THE

GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

SPRING 1999 | VOLUME 26 | NUMBER 2

The Vermont Geological Society's Spring Meeting

Presentation of Student Papers

Room 4, Kalkin Hall

University of Vermont

Burlington, Vermont

Saturday April 17th

Directions: Kalkin Hall is immediately behind the Perkins Geology Building on the north side of campus. Parking is available in the lot adjacent to Perkins. Access is from Colchester Avenue. Construction along Main Street (Route 2, the main Burlington exit off I-89) has been slowing and rerouting traffic during the week. Weekend travel into and out of the city should be relatively easy.

See inside for Program

TABLE OF CONTENTS

Vermont Geological Survey Summer Field Trip

Danby Marble Quarry

Mount Tabor, Vermont

Saturday July 17th

Contact Shelley Snyder by July 1st to make reservations (ssnyder@mtabe.k12.vt.us or 658-0575).

Directions to Quarry:

Follow Rt. 7 south from Rutland through Wallingford and South Wallingford to Danby. Approximately 10 miles south of the point where Rt. drops to two lanes just north of Wallingford, take a right to Mount Tabor Road to Danby Four Corners. At Danby Four Corners (less than a quarter mile from Rt. 7) take a left on to Fire Station Road. Follow for 0.6 miles to Quarry Hill Road. Take a right onto Quarry Hill Road. Follow for 0.4 miles to Quarry Road. Take a right onto Quarry Road and follow through gates and keep a steep hill to quarry entrance. Park on the right before the quarry entrance.

New England Intercollegiate Geological Conference (NEIGC)

Hosted by UVM Geology Department

October 1–3, 1999

Field Trips in Northern Vermont and adjacent New York State

A Complete schedule of trips will be published in the Summer GMG.

SPRING MEETING PROGRAM

University of Vermont
Kalkin Hall
April 17, 1999

8:30 Coffee

9:00 Adam R. Consigli: *GEOCHEMISTRY AND TECTONIC SETTING OF A SUITE OF DIKES NEAR VICTORY, VERMONT*

9:15 Elizabeth R. Goeke: *PRESSURE AND TEMPERATURE STUDIES IN THE EASTERN AUREOLE OF THE VICTORY PLUTON, NORTHEASTERN VERMONT*

9:30 Carey A. Hengstenberg: *REGIONAL SIGNIFICANCE OF THE AVERILL PLUTON, NORTHEAST KINGDOM, VERMONT: A SYN-TECTONIC PLUTON?*

9:45 Myrth T. Anderson: *DEPTH CONSTRAINTS ON THE ORIGIN OF NORTHEAST KINGDOM GRANITES, VERMONT*

10:00 Brian Totten: *ANALYSIS OF IRON OXIDE COATINGS THAT HAVE FORMED AS A RESULT OF ACID MINE DRAINAGE FROM THE PIKE HILL COPPER MINE IN NORTHEASTERN VERMONT*

10:15 Scot Wiercinski: *GEOCHEMICAL AND MINERALOGICAL ANALYSIS OF THE PIKE HILL MINE TAILINGS, CORINTH, VERMONT*

10:30 Break: Recent Surficial Maps of the Montpelier and Barre West 7.5-Minute Quadrangles by F.D. Larsen and S.F. Wright, respectively, will be on display as will the northern section of the new Vermont State Bedrock Map

10:40 Darrin L. Santos: *THE EFFECTS OF TWO YEARS OF INTENSE MILITARY ACTIVITY ON THE SOURCE AREAS, SOURCE-BASIN LENGTHS, AND INITIATION OF CHANNELS IN THE U.S. ARMY'S FORMER DESERT TRAINING CENTER, MOJAVE DESERT, CA.*

Ternary, binary, and rare earth element (REE) diagrams were utilized to classify and distinguish the rocks that were studied. Most dikes have a tholeiitic composition, but there are some outliers that have a more alkalic composition. The majority of the dikes are basaltic in nature. Others vary from andesitic to basanitic. Tectonic discriminant diagrams of the dikes show the majority of the rocks are like mid-ocean ridge basalts (MORB) in composition. REE patterns are slightly enriched in LREE- similar to basalts from some continental extensional environments.

Chemical analyses show that a majority of the studied rocks are similar in nature to Rouff's dikes. They are mostly tholeiitic basalts that were intruded in an extensional environment. Thus, the dikes in this study could be derived by melting asthenospheric mantle, similar to the Comerford intrusive suite.

SEDIMENT CHARACTERIZATION OF ROATAN ISLANDÍS REEFS AND BEACHES, PRE-HURRICANE MITCH, BAY ISLANDS, HONDURAS

Duni, Megan, Department of Geology, University of Vermont, Burlington, VT 05405

Roatan, one of three islands comprising the Bay Islands, lies in the Carribbean Sea approximately 50 km north of Honduras. The fringing reef surrounding much of the island is the southernmost extension of the Belize reef system, the second largest reef system in the world. Though annual visitors to Roatan have been increasing dramatically over the past decade, the islandís tropical ecosystem is considered one of the very last remaining pristine reef systems in the world, yet no descriptive studies regarding Roatan Islandís coral reef have been preformed. In an effort to produce a comprehensive starting point from which future studies monitoring pertenent environmental changes will evolve, I am characterizing sediments at eleven beach sites and seven reef sites surrounding Roatan Island. Sediment characteristics measured at every site include 1) mean grain size, 2) the degree of sediment sorting, 3) biogenic to terrestrial sediment ratios, and 4) mineralogy of terrestrial sediment present.

During the summer of 1998, grab samples were collected from the back reef by Charlotte Mehrtens and Robert Young, and from the islandís beaches by David Bush. Reef samples were wet sieved on location and beach samples were wet sieved at the University of Vermont, Fall 1998. From Fall 1998 to Spring 1999, the degree of sorting and mean grain size of the sieved sediment were determined, insoluble material was isolated, and percent insoluble sediment present was then calculated. X-Ray Diffraction was used to determine mineralogy for all samples smaller than 3.0 phi. Quartz, feldspar, and amphibole were the dominant minerals. Significantly, no terrigenous clays were identified. For coarser-grained samples, mineralogy will be determined using a binocular microscope this spring.

Data is being interpreted using existing maps of shoreline properties, watershed boundaries, human development, and bedrock geology to yield a description of factors that are prominent influences controlling the sediment characteristics at each site. Generally, beaches (n=11) showed very high insoluble residue values, an average of 69.11%, and smaller grain sizes, an average of 1.42 phi (medium sand), while the reefs (n=7) showed extremely low insoluble residue values, an average of 9.85%, and larger grain sizes, an average of 0.17 phi (coarse sand). On average, both reefs and beaches are poorly sorted with an Inclusive Graphic Standard Deviation of 1.68 phi and 1.28 phi, respectively. The evidence of the lack of transport from land to reef or vice versa is supported by what appears to be a lack of impact on the reefs offshore of the sediment plumes observed on the island. Either the sediment composing the plumes settles out before reaching the reef, or it continues traveling into the open sea without settling on the reef. One apparent exception to this generalization is the impact that a dredged inlet has on the Key Hole site. While reefs on this island have an percent insoluble residue not exceeding 6%, the sediments of Key Hole, just offshore of a dredged inlet, rise to 35% insoluble.

A STUDY OF THE UNDERWATER FAULT SYSTEM OF LAKE CHAMPLAIN NEAR PORT KENT, NEW YORK

Gauley, Billie-Jo L., Geology Department, Middlebury, VT 05753

The fault system beneath Lake Champlain is based on the projection into the lake of well-studied land based faults in New York and Vermont. Due to the limited access, little direct study of the underwater faults has been made until now. In western Lake Champlain, underwater faults may explain topographic anomalies such as Ferris Rock. In order to study the faults, we have to rely on instruments that can illustrate the bottom topography. The data consists of 6.8 square miles of side-scan records, taken during the 1997 Lake Survey, and 22.7 nautical miles of Precision Depth Recorder (PDR) tracts. Topographic escarpments on the lake bottom may represent faults. The alignment of escarpments along neighboring PDR tracks gives us the orientation of the fault. The PDR tracts indicate the existence of one fault directly northwest of Schuyler Island as well as one northeast of Trembleau Point. A final side-scan mosaic demonstrates the relationship of the underwater faults to those observed on land. The combination of PDR records and the side-scan mosaic allows us to define the underwater fault system of Lake Champlain near Port Kent in a more detailed manner than previous studies.

PRESSURE AND TEMPERATURE STUDIES IN THE EASTERN AUREOLE OF THE VICTORY PLUTON, NORTHEASTERN VERMONT

Goeke, Elizabeth R., Geology Department, Middlebury College, Middlebury, VT 05753

The Ordovician or Silurian New Hampshire series metasediments are separated from the Silurian-Devonian Vermont series metasediments by the Monroe Fault. In northeastern Vermont, the Devonian Victory Pluton straddles the thrust fault and has long been assumed to be post-tectonic, though recent studies suggest it intruded during fault movement.

In the garnet zone east of the fault peak pressures and temperatures are 4.6–5.6 kbar and 515–575° Celsius. Peak pressures and temperatures in the garnet zone west of the fault are 5.0 kbar and 515–525° Celsius. The nearly equal peak pressures and temperatures indicate that the final garnet growth occurred after all deformation along the fault took place.

