the young geologists that presented at this meeting (Juliet Ryan-Davis and Eric Weber) were funded by the Vermont Geological Society Research Grant Program. Each year, this program competitively awards research grants to 3-4 students (maximum is \$700

each). For some students, this is the only source of funding for their research. Contributions to support this research grant program can be sent to the Vermont Geological Society Treasurer.

Respectfully submitted,  
Jon Kim, Chair

## **TREASURER'S REPORT**

Due to the timing of this newsletter, the Treasurer sends greetings from Italy! Look for a complete report in the Fall GMG.

## **SUMMER FIELD TRIP OF THE VERMONT GEOLOGICAL SOCIETY**

For the Vermont Geological Society summer field trip, Pat and Tom Manley of the Geology Dept. at Middlebury College have offered to run a cruise on Lake Champlain in their research vessel. The goals of the trip will be to demonstrate the use of their survey equipment and discuss their research. The vessel has a capacity of 10-15 visitors, so if more members than this sign up, more than one cruise will be run. The cruise will run a maximum of two hours and will leave from the docks on Thompson's Point in Charlotte on Saturday August 24, 2013. As of July 1, 2013, Jon Kim will be taking reservations by e-mail or phone ([jon.kim@state.vt.us](mailto:jon.kim@state.vt.us), 802/522-5401) for this field trip. Please make your reservation by July 31, 2013.

## **VERMONT STATE GEOLOGIST'S REPORT**

### Bedrock Map Display – UVM Perkins Museum and USGS Lobby, Reston, VA

The 2011 Bedrock Geologic Map display was installed in the Perkins Museum at the University of Vermont in May. The map was re-printed on solid panels and an interpretive panel was created by MajaDesigns with input from Char Mehrstens, Marjorie Gale and Laurence Becker. The display, funded by the Lintilhac Foundation, is permanently mounted to the granite floor as stand-up panels. Gabriela Mora-Klepeis coordinated the installation. The map offers new educational opportunities for museum visitors in terms of map uses and linking mineral specimens, fossils, and age dates to map locations and the geologic time scale in order to understand the geologic setting of the museum specimens. Other map displays are in process at Middlebury College, Johnson State College and the Fairbanks Museum plus the full map assembled north to south is now on display in the main lobby at USGS in Reston, VA.

### Vermont State Bedrock Map Presentations

The New Hampshire Geological Survey Annual Geologic Mappers Workshop was held in Concord, NH on April 16. Rick Chormann, NH State Geologist, hosted the meeting for approximately 40 geologists/hydrogeologists from academia, state government and industry. The meeting provides a forum to share ideas among NH and adjoining New England states. Marjorie Gale represented the Vermont Geological Survey and presented a half-hour slide show about the 2011 Bedrock Geologic Map of Vermont and its applications to issues of water, energy, climate

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*Charlotte Mehrtens and UVM students unload the crated map panels for the Perkins Museum exhibit.*



*UVM's maintenance people came through on the installation!*

and natural communities. Other talks ranged from new digital mapping technologies to basic surficial mapping.

The Institute for Lifelong Education at Dartmouth (ILEAD) offers up to 80 courses each year to its members. Marjorie Gale was invited to present a talk about the 2011 Bedrock Geologic Map of Vermont for a plate tectonics class taught by geophysicists Martin Smith and Randy Martin. The seminar with 25 students evolved from a 40 minute slide presentation to a livelier two hour hands on discussion covering the history of geology, making of the geologic map, basic fundamentals of geology and uses of geologic maps. Students were interested in obtaining more detailed, local maps from our web site and learning about their towns' geology.

### Green Mountain National Forest

Scott Bailey, Research Geocologist, US Forest Service, Northern Research Station is requesting coordination and cooperation with the VGS for an "Evaluation of Spatial Patterns in Soil Parent Material Chemistry and Calcium Mineralogy for the Green Mountain National Forest". Soil base saturation is a primary control on both terrestrial and aquatic species distribution and community composition, and influences forest health, productivity, and resilience. Understanding spatial patterns in calcium supply will aid the Forest in inventorying rare plant species and communities, in assessing the impacts and recovery from air pollution, and in evaluating potential impacts of harvesting and other land management activities on forest health and productivity. The VGS is finalizing a project Memorandum of Understanding with the U.S. Forest Service. UVM Rubenstein School is also a partner.

