THE GREEN MOUNTAIN GEOLOGIST

NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

Spring 2001 VOLUME 28 No. 2

STUDENT PRESENTATIONS
VGS Spring Meeting
April 21, 2001, 8:30 AM
Norwich University

TABLE OF CONTENTS

THE GREEN MOUNTAIN GEOLOGIST
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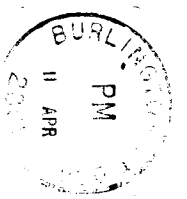

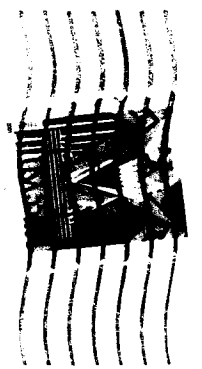

DIRECTIONS TO SPRING MEETING AT NORWICH

Norwich University is located on VT Route 12 a mile south of the center of Northfield. It can be reached from I-89 by taking Exit 5 and following Route 64 west to Route 12, and then north to the university. Coming from the north, it's a toss up which is easier/quicker, using the interstate or taking Route 12 south from Montpelier.

The Geology Department is located in Cabot Science, the southeasternmost brick building on campus, just west of Route 12. The entrance is near the northeast corner of the very large white Kreitzburg Library which can't be missed. The easiest parking for the meeting will be in the commuter lot opposite the Science/Engineering complex on the east side of Route 12.

SPRING MEETING OF THE VERMONT GEOLOGICAL SOCIETY

Annual Presentation of Student Papers
Room 085, Cabot Science Bldg., Norwich University, Northfield, VT

April 21, 2001

PROGRAM

8:30 Coffee

9:00 Sharon A. Wilson, Middlebury College: GEOCHEMICAL ANALYSIS OF SILURO-DEVONIAN MAFIC DIKES IN EAST-CENTRAL VERMONT

9:15 Margaret Sullivan, Middlebury College: GEOCHEMICAL ANALYSIS OF SEDIMENTS IN THE OMPOMPANOOSUC RIVER NEAR THE ELIZABETH MINE, SOUTH STRAFFORD, VERMONT

9:30 Joshua E. Gutierrez, Middlebury College: THE "GENERAL" POCKMARK, BURLINGTON BAY, LAKE CHAMPLAIN, VERMONT

9:45 Angela Conlan, University of Vermont: SPATIAL EXTENT OF SEDIMENT PULSES IN LAKE MOREY, FAIRLEE, VT.

10:00 Nathan West, Middlebury College: A BASIC SLOPE STABILITY ANALYSIS OF ROUTE 125 ALONG THE LEMON FAIR RIVER: CORNWALL, VERMONT

10:15 Ian Hodgdon, University of Vermont: EXPOSED GLACIAL DEPOSITS WITHIN A LANDSLIDE IN THE SMUGGLERS NOTCH SKI AREA CONTAINING A SAPROLITE, TILLS, AND HIGH LEVEL LAKES WITHIN THE BREWSTER RIVER DRAINAGE BASIN

10:30 Matthew D. Whitcomb, Middlebury College: PEDOGENESIS ALONG THE FLANKS OF MOUNT SAINT HELENS

10:45 BREAK

11:00 Andrew McKinney, Keith Klepeis, Djordje Grujic, and Lincoln Hollister, University of Vermont: STRUCTURAL AND KINEMATIC EVOLUTION OF AN OROGENIC WEDGE: THE INTERPLAY BETWEEN THRUST FAULTING AND NORMAL FAULTING IN EASTERN BHUTAN

11:15 Dale Walker, Andrew Claypool and Keith Klepeis, University of Vermont: COMPARISON OF EXHUMATION PROCESSES OF LOWER CRUSTAL GRANULITES IN FIORDLAND, NEW ZEALAND

11:30 Andrew Nichols, Middlebury College: MINERALOGICAL EVIDENCE FOR HYDROTHERMAL ORIGIN OF THE BRANDON RESIDUAL FORMATION AND THE EAST MONKTON KAOLINS

11:45 Dagan A. Murray, Norwich University: THE SILURIAN BRAINTREE COMPLEX, VERMONT: BIMODAL PLUTONISM WEST OF THE RMC