In sillimanite grade rocks east of the fault, one sample contains the assemblage staurolite + sillimanite + garnet + cordierite + ilmenite + rutile + plagioclase + biotite + chlorite. Reaction textures in the thin section suggest that cordierite and garnet were replaced by biotite and sillimanite; staurolite has reacted with biotite, sillimanite and garnet; and ilmenite was replaced by rutile. These reactions are consistent with an increase in pressure or a decrease in temperature.

A pressure increase during contact metamorphism in the eastern (upper) plate of the fault could be explained in several ways. There are several possible explanations: the pluton may have been emplaced above part of its eastern aureole, another thrust fault to the east may have slipped concurrently with the Monroe Fault, or pressure may have increased for some other reason not related to the pluton or the Monroe Fault.

REGIONAL SIGNIFICANCE OF THE AVERILL PLUTON, NORTHEAST KINGDOM, VERMONT: A SYN-TECTONIC PLUTON?

Hengstenberg, Carey A., Geology Dept., University of Vermont, Burlington, VT 05405

The Averill pluton is a medium to coarse-grained biotite granite which intrudes Early to Middle Devonian metasedimentary rocks of the Gile Mountain and Ironbound Mountain Formations. This and related plutons in northeastern Vermont have been previously interpreted as post-tectonic plutons that mark the end of the Acadian Orogeny in Vermont. These interpretations are based on evidence from the contact metamorphic aureoles, apparent lack of foliation within the bodies

of the plutons and discordant map patterns. However, recent studies indicate that significant ambiguities are inherent in the interpretation of emplacement related structures (Karlstrom and Williams, 1995). For example, Hannula et al., (1999) suggest that the Victory Pluton, which was originally described as a post-tectonic pluton in northeast Vermont, was actually emplaced along an active thrust during orogenesis. The focus of this study is to determine the emplacement history of the Averill Pluton as pre-, syn- or post-tectonic by investigating: (1) deformation textures within the body of the pluton, (2) the metamorphic history in the contact aureole and (3) the pluton's relationship to regional metamorphism and deformation.

Field data collected along the contact of the granite in the eastern and western portions of the pluton show folded granitoid dikes in the country rock and a weak foliation defined by aligned biotite and feldspar grains. In the area very proximal to the contact within the body, hand sample specimens of granite appear deformed, with a weak fabric defined by elongate quartz, feldspar and biotite grains. Petrographic textures indicative of deformation occur throughout the pluton but are more apparent near the pluton margin. This is especially noticeable along the northern contact in Quebec and the eastern contact in Vermont where pervasive deformation textures have been observed. These features include: strong muscovite foliations, recrystallized and biaxial quartz, myrmekite and deformed feldspar grains in all thin sections studied thus far. This preliminary data suggests that at least a portion of the body has been deformed during or after emplacement. Pegmatite dikes also occur in both country rock and pluton and are late, cross-cutting all features. These relationships imply that deformation ceased before final emplacement of the Averill pluton.

To determine if the observed deformation relationships are associated with emplacement-related deformation or regional deformation, it is necessary to examine metamorphic history and textural relationships on the country rocks. The country rock shows several generations of metamorphic mineral growth which include, staurolite, sillimanite, biotite and muscovite. In all instances these porphyroblasts appear to have formed prior to foliation development in the rock because the fabric defining the foliation wraps around these porphyroblasts. Foliations in the granite are sometimes parallel to the country rock foliation, and this may suggest an interaction between regional and emplacement-related strain but the effect of regional deformation in the contact aureole cannot be determined completely until regional P–T conditions and foliation trends are defined. Based on metamorphic reactions in the contact aureole, temperatures and pressures of likely emplacement conditions of the Averill pluton are mid-crustal, approximately 550–650°C and 3–7 kbar.

DETENTION POND INFLOW AND OUTFLOW: WATER QUALITY SAMPLING OF CENTENNIAL BROOK, BURLINGTON, VERMONT

Hofeller, Megan, Department of Geology, University of Vermont, Burlington, VT 05405

Human activities have a large impact upon our environment. The use of urban stormwater detention ponds has become a practice to improve the water quality of urbanized streams such as Centennial Brook. This brook, in Burlington, Vermont, is adjacent to the University of Vermont campus and flows through Centennial Woods Natural Area. Three detention ponds are located along the drainageway of Centennial Brook to collect stormwater runoff from campus storm drains, surrounding parking lots, a hospital, hotel, and two gas stations. Two ponds are located downstream from the brookís headwaters, and the other is further downstream. All three are specifically designed to reduce the amount of suspended solids entering the brook and control the discharge into the brook. Stormwater moves through the detention ponds and eventually discharges into Centennial Brook.

The performance of these detention ponds is evaluated by sampling six different locations along the stormwater flow path to the brook. Site 1 was the

untreated water entering the first detention pond. The water sampled at Site 2 was the outflow of the first detention pond at times of high flow and low flow. Site 3 was the inflow to the second detention pond. Site 4 was the outflow of the second detention pond. Site 5 was the water that is being discharged into Centennial Brook. Site 6 was the water being discharged into Centennial Brook from the third detention pond. Each site was sampled for pH, conductivity, chloride ion concentration, and suspended solids during high flow, normal flow and low flow. Each site was sampled six times from February through April 1999.

General trends are made for the analyzed samples from the brook. Surprisingly, the average total suspended solid values were higher at the detention pond outflows than the inflows by a factor of ten. Total suspended solids (TSS) ranged from 6.22 mg/L at Site 1 to 40.40 mg/L at Site 6. Conductivity and chloride ion concentrations corresponded to the high and low flow; there were high conductivity and high chloride concentration values for low flow days and low values for high flow days. The minimum values for both parameters were at Site 1 with a conductivity of 1.39 mmhos and Cl concentration of 0.0137 moles/L; higher values were apparent at Site 4 with a conductivity of 4.58 mmhos and a Cl concentration of 0.0408 moles/L. The pH values ranged from 7.93 to 8.11 and had no temporal or spatial relationship to the drainageway.

Detention ponds in the Centennial Woods Natural Area are not effective at settling out solids during high flows. The high flow days increase the turbulence within the detention ponds and, as a result, increase the suspended solids in the river. In addition, the higher flows dilute the concentrations of ions in the water. Conductivity and chloride ion concentrations corresponded to the amount of water flowing through the drainageway.

GEOCHEMICAL ANALYSIS OF MID-TERTIARY SEDIMENTS FOR EVIDENCE OF PALEOCLIMATE CHANGE, MISSION AND JACKO VALLEYS, MONTANA

Hopping, Bryan A., Geology Department, Middlebury College, Middlebury, Vermont

In the Mission and Jacko Valleys of western Montana there exist depositions of lateritic mid-Tertiary sediments. Study of these sediments is important in gaining an understanding of paleoclimate conditions during the time of deposition. Past study has shown that these sediments were deposited in a semi-arid to arid environment, mainly in the form of fans on the floors of the valleys. Dating of volcanic ash puts these sediments at 32± 1.4 Ma. Analysis of the clay mineralogy of these sediments shows that kaolin minerals dominate in the northern sediments, and more smectite is seen in the more southern deposits. This difference in mineralogy suggests a change in the climate from semi-tropical to semi-arid.

This study continues previous work on these deposits by performing a bulk chemical analysis of these sediments using ICP analysis. Using the known clay mineralogy the samples are roughly ranked from less to more weathered. The rankings are supported by plots of the ratio of soluble to insoluble elements. Preliminary plots of the major and trace elements generally show the expected trends based on the ranking. As expected, weight percent of some of the more soluble elements, magnesium and calcium, decreases from less to more weathered sediments.

Geochemical analysis of these sediments shows a change in chemistry which would suggest a change in climate around the time of deposition. The dating of these sediments puts them near the Eocene-Oligocene boundary. The subtropical climate prior to this boundary is responsible for the higher degree of weathering found in some of the sediments. The sediments which show less weathering, as well as the fan-like deposits, were formed when the climate changed from subtropic to semi-arid.

GEOPYSICAL PROPERTIES OF SURFICIAL SEDIMENTS ALONG THE ANTARCTIC PENINSULA AND IMPLICATIONS FOR PALEOCLIMATE CHANGE

Morse, Timothy L., Geology Department, Middlebury College, Middlebury, VT 05753

The Antarctic Peninsula continental shelf is located within the transition from subpolar to polar climate regimes. Increased temperature effects along the AP (increase of 2.5{symbol 176 \f "Symbol" \s 10}C recorded at Faraday Station) include increases in surface melting across ice shelves, smaller coverage of annual sea ice, and related increases of sediment influx and deposition within the basins and fjords. Climatic related events and sediment deposition patterns make this region a sensitive indicator of paleoclimate. Prior investigations have seen varied sediments along the peninsula shelf and fjords indicating extended development of glaciers, glacial recession, and subsequent paleoclimate evolution during the Holocene.

High-resolution geophysical properties including bulk density, water content, electrical resistivity and magnetic susceptibility were measured on 3-meter kasten and gravity cores from three locations along the Antarctic Peninsula. Relationships between geophysical properties and core lithology are used to describe paleoclimate change.