### Geothermal Energy

The Vermont Geological Survey is funded through the US Department of Energy to contribute to the National Geothermal Data System (NGDS) which is a portal for access to state and federal geologic and geothermal data. The emphasis is on the search for deeper higher temperatures although much of the data collected and collated is also applicable to shallow resources.

Poster Presentation: For the ANR Earth Day Celebration on April 23, the Division prepared a poster session on Geothermal Energy. The VGS explained to visitors the workings of shallow (groundwater heat pump) and deeper technologies (studies to understand the potential for resources hot enough to generate electricity).

Rock Sample Collection Complete: The VGS finished collecting rock samples for thermal conductivity analysis. Rocks of lower thermal conductivity (resistance to the flow of heat) near the surface may act as insulation to trap heat and lead to more advantageous temperatures at

depths of up to 5 km. Plugs were cut from the Vermont samples and sent to Southern Methodist University to be analyzed for density, porosity, and thermal conductivity at slightly elevated pressures. In addition, since one source of heat is radioactive decay at depth, samples will be sent out for geochemical analyses. Data will be used to evaluate the potential for workable temperatures to support electricity production (>150°C) in Vermont and will also contribute to our understanding of background geochemistry in the State.

**Geophysical Logging of Bedrock Wells:** During the last week of May, the Vermont Geological Survey (Jon Kim) and partner, Ed Romanowicz, from the Geology Department at SUNY Plattsburgh conducted geophysical logging on bedrock wells in the Town of Berlin. This logging measured temperature, conductivity, gamma (natural radioactivity), and borehole diameter for three deep (600') closely-spaced wells that were drilled as future public water supplies. Data will be contributed to the NGDS. The analysis of these well logs will yield detailed information on the hydrogeology of the Waits River Formation aquifer and will be shared with the Town of Berlin and their geological consultant.

#### Maps Delivered/Geology and Health

The Vermont Geological Survey and our Norwich University partner recently submitted bedrock and surficial geologic maps of the Bristol Quadrangle to the U.S. Geological Survey. These maps complete our obligations for the 2013 STATEMAP grant. During 2013 and 2014, we will work with the Town of Bristol to obtain accurate locations for private water wells and collate these locations with associated well data such as yield, depth to bedrock, and static water levels. In addition, with our Middlebury College Geology Dept. partner, we plan to test the groundwater from a selected group of wells for naturally-occurring contaminants such as Arsenic, Uranium, Gross Alpha, Manganese, Fluoride etc. The bedrock and surficial maps will be integrated with the groundwater quality and quantity data to analyze the groundwater resources in Bristol. Completion of this work will contribute to the Williston to Bristol "Geology and Health" corridor we have been working on since 2007.

#### Abigail Ruksznis

Congratulations to our most recent VGS temporary employee, Abigail Ruksznis, for her acceptance to graduate school at Stanford University in the fall. Abi worked two summers on mapping projects and assisted on the VGS geothermal project. Both Marjorie Gale and Jon Kim worked with Abi and her able UVM advisor Keith Klepeis. Abigail was the principal author for two Northeast Geological Society of America Abstracts: "Variation in Two Styles Of Acadian Thrust Faulting in the Pinnacle Formation, Richmond, VT" in 2013 and "Integration of Structural Analysis, EMI and GPR Surveys, and Hydrogeology in the Plainfield Quadrangle, Central Vermont" in 2012.

Respectfully submitted,  
Laurence R. Becker, State Geologist

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## ANNOUNCEMENTS

Internship Work Group: While at NE GSA this spring, Helen Mango of Castleton State College and Marjorie Gale of the Vermont Geological Survey discussed the availability of paid and unpaid internships for undergraduate Geology and/or Environmental Science majors at Vermont colleges and universities. Although many students go on to graduate school, many others plan to enter the work force with a bachelor's degree and hope to remain in the northeast. Marjorie then presented the topic at the Spring VGS Board Meeting and a brainstorming session ensued. Initial discussions and investigations show internship programs are quite varied with varying degrees of success.