12:00 Nathan P. Donahue, Norwich University: A TOTAL FIELD MAGNETIC SURVEY OF THE BRAINTREE COMPLEX, VERMONT

12:15 Break followed by announcement of awards

12:30 VGS Executive Committee Meeting

STUDENT ABSTRACTS

GEOCHEMICAL ANALYSIS OF SILURO-DEVONIAN MAFIC DIKES IN EAST-CENTRAL VERMONT

Sharon A. Wilson, Geology Department,
Middlebury College, Middlebury, VT 05753

In the Woodsville and Newbury quadrangles in east-central Vermont and west-central New Hampshire, Siluro-Devonian mafic dikes intrude metasedimentary rocks of the Vermont and New Hampshire Sequences. The dikes are thought to be related to a diorite-gabbro complex, dated at ~420Ma.

In this study, we focus on four previously unstudied outcrops where mafic dikes intrude the Albee Formation. In particular, petrography and geochemistry, including major, trace and rare earth elements, are used to interpret the magmatic and tectonic origin of the dikes. Preliminary geochemical data indicate the dikes have basaltic compositions. Furthermore, linear trends between MgO vs Ni, Zr vs Ti and MgO vs TiO2 suggest that the dikes have retained original igneous signatures despite metamorphism associated with the Acadian Orogeny. Dikes from the four localities are all related geochemically. Moreover, there are well-defined chemical trends among the dikes that can be accounted for by differing amounts of crystal fractionation from the same parent. Trace element tectonic discriminant diagrams, e.g. Ti-Zr-Sr, Ti-Zr and Fe-Mg-Al, indicate the dikes may have formed in a continental extensional environment. The dikes are also geochemically similar to dikes in the Comerford Dike Complex, about 40 km northeast.

The dikes are interpreted to be part of a regional swarm that formed by partial melting of sub-continental, asthenospheric mantle. They intruded the crust in an extensional tectonic environment between the time of Taconic and Acadian orogenies.

GEOCHEMICAL ANALYSIS OF SEDIMENTS IN THE OMPOMPANOOSUC RIVER NEAR THE ELIZABETH MINE, SOUTH STRAFFORD, VERMONT

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

The Elizabeth Mine, an abandoned copper mine in South Strafford, Vermont is leaching highly acidic runoff into the West Branch of the Ompompanoosuc River from a forty-acre tailings pile. The mine is included in the massive sulfide deposits of the Vermont copper belt, which consists of stratabound and stratiform pyrrhotite, chalcopyrite and minor sphalerite and pyrite within metasedimentary and mafic metavolcanic rocks of Silurian to early Devonian age. Discovered in 1783, the mine originally produced copperas (iron sulfate) from pyrrhotite and later (1830-1958) produced copper from chalcopyrite. The main objective of this study is to assess spatial variations in metals concentration and speciation in sediments in the West Branch of the Ompompanoosuc River.

Inductively Coupled Argon Plasma (ICAP) spectrometry indicates that the river sediments are acting as a sink for metals. ICAP analysis of trace elements shows elevated levels of metals at the confluence of Copperas Brook-Ompompanoosuc River, including copper (7.2x-16.6x), cobalt (2.8x) and zinc (2.9x-12.7x). These levels remain slightly elevated downstream, between 2.0x and 6.4x. The only major element to exhibit significant increases is iron oxide, which was elevated 5.8x-7.9x at the entrance of Copperas Brook and remains as high as 2.3x downstream. In contrast to water analysis, metal concentrations in sediments measured 7.7 km downstream from Copperas Brook were as high, or slightly higher than previous sampling sites, implying that Lords Brook is serving as an additional source of contaminants to the river. A correlation diagram comparing copper and iron oxide concentrations has a correlation coefficient of 0.5703. This implies that in addition to iron oxide, other factors such as the solubility of copper, the presence of iron in chlorite and the ability of carbonates to control copper are also controlling the mobility of copper. X-ray diffraction analysis of bulk and <2u fractions indicate that the sediments are dominated by chlorite, illite, feldspar, mica, albite and hornblende. Additionally, broad peaks at 4.7Åand 2.1Å suggest the presence of poorly crystalline iron oxides. Finally, an acetic acid chemical extraction failed to leach significant percentages of metals, indicating that the metals are not readily available under ambient conditions.