Geophysical reflectors have been associated with sand lenses and small scale variations in bulk density and water content of hemipelagic/pelagic sediments. Resistivity measurements indicate a negative correlation with water content and may be a good indicator of paleoclimate change. Magnetic susceptibility shows an inverse profile of biogenic silica and is useful in interpreting regional climate.

HYDRODYNAMICS OF THE SOUTH MAIN LAKE OF LAKE CHAMPLAIN

Osterberg, Erich C., Geology Department, Middlebury College, Middlebury, VT 05753

Lake Champlain provides an outstanding opportunity to further understand internal seiche dynamics of long and narrow stratified lakes. The wind-driven internal seiche has been shown to dominate Lake Champlain's circulation, and is known to have dramatic effects on the lake's thermal structure. Five subsurface moorings equipped with temperature sensors and self-contained Acoustic Doppler Current Profilers (ADCPs) were positioned in areas of varying depth within the South Main Lake of Lake Champlain (between Thompsons Point and Potash Point). From May 14, 1997 to October 14, 1997, the moorings measured current velocity and backscatter every hour in one-meter cells, and measured temperature every hour in four-meter cells, throughout the water column. The data were quality controlled, modeled and analyzed.

During this study period, the South Main Lake was dominated by oscillating north-south currents driven by the internal seiche. At any given time, hypolimnic flow was opposite to that of the epilimnion, although maximum velocities were consistently observed in the epilimnion over the five sites. North-south maximum velocities ranged from 10–47 cm/s, while east–west maximum velocities ranged from and 5–27 cm/s. Auto- and cross-spectral analyses indicate that the first, second and wind-forced modes of the lake were 4.3–5.3 days, 2.6–3.0 days and 10.7 days, respectively. Shorter observed periods of 0.89–1.5 days may reflect an internal seiche system bounded within the study area itself. The varying thickness of the metalimnion revealed the second vertical mode with dominant spectral peaks at 5.3 days and 2.7–3.0 days. Backscatter intensity, however, displays a strong diurnal oscillation, which suggests that the majority of reflecting material was phytoplankton and/or zooplankton.

Gradient Richardson Numbers indicate that the thermocline was characterized by a zone of stability. Mixing across the metalimnion dramatically increased during the initial, downward tilting of the thermocline associated with high-amplitude seiche oscillations, suggesting that epilimnion renutrification may

VERMONT GEOLOGICAL SOCIETY - DUES STATEMENT 2000

Membership dues for 2000 are $15.00 for Members and Associate Members, $20.00 for a family membership with one newsletter subscription, and $8.00 for Student Members. Membership dues are used to publish the *Green Mountain Geologist*, to finance our Student Research Grants, and to cover the costs associated with meetings and field trips. If your address, phone, or e-mail address has changed since last year, please fill in this information below, if not, leave the form below blank. A new membership directory will be published with the Summer *GMG*. Return this form with your check for the appropriate amount made payable to the Vermont Geological Society by March 30, 2000. Send your payment to Kristin Underwood, Treasurer; Vermont Geological Society; Department of Geology; University of Vermont; Burlington, VT 05405-0122. Thank you.

Name: Date:

Street or Box: Check No.:

City, State, ZIP:

Work Phone: Home Phone:

e-mail address: Fax No.:

Circle Type of Membership:

Member ($15) Student Member ($8) Family ($20)

Amount Due: _____

Additional Contribution to VGS Research Grants: _____

Total Enclosed: _____

have occurred during these times. Contrary to the northward direction of the lake's drainage, the net transport of water had a dominant southerly component at all but the southernmost mooring (Potash Point). This can be attributed to the internal seiche's Kelvin wave structure and the position of these moorings to the west of the lake's thalweg. This further suggests that a net counter-clockwise circulation cell may exist south of Thompsons Point.

WATER QUALITY OF CENTENNIAL BROOK, BURLINGTON, VERMONT

Polley, Krista R., Department of Geology, University of Vermont, Burlington, VT 05405

Increased chemicals and runoff in surface water due to urbanization effect the chemical composition of natural streams. In order to evaluate these effects, pH, conductivity, chloride concentrations and suspended solids were measured in Centennial Brook. Centennial Brook flows through the Centennial Woods natural area, adjacent to the University of Vermont. The headwaters of Centennial Brook originate from two detention ponds that are outside the natural area. These detention ponds capture runoff and help remove pollutants before they enter Centennial Brook. Runoff from surrounding forested areas and roads enters directly into the brook.

This study evaluated seven locations along Centennial Brook. At each location, two 900-ml samples were taken twice a week from February 11th 1999 to March 22nd 1999. Samples were taken to the lab to be analyzed for pH, conductivity, chloride ion concentrations and total suspended solids.

The highest pH (8.33) was upstream at site 2, while the lowest pH (7.64) was downstream at site 7. The weathering of the dolostone bedrock found in Centennial Woods helps maintain the slightly basic pH of the stream. Chloride ions, pH and conductivity decreased in concentrations as sites progressed downstream and away from the detention ponds. The chemicals causing the raised values closer to the detention ponds are being diluted as they are carried down stream. During the week before and including March 2nd, snow melt and heavy storm discharge occurred. No significant increase in chloride ion concentration was present at any of the sites during this time. However, conductivity was found to increase dramatically during this period of high discharge. Upstream at sites 1–3 conductivity values were all above 5 milli mhos. Conductivity values on March 2nd decreased progressively downstream but the values were still higher than other sample days respective to the sites. The rise in conductivity did not relate to chloride ion concentration; therefore, conductivity values were not representing the chloride from the street salt but from other unknown ions. Downstream at site 5 average values for conductivity and chloride ions all exceeded the values found upstream at site 4. Site 5 crosses a path in the natural area increasing the amount of foreign materials entering the stream. During times of melt and rain the amounts of suspended solids increased respectively with discharge.

In the month of February, snow is still accumulating and pollutants are trapped in the snow resulting in the similar values of conductivity, and chloride ion concentration for the month of February. These pollutants were released during the melt causing the higher concentrations of conductivity. On March 2nd a rainstorm increased the discharge of the area. Both the melt and the storm increased the runoff entering Centennial Brook thereby increasing the concentration of pollutants. On March 2nd, pH, and chloride ion values remained similar to the samples taken in February, but conductivity values increased suggesting that other ions besides chloride ions were present in the stream. Suspended solids also increased over other sample days from the higher discharge. On March 22nd values for conductivity, pH, chloride ions and suspended solids all dropped below the values seen in February; indicating the contribution due to the snow melt and increase runoff had ended for the Centennial Brook region.

FRESHWATER DILUTION OBSERVED IN STABLE OXYGEN ISOTOPE RECORD OF SCLERACTINIAN CORAL MONTASTREA ANNULARIS: ROATAN, HONDURAS

Rosenheim, Brad E., Dept. of Geology, Univ. of Vermont, Burlington, VT, 05405, brosenhe@zoo.uvm.edu

Roatan, Honduras, is a steep-sided island under high development pressures resulting in deforestation and increased runoff. Local concerns for the health of the island's reef have emerged recently as live coral coverage has decreased and brown and green algae coverage has increased in certain areas. In an attempt to correlate these changes with deforestation and increased runoff, we are analyzing three specimens of M. annularis for trends in oxygen isotope ratios over space and time.

Three corals have been sampled from areas of the reef representing long-established development, recently filled wetland, and pristine offshore patch reef, respectively. X-radiography has concluded that each coral is 5–7 years old. Thus far, stable isotope data has been obtained for the specimen collected adjacent to the recently filled wetland. Each growth band was sub-sampled according to the X-radiograph to observe the coral's seasonal $\delta^{18}O$ variability. Besides seasonal variance, this coral shows a decrease of 0.75‰ (four times larger than the mean annual standard deviation) in $\delta^{18}O$ values over the previous six years. We do not expect to see any temporal trends other than seasonal variation in the other two specimens due to the unaltered geohydrology of the adjacent coast during the life of the corals. It is hypothesized that the offshore patch reef coral should be, on average, more enriched in $\delta^{18}O$ than the coral sampled adjacent to the long-established development.

The results of this project represent the first quantification of reef quality on the island of Roatan. They offer a geohydrologic interpretation to accompany climatic discussion of $\delta^{18}O$ values in modern scleractinian corals as an indicator of anthropogenic environmental effects.

THE EFFECTS OF TWO YEARS OF INTENSE MILITARY ACTIVITY ON THE SOURCE AREAS, SOURCE-BASIN LENGTHS, AND INITIATION OF CHANNELS IN THE U.S. ARMY'S FORMER DESERT TRAINING CENTER, MOJAVE DESERT, CA.

Santos, Darrin L., Department of Geology, University of Vermont, Burlington, VT 05405

During World War II the U.S. Army established twelve 'tent cities' used as base camps for housing troops and equipment during training exercises in the Mojave and Sonoran Deserts of California and Arizona. The Desert Training Center was used intensively for two years as over one million American troops and support personal filtered through. The base camps were partially dismantled 54 years ago, but road berms and stone walkway alignments are still intact today. The road berms act as local stream barriers, diverting streams from their natural path down the steepest gradient. The diversion of streams has created zones (5 to 40 m) void of channels down slope of roads. Compacted soil surfaces also remain within the camps, and have yet to recover even after 50 years of camp abandonment.