We intend to form a small work group to research existing internship programs/opportunities and to investigate roles the VGS membership and organization could pursue. We are particularly interested in participation from the business community and if you would like to be part of the work group, please contact Marjie at 802-522-5210 or e-mail [Marjorie.gale@state.vt.us](mailto:Marjorie.gale@state.vt.us).

## WHERE'S IT, WHAT'S IT?



Send me an e-mail ([marjorie.gale@state.vt.us](mailto:marjorie.gale@state.vt.us)) with the Vermont town name and a brief description of what is in the picture. All correct entries will be entered in a drawing for a copy of the 2011 Bedrock Geologic Map of Vermont. Look for the answers in the GMG Fall Issue along with another puzzler. Feel free to contribute your own Vermont puzzlers too. (Photo: J.Kim)





***Answer to Spring's Where's It, What's It?: The Green Mountain Giant, Whitingham, VT as described in Hitchcock, E. et.al, 1861 (Photo: M. Gale)***

*“But the most gigantic specimen with which we have met, lies on the naked ledges on a high hill on the farm of Jonathan Dix, in the west part of Whitingham. From this hill we look westerly into the valley of the Deerfield River, which must be over 500 feet deep, and from the character of the rock, corresponding to that of the Green Mountains (a highly micaceous gneiss), we feel sure that the boulder was transported across this valley. Yet its length is 40 feet; its horizontal circumference is 125 feet; its average width 32 feet; its cubic contents 40,000 feet, and its weight 3400 tons. Think of the power requisite in the first place to tear off from the ledge such a gigantic mass, and then to lift it up and carry it across a deep mountain valley, and then to plant it near the highest part of a rocky ridge. It does not seem to have been much rounded, and cannot therefore have been subject to mere mechanical or aqueous attrition. Hence we suppose it to have been lifted up bodily and transported- not rolled – along with other fragments by a vis a tergo. The sketch below will give some idea of one of the sides of this boulder. An end view is quite different. It is situated in the midst of a forest and a little southeast of and below the crest of the hill.*

*Until a larger boulder shall be found, we propose for this one the name of Green Mountain Giant. It is the largest we have met with in New England, save one at Fall River – which is now destroyed for architectural purposes. The Giant should have a ladder attached to it, and the forest around it be cleared away, that persons of taste might be induced to visit it. Such objects are beginning to be incorporated into the world's literature, and we already have at least one volume entitled “The Boulder,” as well as Hugh Miller's Autobiography of a boulder. Ere many years we predict that the Guide Books for summer tourists will describe the route to the Giant.”*

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## CALENDAR

- August 24: VGS Summer Field Trip on Lake Champlain
- Sept. 9-12: 2013 Highway Geology Symposium, North Conway Grand Hotel, North Conway, NH: <http://www.highwaygeologysymposium.org/default.asp>
- Sept. 23-24: National Ground Water Association Conference on Groundwater in Fractured Rock and Sediment, Hilton Burlington, Burlington, VT
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October 11-13: New England Intercollegiate Geologic Conference, Millinocket Lake, ME

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#### **Officers**

President	Jon Kim	(802) 522-5401	jon.kim@state.vt.us
Vice President	Keith Klepeis	(802) 287-8387	keith.klepeis@uvm.edu
Secretary	Will Amidon	(802) 443-5988	wamidon@middlebury.edu
Treasurer	David Westerman	(802) 485-2337	westy@norwich.edu

#### **Board of Directors**

Les Kanat	(802) 635-1327	les.kanat@jsc.edu
George Springston	(802) 485-2734	gsprings@norwich.edu
Kristen Underwood	(802) 453-3076	southmountain@gmavt.net