THE "GENERAL" POCKMARK, BURLINGTON BAY, LAKE CHAMPLAIN, VT

Joshua E. Gutierrez, Geology Department,
Middlebury College, Middlebury, VT 05753

The "General" pockmark is roughly 40 meters in diameter, 4 meters in depth and is located in Burlington Bay, Lake Champlain between Shelburne Point and Lone Rock Point. It is one of the largest pockmarks found in Lake Champlain. Pockmarks form as the result of upward migrating fluid or gas. As this fluid or gas is released into the water column, fine-grained sediments become suspended in the water column and can therefore be easily removed by currents while coarse-grained sediments remain behind forming a crater like depression. The goal of this study was to determine whether or not this large pockmark was actively venting fluid or gas into the water column during an 11-month field program from September 2, 1999 to July 25, 2000.

Five sediment cores (2 inside, 1 on the edge and 2 outside of the pockmark) were collected and analyzed for magnetic susceptibility, physical properties and 210Pb dating. Also, a mooring was placed in the deepest section of the pockmark (27.7m). The mooring was placed September 2, 1999 and retrieved July 25, 2000. The mooring was equipped with an Acoustic Doppler Current Profiler (ADCP), temperature chains (sensors every 4m) running horizontally along the lake floor and vertically from the center of the pockmark, a bottom mounted 35 mm stereo image camera and a Savonius rotor current meter located .3m above the lake floor. Differences between the physical properties of cores taken from within and without the pockmark are evident. Bottom photographs show episodic events of suspended sediment. Initial analysis of the temperature data suggests the presence of anomalous temperatures near the wall of the pockmark. ADCP data is presently being examined for possible correlations with these episodic events.

SPATIAL EXTENT OF SEDIMENT PULSES IN LAKE MOREY, FAIRLEE, VT

Angela Conlan, Dept. of Geology,
University of Vermont, Burlington, VT 05405

Lake Morey, located in Fairlee, VT is a ~12m deep lake with steep surrounding topography. Two cores were taken from the lake. One core was taken close to a delta that collects sediments from a steep drainage basin; the second was taken further from the delta in deeper water.

The two cores were analyzed using five different methods: magnetic susceptibility, x-radiography, visual logging, loss on ignition (LOI), and grain size analysis using a laser diffraction unit. Each of these methods uses different means to detect a change in the type of material throughout the core. This research focuses mainly on the deep-water core, comparing it with the core closer to the delta.

The susceptibility test for the deep-water core shows a slight increase of magnetic susceptibility with depth, from 2 SI units at the top of the core to 5 SI units at 500cm. There were no significant peaks in SI units throughout the entire core. When plotted against depth, the LOI data show a decrease in percent LOI from approximately 22% at the top of the core to 12% at 500cm. The LOI data also show no significant peaks throughout the core. The mean particle size throughout the deep-water core is approximately 9.5μm. The mean value does not change with depth. However, there are 5 significant peaks in the core made up of particles that range in size from 20-30μm, as well as several smaller peaks. These larger grains are evidence of hydrologic events that have transported terrestrial sediments into the pond. The mean particle size of the core taken closer to the delta is approximately 18μm, twice that of the core taken from deeper water, with particle sizes as large as 66μm deposited during significant hydrologic events. Grain size analysis identified 7 significant hydrologic events, and several smaller events in the core taken closer to the delta.

These results show that grain size analysis using a laser diffraction unit is far more sensitive to changes in sediment input than the other methods. The changes in grain size throughout the deep-water core are large enough to identify some of the same events as found in the core taken from the delta, but the particles are significantly smaller than those found closer to the delta, making lower energy hydrologic events undetectable in the core taken further from the delta.

A BASIC SLOPE STABILITY ANALYSIS OF ROUTE 125 ALONG THE LEMON FAIR RIVER: CORNWALL, VERMONT

Nathan West, Geology Department,
Middlebury College, Middlebury, VT 05753

The stability of natural earthen slopes is dependent primarily on moisture and the strength properties of the soils present. Certain soil types and moisture conditions can cause catastrophic slope failure. Conversely, considered application of engineering concepts can restore slopes to a stable condition. Some of the parameters that influence the landslide-related behavior of soils are: [1] moisture content; [2] grain size distribution; [3] cohesive properties (liquid and plastic limit, shear strength); and [4] the mass of material bearing down upon the soil. One primary region of failure has been identified between Route 125 and the Lemon Fair River. It is on the order of hundreds of meters in size and extends well into the existing roadway. Investigation by the Vermont Department of Transportation has yielded numerous soil borings and laboratory tests of the subsurface at this site and the surrounding area in preparation for bridge construction south of the subject site.