Camp Iron Mountain, one of the Desert Training Center base camps, is located east of the Iron Mountains on a flat, gently sloping alluvial plain (also known as a bajada) in the Mojave Desert of southern California. The climate is arid, receiving less than 7.87 cm of rainfall annually, and is sparsely vegetated, dominated by creosote bush (Larrea tridentata). I show that the military's modification of the surface hydrology (by leaving road berms intact) and modification of the soil surface (by compaction) has altered the location of channel heads inside Camp Iron Mountain, as compared to the location of channel heads on the bajada surface outside and surrounding Camp Iron Mountain. The differences between channel head locations is determined by calculating the source area (area of ground surface

where rainfall will collect to form overland flow) and source-basin length (distance from the channel head to the local drainage divide) of each channel head. The channel heads in areas inside the camp that are affected by road berms, express larger source areas and source-basin lengths than the source areas and source-basin lengths of channel heads occurring outside the camp in areas not impacted by military activity. The areas inside the camp affected by considerable soil compaction have channel heads that express smaller source areas and source-basin lengths as compared to the channel heads outside of the camp.

OBSERVATION AND ANALYSIS OF THE INTERNAL SEICHE IN LAKE CHAMPLAIN, SHELBURNE BAY, VERMONT

Sardilli, David B., Geology Department, Middlebury College, Middlebury, VT 05753

The Champlain Water District (CWD), located on the eastern shore of Shelburne Bay, Vermont, is a facility used for water collection, purification, and distribution to a total of twelve communities including South Burlington and Shelburne. In total, the facility is responsible for providing roughly 60,000 people and many local businesses in these areas with a high quality water supply. Additionally, the facility is dedicated to a thorough understanding and optimization of the intake water characteristics so that it may provide its customers with the best quality water available. In order to better understand the circulation characteristics of Shelburne Bay, the CWD supported a pilot study of current and temperature observations in the near vicinity of its intake pipe from July of 1997 through June of 1998. The presence of two effluent pipes on the southeastern shore of Shelburne Bay and the newly completed Burlington Bay effluent piper were factors in launching the study.

Using an acoustic doppler current profiler and seven temperature sensors, data sets were analyzed using a combination of statistics, spectral analysis, hodographs and two dimensional computer visualization. Observed data suggests that the main lake seiche with a period of 4.5 days is not present in Shelburne Bay. This is most likely due to the bottom topography in the area which contains a ridge line serving to isolate the Shelburne Bay- Burlington Bay system. Rather, data analysis indicates the presence of a diurnal seiche operating in the area. Whether or not the lateral boundaries for this seiche include Burlington Bay is under evaluation. Additional studies concerning backscatter intensity, wind forcing, and mean circulation are also explored.

ANALYSIS OF IRON OXIDE COATINGS THAT HAVE FORMED AS A RESULT OF ACID MINE DRAINAGE FROM THE PIKE HILL COPPER MINE IN NORTHEASTERN VERMONT

Totten, Brian, Geology Department, Middlebury College, Middlebury, VT 05753.

A study was done in order to analyze the metals content of iron oxide coatings that have formed in a small stream bed as a result of acid mine drainage from the Pike Hill Mine. The Pike Hill Mine was actively mined for copper up to 1919 and is located near Cornith, Vermont at the headwaters of Pike Hill Brook which is a component of the Waits River watershed. As the Pike Hill Brook flows through several hundred yards of tailings it oxidizes sulfide minerals and becomes highly acidic. The highly acidic water dissolves metals from the tailings and transports them downstream where they precipitate out of solution as iron oxide coatings on the stream bed as pH increases. By studying the content of these coatings using XRD, ICP, and SEM analysis, it can be estimated what environmentally detrimental metals are present in the system and how mobile these metals are.

Solid iron oxide coatings were taken from the surfaces of rocks and tailings in the stream bed, and were prepared for XRD analysis using a sonifier. XRD analysis showed that the samples obtained are almost pure iron oxide and have little mica or quartz which would be indicative of the surrounding country rock. ICP analysis

has shown changing concentrations of metals downstream which appear to be a result of acid/metal rich or acid/metal poor influxes of water into the stream. Iron concentrations range from 83,950 ppm to 1,000,000 ppm and copper concentrations range from 749 ppm and 10,540 ppm. By comparing variations in concentration downstream, it appears that the Pike Hill Brook system can be subdivided into groups of elements with similar geochemical behavior. These groupings are (Ni, Cr and Ag), (Cu, Co), and (Ti, Zn and Mn). SEM analysis has shown several crystal forms of iron oxide.

CORRELATION BETWEEN FROG MALFORMITIES AND HEAVY METALS IN WARD MARSH, WEST HAVEN, VT, AND MUD CREEK, ALBURG, VT.

WALL, Andrew J., Geology Dept. Middlebury College, Middlebury, VT 05753

Studies performed by the Vermont Agency of Natural Resources (VTANR) and Jim Andrews of Middlebury College have found frog malformations in a number of sites across the Lake Champlain Basin. The surveys documented rates of morphological abnormalities in the Northern Leopard frog (*Rana pipiens*) ranging from 2% to 45% depending on the site (VTANR, 1998). Further laboratory research by VTANR, using the Frog Embryo Teratogenesis Assay: Xenopus (FETAX), showed that frog embryos grown in *water* from Ward Marsh WMA, in West Haven, VT, had an 89% malformity rate with a 6.6% mortality rate. In the assays using *sediment* from Ward Marsh, there was a 100% malformity rate and a 38.3% mortality rate (VTANR, 1997). This evidence indicates that the sediment is a potential source of teratogens. Mud Creek, in Alburg, VT, which was used as a control in this study, has very little evidence of malformities in the field and laboratory FETAX assays.

In other studies, frogs exposed to Cu^{2+}, Zn^{2+}, Co^{2+}, Ni^{2+}, Cd^{2+} in FETAX assays have shown these metals to be teratogens, causing malformities and mortality. The malformities of frogs exposed to these metals include retinal depigmentation and pelvic and hind limb malformities (Plowman et al., 1991,1994; Luo et al, 1993). These types of malformities have been found in Ward Marsh by VTANR, which leads us to suspect that the frog malformities may be related to high concentrations of metals in the sediment.

EPA method 200.2 for total recoverable analytes was used to prepare sediment samples from Ward Marsh and Mud Creek for ICAP analysis. Samples at Ward Marsh and Mud Creek were collected in transects ranging from subaerially exposed soils adjacent to the marsh to subaqueous sediment in the marsh, including all levels in between. Concentrations of Cu^{2+}, Zn^{2+}, Co^{2+}, Ni^{2+}, Cr^{2+} in the sediment at the two sites were determined using the ICP, with replicate runs.

Sediment samples from Ward Marsh contain statistically higher concentrations of Zn^{2+} (mean = 103 $\pm$ 34 mg/kg), Co^{2+} (mean = 18.3 $\pm$ 3 mg/kg), Ni^{2+} (mean = 39.4 $\pm$ 7.7 mg/kg), and Cr^{2+} (mean = 43.4 $\pm$ 11.8 mg/kg), than Mud Creek. Cu^{2+} concentrations were similar between the two sites. Furthermore, metal concentrations in Ward Marsh indicate a trend ranging from low concentrations in soils farther from East Bay to higher concentrations in subaqueous sediment closer to the bay. This relationship implies that East Bay is a potential source of heavy metals, which are accumulating in the sediment and that elevated metals concentrations could be responsible for frog malformities observed in the field at Ward Marsh.

GEOCHEMICAL AND MINERALOGICAL ANALYSIS OF THE PIKE HILL MINE TAILINGS, CORINTH, VERMONT

Wiercinski, Scot, Geology Department., Middlebury College, Middlebury, VT 05753

The Pike Hill Mine is an abandoned copper mine located in east central Vermont. The northernmost of a series of copper mines in the Orange Country Copper District of the state, the mine lies in the Waits River Formation. Mined sporadically between the 1850's and the 1910's, the mine was active long before

regulations on waste rock disposal were in place. Consequently, the oxidation of many of the remaining primary minerals (pyrite, chalcopyrite, and sphalerite) has lead to the creation of acid mine drainage. X-Ray diffraction (XRD), scanning electron microscopy (SEM), inductively-coupled plasma atomic emission spectroscopy (ICP), and pH analysis of the tailings were conducted to determine the tailings chemistry and mineralogy. Secondary and tertiary minerals like jarosite, various iron oxyhydroxide phases, and gypsum were recognized in XRD and SEM analysis, and no sulfides were detected, indicating that a high degree of sulfide oxidation has occurred. The presence of gypsum, a highly soluble phase, indicates that wet/dry cycles play an important role in metals cycling.