#### **Chairs of the Permanent Committees**

Advancement of Science	Jon Kim	jon.kim@state.vt.us
Membership	David Westerman	westy@norwich.edu
Public Issues	Laurence Becker	laurence.becker@state.vt.us
Publishing	Marjorie Gale	marjorie.gale@state.vt.us

**Vermont Geological Society  
Norwich University, Dept. of Geology  
158 Harmon Drive  
Northfield, Vermont 05663**

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*Please send it to the Treasurer at the above address*



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## **UVM PROFESSOR ALLEN S. HUNT – A REMEMBRANCE**

Workers of each generation have lasting influence on their successors. Geology is no exception and with the loss of Dr. Allen S. Hunt on August 27, 2013, it important to remember his science and his quiet but very significant influence on his students, geology and the State of Vermont. As my graduate school advisor at UVM, I am indebted to Allen for his guidance and mentorship.

Dr. Hunt's work on Lake Champlain represents the core of a generation of Lake Champlain scientists with earlier data collection tools forming a quantitative base for subsequent studies. In recent years, we think of an extensive application of research funds through the support of Senator Patrick Leahy prompted by heightened concern for this spectacular water resource - but every step has a precursor.

In 1968, as a founding member, the Lake Champlain Study Center issued its first Champlain Research Report establishing a comprehensive study approach for the Lake. Allen Hunt's geologic studies integrated his science with botanists, limnologists, microbiologists and zoologists. A bathymetric map by Hunt and Boardman, a student, makes up the first report. The Melosira research vessel as the platform for soundings and core sampling continues work today through the support of the Lintilhac Foundation. From this vessel, Allen and his students made first and major contributions in bathymetry, sedimentology, paleontology, and paleomagnetism. Cognizant of environmental issues, his masters students studied oil and arsenic contamination and heavy metal dispersion. In recognition of his work, the Hunt Rise is named for a bathymetric high northwest of Burlington.

My own work centered on a growing concern of the time related to shoreline erosion. We started with bank profiles on Arnold, Potash and Appletree Bay. For Allen, we conducted a study for the New England River Basins Commission creating a map of lakewide shoreline erosion potential and my thesis focused on the nearshore, beach, and banks of Appletree Bay in Burlington. As development pressures increase, the shoreline erosion concern continues to this day. We worked together to show how wave energy and sediment transport on the beach and bank are part of one system that must be understood for effective management. The work has influenced the City of Burlington and the Department of Environmental Conservation's approach to shoreline questions as well as studies related to causeway removal in Missisquoi Bay.

In remembering a professional who showed the importance of data to make the case, the personal is not far from the surface. I found my graduate school desk in the basement of Perkins across from his office and outer work area with numerous map cabinets and fossil drawers. As we talked, I learned of his projects. His wall of student fame with a picture of each showed his real care for the young scientists in his charge. While helping with his research vision, he brought us along with his advice and counsel. It was a give and take as there was always easy access for the exploration of the research direction. My images of those office visits involved a lot of laughter. I can still hear the sound of his enjoyment in the work that gave me direction when it was most needed. Aspects of his legacy are numerous while his science integrity stands out as a personal guide for my public service work.

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Condolences go out to his wife Nancy Hunt and family. Nancy was always there in the graduate school years and with exceptional loving care as his passing approached.

If you want to learn more please see the Times Argus:

<http://www.timesargus.com/article/20130904/OBITUARIES/709049999/1042/IRENE>

Respectfully submitted,  
Laurence R. Becker, Vermont State Geologist



Southwest view along Lake Champlain from Split Rock Point, VGS Summer Field Trip

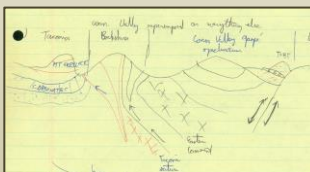
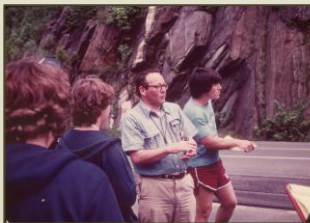
## PRESIDENT'S LETTER

Field trips are certainly one of the best activities supported by the Vermont Geological Society. I'm sure that most of us can think of a field trip or two that "sealed the deal" for pursuing geology as a career or hobby. For me, I used to go fossil collecting with my father at Akron Falls State Park near Buffalo, New York when I was 8-10 years old. I was reminded of these "georoots" last Memorial Day weekend, when I returned there with family (see left) and saw where I had once sought fossils in a stream valley lined with the Devonian Onondaga Limestone.