In order to determine the causes of observed slope failure northwest of Cornwall, VT, along a section of Route 125, further study of the subsurface and its properties is necessary. Boring logs, inclinometer data, and laboratory tests were studied in order to calculate parameters of slope failure. The paper discusses in general the parameters of slope failure and their specific effect on this site. The potential contribution of soil properties and moisture conditions to the existing area of failure, are discussed, and the probability of continued failure at the site is estimated based on a variety of possible events.

EXPOSED GLACIAL DEPOSITS WITHIN A LANDSLIDE IN THE SMUGGLERS NOTCH SKI AREA CONTAINING A SAPROLITE, TILLS, AND HIGH LEVEL LAKES WITHIN THE BREWSTER RIVER DRAINAGE BASIN

Ian Hodgdon, Dept. of Geology,
University of Vermont, Burlington, VT 05405

A recent landslide in North Central Vermont 1 km south of the Smugglers Notch Ski Area exposes an orange saprolite overlain by a gray till which is overlain by glacially dammed lake sediments (clay) which is overlain by a third till deposit.

At the landslide, the orange saprolite is 5 m thick and contains a range of clast sizes, which due to the severity of weathering, all are easily broken with bare hands. Well data collected from the Smugglers Notch Ski Area indicate the saprolite extends at least 1.6 km to the north and has a maximum thickness of 47 m (150 ft). The saprolite exposed in the landslide was caused by subaerial weathering rather than hydrothermal alteration. This was concluded because the intact bedrock just below the saprolite along the contact shows no signs of hydrothermal alteration. Analysis of similar saprolites by J. S. Wright from Scotland and LaSalle from Qubec, indicate weathering for long times or under warm and humid conditions. This suggests that saprolite formation possibly occurred at the end of the Tertiary.

The gray till, deposited by a Laurentide glacial advance, overlies the saprolite, and contains very few striated cobbles. This till is comprised mostly of silt, sand, and pebbles. Clay deposits overlying the gray till were deposited when a glacial lake was created during ice sheet retreat. The outlet for this elevated lake was to the south through Smugglers Notch at an elevation of 652.9 m (2,070 ft), until the glacier retreated far enough to the north to allow the lake to drain along the valley wall to the west. The clay deposit has been deformed, indicative of another glacial advance. There is a third till that overlies the clay deposit and is composed of clasts of sizes ranging from fine sand to rocks 24 cm in length. This till appears to have undergone very little weathering due to the fresh appearance of the sediment. The landslide occurs on a tributary of the Brewster River drainage basin. Within this drainage basin are four stream terraces. Terrace 1 is at an elevation of 481.7 m (1,527 ft), Terrace 2 is at an elevation of 458.6 m (1,454 ft), Terrace 3 is at an elevation of 425.8 m (1,350 ft), and Terrace 4 is at an elevation of 413.5 m (1,311 ft). These are believed to be fluvial terraces because to date, there have been no deltas found to correlate with the terraces that would suggest they were lake derived.

PEDOGENESIS ALONG THE FLANKS OF MOUNT SAINT HELENS

Matthew D. Whitcomb, Geology Department,
Middlebury College, Middlebury, VT 05753

On May 18th, 1980 Mount Saint Helens experienced an eruption that changed the surrounding land irreversibly. Recumbent trees, hummocky topography, and deep, sedimentary lahar deposits are visible 20 years later as if the eruption were yesterday. However, on a smaller scale the monument's sub-alpine soil was affected in a more subtle manner. With vegetation temporarily destroyed by the scorching heat of tephra deposition, soils would no longer develop at rates influenced by species richness and the rain of the Pacific Northwest. Rather, a layer of tephra ranging in thickness from several centimeters to several meters would serve as the primary influence for new pedogenic rates within the monument.