ICP and pH analysis demonstrate that the intense oxidation and high metals content of the tailings will continue to produce acidic drainage into the future. ICP analysis showed very high concentrations of Fe which ranged from 2 to 33% while Cu concentrations ranged from 170-48,030 ppm. Concentrations of many toxic elements (Ni and Cr) were consistently below dangerous levels (<185 ppm), and other toxic elements (Co, Zn, and Mn) were also consistently low, but exhibited some high values in one or two samples. The pH analysis yielded values which were also very low. All but two samples had a value less than 3, and some had values below 2. Changes of pH over time demonstrate a kinetic effect relative to the amount of acidity produced. Present in the Waits River Formation are various carbonaceous materials which were expected to buffer some of the acidic drainage; the low pH values, however, suggest this is not occurring.

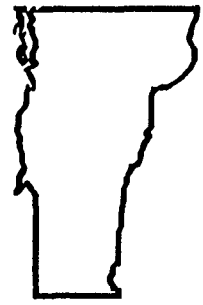
THE GREEN MOUNTAIN GEOLOGIST
VERMONT GEOLOGICAL SOCIETY
DEPARTMENT OF GEOLOGY
UNIVERSITY OF VERMONT
BURLINGTON, VERMONT 05405-0122

The *GREEN MOUNTAIN GEOLOGIST* is published quarterly by the Vermont Geological Society, a non-profit educational corporation.

ADDRESS CHANGE?
Please send it to the Treasurer at the above address.
–Printed on Recycled Paper–

LAUNDRY BLDG.

THE GREEN MOUNTAIN GEOLOGIST



QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

FALL 1999 VOLUME 26 NUMBERS 3 & 4

The Vermont Geological Society's
Annual Meeting and Election of New Officers
October 19, 1999, 6 PM at Arvads in Waterbury

New England Intercollegiate Geological Conference (NEIGC)
October 1–3, 1999

Symposium on Surficial Mapping
September 30, 1999
Burlington

Earth Science Week
October 10–16, 1999

See inside for details

PRESIDENT'S LETTER

Greetings:

Our annual meeting and election of new officers is scheduled for 6 pm on October 19, 1999 at Arvads in Waterbury. Nominations are: President-Shelly Snyder, Vice-president-open, Treasurer-Kristen Underwood, Secretary-Jeff Hoffer. Please join us on the 19th and help support your society. There are numerous events coming your way this fall. Earth Science Week and NEIGC are two major events in which many of our members participate. Notices and schedules for these programs are included in this month's newsletter. We will not have a separate fall field trip this year because both NEIGC and Geologist-in-the-Parks offer ample opportunities for field trips.

Many of our members have volunteered to help with activities during Earth Science Week. If you want to volunteer, please contact me. The current list of events for the week is:

Celebrate Earth Science Week
October 10-16, 1999

Events coming your way during the week are: "Geologist-in- the- Parks" on Sunday October 10th. Contact Marjorie Gale, Vermont Geological Survey, 103 South Main St., Laundry Building, Waterbury, VT 05671-0301. 802-241-3608. Email marjieg@dec.anr.state.vt.us. Geologists will kick-off Vermont's Earth Science Week celebration at these sites:

1. The summit of Owl's Head in Groton State Forest, noon until 4 p.m.. Peter Gale, from Stone Environmental, will have maps and booklets about the geology of the forest area.

2. Redstone Quarry, Hoover St., South Burlington, noon until 4 p.m.. Shelly Snyder, geologist and educator from Mt. Abraham Union High School will be at the quarry to lead tours and discuss local geology.

3. Jon Kim, a geologist with the Vermont Geological Survey, will lead a hike: "The Geology of Mt. Elmore State Park" at 10 a.m. on Sunday. The hike is limited to 15 participants. Please call (802) 241-3469 to reserve a spot.

4. Emerald Lake State Park, East Dorset, VT, time TBA. Helen Mango, a geologist and educator from Castleton State College, will be at the park to discuss local geology.

Vermont Earth Science- Up, Down, and All Around
Contact Christine Massey, Perkins Museum, Geology Department, University of Vermont, Burlington, VT 05405-0122. 802- 656-1344 or 656-8694. Email: cmassey@zoo.uvm.edu

The Perkins Geology Museum and the Vermont Geological Society are sponsoring a poster contest for Vermont students in grades K-2, 3-5, 6-8, & 9-12. The focus is on local geology, processes and understanding what we see around us. Posters must be received by the museum on or before October 19, 1999. There will be a $30 cash prize for each grade group.

Speaker's bureau to visit Vermont classrooms. Contact Kristen Underwood, Griffin International, Williston, VT. 802- 865-4288. E-mail griffint@together.net with ES Week in heading.

Earth Scientists in Vermont have volunteered to visit classrooms as speakers, field trip leaders, hands-on activity leaders, or to help understand local geology. Some topics of expertise are GIS application and natural resources, hazardous waste site clean-up, Vermont geology, minerals, and industrial archaeology. We will try to match your request with a volunteer based on availability.

Saturday, October 16, 1999 Earth Science Week Drop-In Family Mineral workshops
Host: Omya/Pluess–Staufer employees
Contact: Alice Blount
Telephone: (802) 459–3428 (ext. 267)
E-mail: alice.blount@omya.com
Location: Fox Room, Rutland Public Library Time: 1-4 pm
Information: This workshop is fun hands-on activity . We will do simple mineral tests and learn about minerals we use everyday.

For information about Earth Science Week contact:

Contact Marjorie Gale at 802-241-3608. Email marjieg@dec.anr.state.vt.us.
Local events are posted on the web site at http://www.anr.state.vt.us/geology/vgshmpg.htm.

Perkins Museum, Geology Department, University of Vermont, Burlington, VT 05405. Contact Christine Massey at 656-1344. Email: cmassey@zoo.uvm.edu

The American Geological Institute, a not-for-profit federation of 32 professional organizations in the Earth Sciences, has a list of Earth Science Week ideas and activities. They may be contacted at AGI, 4220 King Street, Alexandria, VA 22302 or by visiting the web site at www.earthsciweek.org.

This a joint project of the Vermont Geological Society, the Vermont Geological Survey at the Department of Environmental Conservation, the Perkins Museum at the University of Vermont and the American Geological Institute. Numerous other individuals, organizations and businesses will also sponsor activities during the week.

Marjorie Gale,Vermont Geological Survey

STATE GEOLOGIST'S REPORT

The following is a brief report—look for more details in the winter GMG.

The push to finish the bedrock map compilation begins this fall. The publications process starts with scientific review of the compiled map scheduled to kick off in the winter of 2000. Surficial geologic maps are being digitized for Montpelier, Barre West and St. Johnsbury to be delivered September 30, 1999. Summer of 1999 surficial mapping is underway in the Burlington, Colchester and Newbury quadrangles. An opportunity for a hazard mapping program that would combine both landslides and the erosion hazard from the shifting position of streams is an outgrowth of the recent landslide in Jeffersonville. The Vermont Survey continues to be very active in fluvial geomorphology questions. Recent contract work focuses on stream studies toward a stable channel design for the Granville area. The State Geologist attended a glacial geomorphology training in Alaska organized by the Midwestern State Geologists and the USGS. (They will be approaching Congress soon for an appropriation to do surficial geologic mapping in four Midwestern states). Truly a spectacular trip with hopes of a follow up slide presentation to explain glacial geomorphology and its meaning for Vermont. Looking forward to the Surfical Geologic Mapping Symposium at NEIGC cosponsored by the Vermont Survey, USGS, and UVM on September 30, 1999.

Laurence R. Becker, State Geologist
Vermont Geological Survey
103 South Main Street
Waterbury, Vermont 05671-0301

VERMONT GEOLOGICAL SOCIETY TREASURER'S REPORT

April 1, 1999

Dear President and Board:

The financial condition of the Society remains strong. Please see the attached financial reports as of April 1, 1999. A summary of these reports follows:

Checking Balance @ 4/01/1999	$1,234.51
Excess of Expenses over Income 4/01/98 to 4/01/99	$(2,427.17)

Current dues payments are in the possession of Steve Wright. They have not been processed and are not included in the numbers presented above. The dollar amount of the payments received is not currently known to me.

All major bills known to me have been paid and are included in the above numbers.

Because I will be taking a Federal job out of Vermont , I have notified Stephen Wright that I will be resigning as Treasurer as soon as the bank can process the change of signature card which I have sent to Steve for execution.

It has been a pleasure to serve you as Treasurer and I wish you and all the members of the VGS all the best in your future endeavors.

Sincerely yours,
Allan W. Carpenter

ONE YEAR VGS INCOME STATEMENT
April 1, 1998 to April 1, 1999

Income:	
Dues-member	$1,545.00
Dues - Student	40.00
Interest	17.80
Stud Res Grant	50.00
Other income	5.00
Total Income $ 1,657.08	
Expenses:	
Earth Day Prizes	150.00
Meetings	243.00
Postage	288.36
Publication - GMG	808.00
Research Grants	2,200.00
Scholar Grants	275.00
Supplies	28.00
Travel	91.89
Total Expenses	$ 4,084.25

Excess of Expenses overIncome $(2,427.17)

NEIGC FIELD TRIPS: OCTOBER 1-3, 1999

Sponsored by the UVM Geology Department

NEIGC Web site: http://kilburn.keene.edu/NEIGC/1999/

Program:

The organization of this year's field conference is similar to those in the past. Please register for those field trips you would like to attend on the attached form. Field Guides will be distributed to Friday's field trip leaders. The Welcoming Party and On-Site Registration will be at the Ramada Inn (see map) from 7:00 to 9:30 PM on Friday. Following Saturday's field trips, the NEIGC banquet will begin at 7 PM, also at the Ramada Inn. Please remember to bring a lunch as most trips will not make lunch stops near to stores.