At Colgate University, it was required that geology majors attend a 12-week summer field camp that had multi-week modules in western Massachusetts, and the Taconic Mountains, St. Lawrence Lowlands, and Adirondacks of New York State. In the photo (left sidebar) from 1980, Leo Hall, a Structural Geologist who used to teach at UMass/Amherst, led us on a field trip across the Berkshire Mountains of Massachusetts. The enthralled person to Leo's right in the blue T-shirt and maroon shorts is me, at the moment when I knew I would be a geologist for life. In fact, I still have the western Massachusetts cross section that Leo drew in my notebook from that memorable field trip. I now segue to the VGS summer field trip that was run last August.



Akron Falls State Park, NY

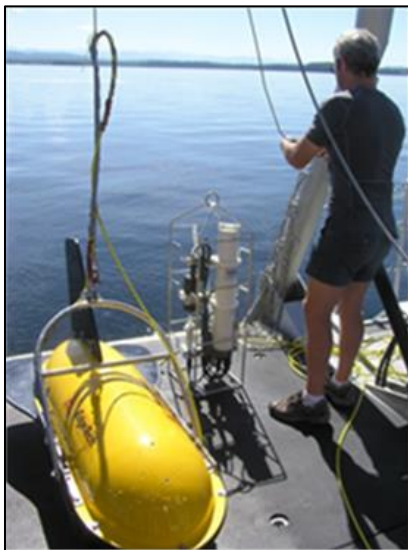


**Summer Field Trip:** On August 24th, Pat and Tom Manley of Middlebury College led a two hour cruise on Lake Champlain on the R/V David Folger. The trip left from the Point Bay Marina in Charlotte with 12 Vermont Geological Society members aboard.



VGS members on board the David Folger with Pat and Tom Manley.

The purpose of the trip was to explain the geologic history of Lake Champlain and to demonstrate the operation of three instruments that have been critical in deciphering this history, which are: 1) Edgetech CHIRP sub-bottom profiler / side scan system (stratigraphy of lake bottom deposits), 2) Seabird CTD (conductivity–Temp–Depth) instrument (data that constrains signal velocity in water), 3) Reson 7125 dual-frequency Multibeam transmitter & receiver (wide-angle bottom topography).

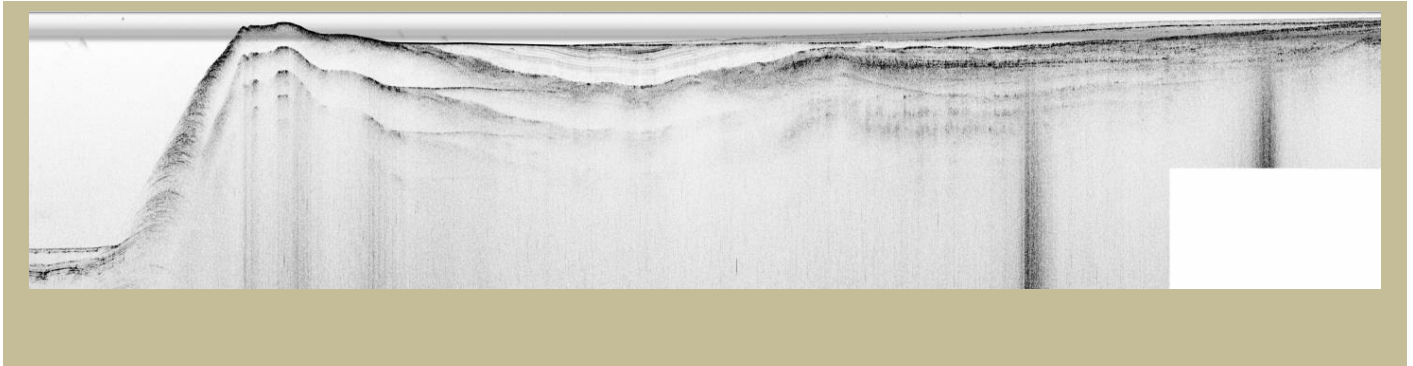


Chirp(left-yellow) and CTD



Multibeam Instrument

After leaving the dock, Pat and Tom narrated a slideshow that gave an overview of the lake history. Each of the instruments described above was then sequentially deployed and the data from each was acquired and observed in real-time. The boat surveyed a generally westward course that followed the southeastern shoreline of Thompson's Point and then crossed the deepest part (~400') of Lake Champlain toward Split Rock Point.



Chirp profile from Thompson's Point (right=east) toward Split Rock Point (left=west). Note the rapid increase in water depth.

Many thanks to Pat and Tom Manley!

Respectfully submitted,  
Jon Kim, President

## TREASURER'S REPORT

**Finances:** The Society is in the best financial position of its history. In my last report I acknowledged the loss of one of our longest-term members, Sanborn "Sandy" Partridge (1915-



2013). I was very pleasantly surprised when his niece, Laura Partridge, contacted me in July on behalf of Sandy's Trust, telling me that Sandy had left a gift to the Vermont Geological Society. A check for \$4,000 arrived shortly thereafter and went straight to the bank. The VGS Executive Committee is developing alternatives for consideration as to how we might best use these unexpected funds, but in the meantime, they bring our current balance to \$10,606. Other than this gift, things have been quite stable as we approach distribution of the next round of Research Grants to deserving students.

**New Members:** Please join me in welcoming the following new and returning Members:  
Greg and Nancy McHone (returning members), Grand Manan, CAN  
Ethan Thomas (new member), East Hardwick, VT

Respectfully submitted,  
Dave Westerman, Treasurer

## ANNOUNCEMENTS

In Press: Ryan, P., Kim, J., Mango, H., Hattori, K., and Thompson, A, Dissolved Arsenic in a Fractured Slate Aquifer System, New England, USA: Influence of Bedrock Geochemistry, Groundwater Flow Paths, Redox and Ion Exchange: *Applied Geochemistry*.

Internship Work Group: A small workgroup has formed but has not yet met to research existing internship programs/opportunities and to investigate roles the VGS membership and organization could pursue. The work group is Marjie Gale (VT Geological Survey), Helen Mango (Castleton State College), Miles Waite (Waite Environmental), and Michelle Nucci (Wilcox and Barton, Inc.). If any other members wish to be involved in this early stage, please contact Marjie Gale at 802-522-5210 or e-mail [Marjorie.gale@state.vt.us](mailto:Marjorie.gale@state.vt.us).

## CALENDAR

November 18, 2013, 4:15 - 5:15 pm, UVM Guest Lecture, Delehanty Hall, Rm 219: Tony Fowler, University of Ottawa, "Non equilibrium mineral growth and pattern formation in igneous rocks"

January 10, 2014, 12:30 pm, Middlebury College Guest Lecture, McCardell Hall, Rm 417: John Garver, Western Ontario

March 14, 2014, 12:30 pm, Middlebury College Guest Lecture, McCardell Hall, Rm 417: John Rayburn, SUNY

March 23-25, 2014, Geological Society of America Northeast Section Meeting, Lancaster, PA

April 18, 2014, 12:30 pm, Middlebury College Guest Lecture, McCardell Hall, Rm 417: Albert Malinverno, Lamont-Doherty Earth Observatory, Columbia University

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.

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Public Issues	Laurence Becker	laurence.becker@state.vt.us
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**Vermont Geological Society  
Norwich University, Dept. of Geology  
158 Harmon Drive  
Northfield, Vermont 05663**

***ADDRESS CHANGE?***

*Please send it to the Treasurer at the above address*