FRIDAY FIELD TRIPS

TRIP A-1:
SURFICIAL GEOLOGY OF THE EASTERN HALF OF THE ST. JOHNSBURY 7.5 X 15 MINUTE QUADRANGLE, NORTHEASTERN VERMONT

Leaders: George Springston and George M. Haselton

On this trip we will examine the surficial deposits in parts of St. Johnsbury and Danville, Vermont. We will visit a section of interbedded till and lacustrine material and discuss the possible correlation of these features with the Littleton-Bethlehem readvance. The lithologic composition of the basal till and reconnaissance till fabrics will be discussed. We will also visit one or more ice-contact deposits in the uplands of Danville. In an active sand and gravel pit in the Passumpsic valley we will examine what is currently a superb exposure of esker and outwash deposits overlain by lacustrine material. Finally, a stop will be made to examine multiple striation directions on bedrock.

Meet at Danville Village Green at 9 am. Bring lunch.

Contact: George Springston, 81 East Hill Road, Plainfield, VT 05667; 802-454-1220; georges@together.net

TRIP A-2:
SLOPE STABILITY AND LATE PLEISTOCENE/HOLOCENE HISTORY, NORTHWESTERN VERMONT

Leaders: Paul Bierman, Stephen Wright, and Kyle Nichols

This field trip features stops at recent landslides that offer superb exposures of the surficial materials that failed and provide evidence of the mechanisms of failure. We will begin at Town Line Brook in Winooski, a stream along which landslides have occurred repeatedly over the last 10 years. We will then travel east making one or more stops in Richmond and Bolton that emphasize the glacial history of the region. Our next stop is along the Miller Brook Valley in Stowe to see an active alluvial fan and a stream cut through the materials that feed it. We will then head into Smugglers Notch to look at a debris flow and from there down to Jeffersonville to view the spectacular exposure created by three large landslides that occurred early this summer. We will then return to Burlington.

Meet at the Champlain Mill parking lot (in downtown Winooski on the north side of the big bridge on Rtes. 2 and 7 connecting Burlington and Winooski) at 8:30 AM. Please bring a lunch.

Contact: Paul Bierman, Department of Geology, University of Vermont, Burlington, VT 05405, 802-656-4411, pbierman@zoo.uvm.edu

TRIP A-3:
LITHOTECTONIC PACKAGES AND TECTONIC BOUNDARIES ACROSS THE LAMOILLE RIVER TRANSECT IN NORTHERN VERMONT

Leaders: Barry Doolan, Peter Thompson and Thelma Thompson

Lithotectonic packages have been identified within the Camels Hump Group across the northern Green Mountain anticlinorium, separated by regionally extensive thrust faults: Brome-Underhill fault, Honey Hollow fault, Prospect Rock fault, and Johnson talc mine fault. Stops will be made from west to east along the Lamoille River valley to compare stratigraphy and structural style from one package to the next, and to demonstrate the timing of these faults relative to foliation, metamorphism and folding. Some stops will revisit exposures that were featured on Albee's 1972 NEIGC trip. the "Foot Brook syncline" is reinterpreted as a fault slice of Ottauquechee and Stowe correlatives thrust over Hazens Notch and Fayston rift-drift clastics, all deformed by Taconian and Acadian folds. The trip will end near the starting point of Trip B-3, which will continue the transect eastwards.

Contact: Barry Doolan, Department of Geology, University of Vermont, Burlington VT 05401: PHONE 802-656-0248; FAX 802-656-0045; bdoolan@zoo.uvm.edu

Departure Time and Location: 9:00 AM Jana's Cupboard, intersection of Route 15 and 108 in Jeffersonville, Vermont. Bring Lunch.

TRIP A-4:
MINERALOGY, PETROLOGY, AND HEALTH ISSUES AT THE ULTRAMAFIC COMPLEX, BELVIDERE MT., VERMONT, USA

Trip Leaders: Mark Van Baalen and Carl A. Francis, Harvard University, and Brooke T. Mossman, University of Vermont.

The Belvidere Mt. ultramafic complex is part of the discontinuous belt of Appalachian serpentinites emplaced during the Taconic orogeny. Serpentinization at Belvidere Mt. involved hydration of the original peridotite and dunite. Understanding of the serpentinization process has increased greatly in recent years, but some aspects remain controversial.

Belvidere Mt. has been quarried for chrysotile asbestos during most of the 20th Century; active mining operations ceased in 1993. Public health concerns about the health effects of asbestos have generally failed to consider the different mineralogical and biomedical properties of asbestiform minerals. This in turn has led to unwarranted fears of exposure to minute amounts of chrysotile asbestos.

The purpose of this trip is to examine serpentine textures that shed light on the serpentinization process itself, to observe the numerous accessory minerals associated with the serpentinite, and to discuss current understanding of the health effects of mineral dusts in occupational and non-occupational settings.

Contact: Mark Van Baalen, Department of Geology, Harvard University, Cambridge, MA; MVB@HARVARDA.HARVARD.EDU

Meeting Time and Place: Uncle Bill's Diner, Eden, VT, at 8:30 a.m. The diner is on State Route 100, just 2 miles south of its intersection with Route 118 in Eden.

TRIP A-5:
NATURE OF THE ALBEE-AMMONOOSUC CONTACT, MOORE RESERVOIR AREA, N.H.-VT.: THE PIERMONT-FRONTENAC ALLOCHTHON--EMBATTLED BUT THRIVING!

Leader: Robert H. Moench

This trip is focused on Foster Hill, about 6 miles west of Littleton, N.H., which is the type area of the Foster Hill detachment (FHF) at the sole of the allochthon. M.P. Billings and D.W. Rankin have mapped an unproven depositional contact between their Ordovician Albee Formation and the overlying Ammonoosuc Volcanics. Ever since my earliest work there (about 1983) I have interpreted this same contact as a premetamorphic fault, but I gained a thorough understanding of relationships there only after I mapped Foster Hill at 1:6,000, in 1997. This new map documents the Foster Hill fault and, shows an isoclinally folded sequence of Ammonoosuc and underlying slaty laminated flysch to the east, and a mainly homoclinal sequence of subdivided "Albee" to the west, mapped as the Silurian Perry Mountain, Smalls Falls, and Madrid Formations and the Lower Devonian Ironbound Mountain Formation. The homocline is unsystematically folded within about 300 ft. of the FHF, which is best seen where the Perry Mountain (quartzite and slate) is sharply truncated against the Ammonoosuc (calcitic greenstone).

We will spend about 3.5 hours on Foster Hill; other stops provide regional context, on the lower east side of Gardner Mountain (type area of "Albee"), N.H., and in Vermont.

Contact: Bob Moench, moenchssrh@igc.org

MEETING PLACE: I-93, Exit 44 rest area, near Moore Dam. Follow signs from exit ramps to rest area, which is on rte. 135/18 about 0.1 mile south of I-93.
TIME--8:30 a.m.; we will depart at 8:40. Friday, October 1. I will be available for a premeeting trip on the 30th.
QUADRANGLE MAPS (7.5'): Stops are on Lower Waterford and Miles Pond; Littleton and Concord also useful.

TRIP A-6:
FAULTS AND FLUIDS IN THE VERMONT FORELAND AND HINTERLAND IN WESTERN VERMONT

Leaders: Rolfe Stanley, Tracy Rushmer, Caleb Holyoke, Andrea Lini

This trip will begin to the west in the Ordovician sequence on South Hero Island (Lessor's Quarry and "The Beam") in the unmetamorphosed, but cleaved rocks of the Vermont Foreland and end along the western front of the hinterland at Hinesburg (Hinesburg Thrust) and Lincoln, Vermont (Cobb Hill thrust fault, and South Lincoln thrust fault) where Middle Proterozoic rocks of the Lincoln Massif are displaced westward over the late Proterozoic to Lower Ordovician rocks along ductile/synmetamorphic Taconian faults. Discussion will focus on structural analysis, fluid interaction, isotopic studies, and systems feedback processes in fault evolution. We will not visit the Champlain thrust fault at Lone Rocks Point (see Trip C-5).

Departure time 9 AM at the Apple Store just west of the South Hero Post Office in the village of South Hero, Vermont.

Contact: Rolfe Stanley, Department of Geology, University of Vermont, Burlington, Vermont 05405; rstanley@together.net

TRIP A-7:
GEOLOGIC FIELD TRIP SITES FOR TEACHERS IN NORTHWESTERN VERMONT

Leaders: Christine Massey (UVM Perkins Geology Museum) and Shelley Snyder (Mt.
Abraham Union High School)

The areas around Burlington, Vermont provide a wealth of accessible geologic information for interpretation by school teachers and students. On this trip, teachers will learn about the geological history of Vermont through visits and hands-on exploration of four local sites. All of the sites are accessible to the general public (with prior permission) and are suitable for visits by groups of students. We will share our techniques for exploring these sites with young earth scientists.

Our trip begins at Redstone Quarry Natural Area (Burlington) in an ancient shoreline environment which we now view as the Monkton Quartzite. We will visit the famous Champlain Thrust Fault at Lone Rock Point (Burlington) and examine marine off-shore environments of the Iberville Shale and Dunham Dolostone formations. The islands of South Hero and Isle La Motte provide two quarries for viewing some of the life forms preserved in the limestones of the ancient Iapetus Ocean. The Glen's Falls Limestone at Lessor's Quarry (South Hero) shows bryozoa, brachiopods and other fossils, while the Crown Point Limestone at the Fisk Quarry Preserve (Isle La Motte) preserves an ancient reef ecosystem which contains such fossils as stromatoporoids, bryozoa, algae, gastropods, cephalopods, and others.

Meeting time and place: Begin at the UVM Perkins Museum in Burlington (off Colchester Avenue, next to Fleming Museum) at 8:30 am for an introduction to educational opportunities at the Perkins Museum and overview of teacher trip. Depart 8:45 am. Bring a lunch. None of our stops have public facilities.

Contact: Christine Massey, UVM Perkins Museum, Department of Geology, University of Vermont, Burlington, VT 05405-0122. Phone: (802) 656-1344, Fax: (802) 656-0045, e-mail: cmassey@zoo.uvm.edu

---

SATURDAY FIELD TRIPS
TRIP B-1:
DEGLACIATION HISTORY OF THE STEVENS BRANCH VALLEY: WILLIAMSTOWN TO BARRE, VERMONT

Leader: Stephen Wright

This trip begins at the outlet of Glacial Lake Winooski, the last stop on Larsen's 1987 NEIGC field trip, and follows the Williamstown Esker to north of Barre where it is completely buried by lacustrine sediments. Good exposures in pits, stream sections, and one recent landslide allow deduction of deglaciation processes in both ice-contact and lacustrine environments. We will finish at an exposure of deformed, preglacial lacustrine sediments, a prelude to the theme of Fred Larsen's Sunday field trip.

Meeting Place and Time: 8:30 AM at the Berlin Corners "Park and Ride," Exit 7 on I-89

Contact: Stephen Wright, Department of Geology, University of Vermont, Burlington, VT 05405; swright@zoo.uvm.edu, 802-656-4479
All stops lie within the Barre West and Brookfield 7.5-minute Quadrangles.

TRIP B-2:
FIRE AND ICE AND ICE... AND FIRE? THE ORIGIN AND FATE OF THE SANDSTONE PAVEMENT PINE BARRENS IN NORTHEASTERN NEW YORK

Leaders: David A. Franzi and Kenneth B. Adams, Plattsburgh State University

The Altona Flat Rock sandstone pavement jack pine barrens is an island ecosystem amidst the larger matrix of northern hardwood and mixed hardwood-conifer forests in the upper Little Chazy River watershed. The New York Natural Heritage Program describes sandstone pavement
barrens as open-canopy woodlands on very shallow soils over nearly level sandstone bedrock. The Altona Flat Rock is part of a discontinuous belt of sandstone pavements in northeastern New York that were created by catastrophic floods from the drainage of glacial Lake Iroquois and younger post-Iroquois proglacial lakes in the St. Lawrence Lowland. The boreal jack pine dominates the Altona site, near the southern limit of its natural range, because of its adaptations to fire and its ability to survive in a droughty, nutrient-deficient, high-stress environment. Jack pine requires periodic crown fires for successful regeneration to occur. A fire releases seed from serotinous cones stored in the jack pine canopy, prepares a nutrient-rich ash seedbed, and reduces competition for the young seedlings. The sandstone pavement jack pine barrens in northeastern New York are marginal communities in delicate equilibrium with existing hydrogeological and climatological conditions. The extensive ice storm that affected much of northern New York and New England in January 1998 severely impacted large portions of the pine barrens, leaving the future of this fragile ecosystem uncertain. In 1998, Miner Institute contracted a logging company to complete a restoration cutting on approximately 60 ha of pine barrens heavily damaged by the ice storm. The objectives were to reduce the hazardous fuel loadings (reduce the risk of uncontrollable wildfires) and try to initiate regeneration of jack pine without fire. Restoration cutting on an additional 160 ha is presently occurring. On this field trip we examine the deglacial events leading to the formation of the sandstone pavements by following the path of glacial meltwater from the Gulf at Covey Hill, P.Q. to Altona Flat Rock. We will also address the linkages between the hydrogeology and ecosystem-level processes in the pine barrens and discuss the disturbance impact of the 1998 ice storm. The trip will feature several sites in the southeastern portion of Altona Flat Rock where Plattsburgh State University and the W.H. Miner Institute jointlysponsor an Ecosystem Studies Field Laboratory for undergraduate education and research.

Meet on the Vermont side of the Grand Isle–Plattsburgh Ferry at 8:20 AM.

Contact Person: David Franzi, Center for Earth and Environmental Science, Plattsburg State University, Plattsburg NY 12901 Tel. 518-564-2028; FAX 518-564-7827; email: david.franzi@plattsburgh.edu

TRIP B-3:
LAMOILLE RIVER VALLEY BEDROCK TRANSECT #2

Leaders: Jonathan Kim, Marjorie Gale, Jo Laird, and Rolfe Stanley

The eastern Taconide Zone in northern Vermont consists of polydeformed Pre-Silurian metasedimentary and meta-igneous rocks of the Hazens Notch (including Belvidere Mt. Complex), Ottauquechee, Stowe, and Moretown fms. (from west to east). In conventional tectonic interpretations, these lithotectonic units straddle the Vermont extension of the Baie-Verte/Brompton Line which separates rifted margin rocks from more easterly-situated oceanic rocks of the Taconian accretionary

wedge. The tectonic stratigraphy in this area is a result of the dissection of older Taconian Lithotectonic Packages (LPs) by younger steeply-dipping Acadian thrust faults; many lithologies are common to multiple lithotectonic packages.

This trip will start at Belvidere Mountain, traverse the northern Vermont Ottauquechee-Stowe-Moretown Belt north of the Lamoille River and end at Mt. Elmore at the northern end of the Worcester Range. Structural geology, petrology, and igneous geochemistry will be integrated with detailed mapping recently completed for the new Vermont State Bedrock Geologic Map. This trip is a complement to Lamoille Valley Transect #1.

Meet at the McDonalds in Morrisville which is at the intersection of Routes 15 and 100. We will depart from this location at 8:30 AM (we will also return here). There are two Motels near this intersection which are the Sunset Motor Inn (1-800-544-2347, 802-888-4956) and the Plaza Hotel (1-800-334-2879, 802-888-7761) if anyone wants to stay nearby.

Contact: Jonathan Kim, jonk@dec.anr.state.vt.us, 802-241-3469 or Marjorie Gale, marjieg@dec.anr.state.vt.us, 802-241-3608, Vermont Geological Survey 103 South Main St., Laundry Building ,Waterbury, VT 05671-0301

7.5' Quadrangles: Hazens Notch, Eden, Lowell, Albany, and Morrisville.

TRIP B-4:
EVIDENCE FOR MOVEMENT OF THE MONROE FAULT DURING INTRUSION OF THE VICTORY PLUTON, NORTHEASTERN VERMONT

Leader: Kimberly Hannula

The Victory Pluton is one of several Acadian plutons that appear to crosscut and post-date all Acadian deformation in northeastern Vermont. Microstructural and metamorphic evidence within the Victory Pluton's aureole, however, suggests that the Monroe Fault, which separates rocks of the Connecticut Valley Trough from those of the Bronson Hill Belt, was still active during intrusion of the Victory Pluton. This field trip will visit several sites within the aureole of the Victory Pluton, and will examine evidence for deformation and for metamorphic pressure increases during contact metamorphism. Sites will include the contact zone of the Victory Pluton west of the Monroe Fault, pulled apart and partially replaced andalusite near the Monroe Fault, the Monroe Fault itself in the garnet zone of the Victory Pluton, and cordierite reaction textures east of the Monroe Fault.

Contact: Kim Hannula, Geology Department, Middlebury College, Middlebury, VT 05753; PHONE 802.443.5652; hannula@middlebury.edu

Departure time and location: 9:30 am, North Concord General Store, on U.S. Rt. 2 east of St. Johnsbury.

TRIP B-5:
A FIELD DISCUSSION OF THE PINNACLE FORMATION, A LATE PRECAMBRIAN RIFT VALLEY FILL, AND THE DEVELOPMENT OF THE IAPETUS BASIN.

Leaders: Lars Cherichetti & Alexis Richardson

The stratigraphy of the ancient margin of North America includes from rift-related volcanic rocks and early clastic sediments (Tibbit Hill and Pinnacle Formations), which predate the fully developed Cambro-Ordovician passive margin platform

sequence bordering the ancient Iapetus Ocean. Rift-related clastic rocks in ancient orogens such as the Appalachians provide the best evidence for reconstructing the depositional environments existing during continental breakup. Such analyses are best determined in major reentrants such as the Québec reentrant because of the preservation of original deposition features and the ability to correlate stratigraphic units along strike without major truncations by faulting. The Pinnacle Formation of Vermont and Québec extends for a distance of over 200 km and is rivaled in the Appalachians only by the Ocoee Belt within the Tennessee reentrant of the southern Appalachians. This field trip will investigate the stratigraphy of the Pinnacle Formation in northwestern Vermont, and discus associated depositional environment interpretations, as well as implications for tectonic-scale Iapetus Basin development. If you enjoy stratigraphy, structural geology, rapid depositional environments, tectonics and cows you will enjoy this field trip.

Contact Person, Lars Cherichetti, alexlars@gateway.net

Meeting time and Place: Votey Lot, next to the Perkins Geology Building, UVM Campus at 8:30 am. Bring a lunch.

SUNDAY FIELD TRIPS

TRIP C-1:
GLACIAL HISTORY OF THE MONTPELIER, VERMONT, 7.5-MINUTE QUADRANGLE

Leader: Frederick D. Larsen, Norwich University.

This 3/4-day trip is a continuation of Trip B-1 by Stephen Wright. Until recently in the Montpelier quadrangle we have been dealing with a deglacial sequence of Late Wisconsinan glacial till, late-glacial Lake Winooski, draining of the lake and postglacial sedimentation. Recent discoveries of good exposures in deformed preglacial varves, a possible two-till site (?) and a mystery site with a package of compact deformed varves over till are high lighted, and extend our knowledge back before the last glacial advance.

Meet at Montpelier High School, just off Memorial Drive 0.75 mi northeast of Exit 8, Interstate I-89, 8:00 AM, Sunday, October 3, 1999. Exposures may be wet. Bring lunch and drink, we will eat in the pit.

Contact: Fred Larsen, Department of Geology, Norwich University, Northfield, VT 05663, 802-485-2336.

TRIP C-2
PINE STREET CANAL SUPERFUND SITE: HYDROGEOLOGY AND ITS EFFECTS UPON THE EXTENT OF MANUFACTURED COAL GAS CONTAMINATION

Leader: Don Maynard

The field trip will include a description of the glacial geology, the hydrogeology, and the historical uses and modifications to the Site. The contaminant release and transport mechanisms, the extent of contamination, and proposed remedial actions will be discussed. A site walkover will include observations of the contaminant source area, the historical barge canal, emergent wetlands, and Lake Champlain. The Site is heavily vegetated, and views may be limited if the leaves have not fallen.

(across the street from the large blue Whiting Company facility). This location is south of the intersection with Howard Street, and north of the intersection with Lakeside Avenue.

Contact: Don Maynard, The Johnson Company, Montpelier, VT, 802-229-4600, DMM@jcomail.com

TRIP C-3 (REPEAT OF A-3):
LITHOTECTONIC PACKAGES AND TECTONIC BOUNDARIES ACROSS THE LAMOILLE RIVER TRANSECT IN NORTHERN VERMONT

See Description, Meeting Place, and Time for Trip A-3.

TRIP C-4:
THE NEW ENGLAND - QUÉBEC IGNEOUS PROVINCE IN WESTERN VERMONT

Leaders: J. Gregory McHone and Nancy W. McHone

The central Lake Champlain Valley south of Burlington, Vermont contains a spectacular assortment of Mesozoic intrusions of the New England-Québec igneous province. The lake shore has particularly good exposures of dike rocks and structures that have attracted study since the mid-19th century. We will examine monchiquite and camptonite (lamprophyre) dikes, and several bostonite (trachyte) dikes that show interesting intrusive features. Outcrops near the top of Barber Hill, a small plutonic complex in Charlotte, display varieties of syenite that may be derived from bostonite magmas, and which may be crosscut by lamprophyres.

We will start at Shelburne Shipyard near the northern end of Shelburne Point at 9 a.m. on Sunday, October 3. Stops will include the shipyard monchiquite, shoreline bostonites at Shelburne Farms and Charlotte town beach, Barber Hill syenite, bostonite and lamprophyre dikes along Route 7, and camptonite at Redstone Quarry. At all stops, we will discuss the petrology of the rocks and their intrusive structures, which can be related to crustal tectonics as well as magma mechanics.

Contact: J. Gregory McHone Graduate Liberal Studies Program, Wesleyan University, Middletown, CT 06459; Phone (860) 685-3339 Fax: (860) 685-2901 Email: jmchone@wesleyan.edu

TRIP C-5:
THE CHAMPLAIN THRUST FAULT AT LONE ROCK POINT

Leader: Rolfe Stanley

We will study fault characteristics exposed along 1 mile (1.6 km) traverse where wave erosion of the weaker Middle Ordovician shale of the lower plate has exposed the fault zone in all its glory. See fault mullions along the base of the Lower Cambrian Dunham Dolostone, fault breccia, slivers of Lower Ordovican limestone, lower plate duplexes and multiple generations of folds. Discussion will focus on fault fabrics and regional significance of the Champlain thrust fault. Read Stanley, R. S., 1987, The Champlain thrust, Lone Rock Point, Burlington, Vermont: Geological Society of America, Centennial Field Guide for the Northeast Section, p. 67-72 for further instructions and a discussion of the outcrop.

Meeting Place: Votey Parking lot, Perkins Geology Hall, University of Vermont. 9:15 AM. We will consolidate participants into vans and drive to the Lone Rock Point. Trip duration will be less than 4 hours. Christine Massey will be joining us as a K-12 teacher Guide

Contact: Rolfe Stanley, Department of Geology, University of Vermont, Burlington, Vermont 05405; rstanley@together.net

NEIGC 1999/BURLINGTON
October 1-3, 1999
REGISTRATION FORM

NAME _____

ADDRESS _____

_____

_____

E-MAIL _____

FIELD TRIP CHOICE	1ST	2ND	3RD
FRIDAY, OCT 1		_____	
SATURDAY, OCT 2	_____		
SUNDAY, OCT 3	_____		

1. NEIGC FEES:	Pre-registration (Received by 9/26)	On-site
Registration	$10	$15
Guidebook	___copies @ $18	$18
Banquet (Saturday Evening)	___tickets @$20	$20

Circle Choice: (1) Chicken Marsala; (2) Roasted Vegetables Primavera; (3) Top Sirloin Forestier

TOTAL NEIGC FEES _____

2. Pre-Meeting SYMPOSIUM ON SURFICIAL GEOLOGIC MAPPING
(SEE NEIGC WEBSITE) Thursday, September 30th, Ramada Inn, Burlington

	Pre-registration (Received by 9/26)	On-site
Professionals	$10	$15
Students	$5	$5

TOTAL SYMPOSIUM FEES _____

Make Check for sum of NEIGC and Symposium Fees Payable to UVM–NEIGC99

Mail to: Jack Drake
Department of Geology
University of Vermont
Burlington, VT 05405

For further information about conference
(1) Consult the NEIGC Website:
http://neigc.org/NEIGC/1999/
or (2) Barry Doolan at University of VT
802 656-0248; 802 656-0045 (FAX)
bdoolan@zoo.uvm.edu

UNIVERSITY OF VERMONT GEOLOGY SEMINAR SERIES

All seminars at 4:15 PM in Room 200 Perkins Geology Building. Refreshments served prior to the lecture. Contact Andrea Lini for additional information: alini@zoo.uvm.edu, 802-656-0245.

Monday September 13: Bob Tracy, Virginia Tech, "Some New Perspectives on Paleozoic Tectonics of Southern and Southwestern New England Based on Recent Metamorphic Studies."

Monday September 27: Mary Roden-Tice, Plattsburgh State University, "Evidence for Differential Unroofing in the Adirondack Mountains, New York, Determined by Apatite Fission-Track Thermochronology"

Monday October 11: Dr. Dorothy Stout, Cypress College, Traversing the Collision Zone between the Asian and Indian Plates: Tibet and the Himals." Also, Dorothy will present two short films following her talk Monday, Oct. 11 at 5:30 PM in Perkins 300 entitled "Geology Goes Hollywood" (22 min) and "Why They Get It Wrong" (15 min) about how the general public perceives geology through the movies.

Monday October 18: Mark Abbot, University of Massachusetts, " Holocene Paleohydrology of Andean Lakes."

Monday November 8: Beverly Wemple, University of Vermont, "Investigations of Runoff Production and Erosion on Forest Lands."

Monday November 22: David Westerman, Norwich University, "Tectonic History of the Nested Christmas-Tree Laccolith Complex of Elba Island, Italy."

Monday December 6: Kirsten Menking, Vassar College, "Paleoclimatology descends into hell: Battling the muck in the Estancia Basin."

THE GREEN MOUNTAIN GEOLOGIST
VERMONT GEOLOGICAL SOCIETY
DEPARTMENT OF GEOLOGY
UNIVERSITY OF VERMONT
BURLINGTON, VERMONT 05405-0122

The *GREEN MOUNTAIN GEOLOGIST* is published quarterly by the Vermont Geological Society, a non-profit educational corporation.

ADDRESS CHANGE?
Please send it to the Treasurer at the above address.
–Printed on Recycled Paper–

Marjorie Gale
379 Poker Hill Rd.
Underhill, VT 05489