A paper by Ugolini, Dragoo and LaManna (1997) discusses the compositions of these andisols, namely the presence of vermiculite, as affected by tephra depositions. Results of my study are similar in that soil samples also contain trioctahedral vermiculite, as proven by XRD analysis. However, because my samples are taken from a variety of microclimates within the monument, data include pedogenesis within both tephra and lahar deposits. Scanning electron microscope analysis will be used to further assess mineralogical compositions and weathering sequences. Ultimately, pedogenic rates in soils collected in August 2000 will be compared with pedogenic rates in soils just outside of the monument and blast/ash fall zone. The comparison soils were also collected in 2000.

Thus far, XRD analysis of several locations including both lahar and ash depositions indicate an abundance of fresh plagioclase feldspar. In addition, the ash deposits contains vermiculite and the lahar contains vermiculite and halloysite as well as kaolinite/smectite. The presence of halloysite and kaolinite/smectite indicates that the lahar is undergoing more advanced or rapid weathering in comparison to the tephra zones. What causes this? Continued SEM analysis will provide the information to determine whether the feldspar is weathering into vermiculite, halloysite, and kaolinite/smectite or whether all three are detrital and formed on the volcano prior to the eruption.

STRUCTURAL AND KINEMATIC EVOLUTION OF AN OROGENIC WEDGE: THE INTERPLAY BETWEEN THRUST FAULTING AND NORMAL FAULTING IN EASTERN BHUTAN

Andrew McKinney[1], Keith Klepeis[1], Djordje Grujic[2], and Lincoln Hollister[3]
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The High Himalayan Crystalline Belt (HHC) of eastern Bhutan preserves a near continuous section of high-grade gneisses, leucogranites, and Tethyan facies metasedimentary rocks that were deformed by different styles of faulting during the Late Tertiary collision between India and Asia. Early top-up-to-the-south ductile thrust faulting along the Main Central Thrust (MCT) placed garnet-kyanite-sillimanite-bearing aragneisses and leucogranites on top of less deformed garnet-staurolite-bearing rocks of the Late Precambrian Daling-Shumar Group near Tashigang. This deformation produced a penetrative north-dipping foliation and north-plunging mineral lineations within the high-grade rocks of the HHC. Top-up-to-the-south thrusting also occurred either simultaneously with or preceding development of a regional-scale ductile normal fault that accommodated top-down-to-the-north displacements structurally above the MCT. Together, the MCT and this normal fault form the lower and upper boundaries, respectively, of an orogenic wedge. Following development of this wedge, both the MCT and normal fault were folded by tight inclined folds that form a type 1 interference pattern (domes and basins) at the scale of the mountain range. These folds form three sets that plunge gently and moderately to the northwest, northeast, and east. We have identified domains where each of these sets are dominant and mutually affect one another. Following folding, a major out-of-sequence thrust fault (the Kakhtang thrust) was emplaced across the top of the structural pile. The Kakhtang thrust is not folded. Finally, top-down-to-the-north displacements along the South Tibetan Detachment Fault and top-up-to-the south displacements along the Main Boundary Thrust also post-date folding of the MCT and emplacement of the Kahkthang thrust. Our data suggest that periodic top-down-to-the-north normal faulting alternated in time with top-up-to-the-south thrust faulting and constriction-related folding during growth of an orogenic wedge in Bhutan. The styles of thrust faulting and normal faulting we observed are kinematically compatible with the southward extrusion of deep crustal rocks between slabs of colder crustal material composed of Tethyan facies cover rocks.

COMPARISON OF EXHUMATION PROCESSES OF LOWER CRUSTAL GRANULITES IN FIORDLAND, NEW ZEALAND

Dale Walker, Alexander Claypool, Keith Klepeis
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High-pressure (14-16 kbars) granulite and amphibolite facies orthogneisses exposed in the Fiordland belt of southwestern New Zealand record a polyphase history of Early Cretaceous to Late Tertiary tectonism. Northern Fiordland is dominated by subvertical, NNE-striking foliation (S1) defined by amphibole, garnet, clinopyroxene and plagioclase assemblages formed at lower crustal depths (>45 kms) during Early Cretaceous convergence along the margin of Gondwana. Southern Fiordland is dominated by shallowly dipping, ENE-striking foliation defined by similar high-grade mineral assemblages as seen in Northern Fiordland.

At the northwestern boundary of the granulite belt, a NNE-striking subvertical shear zone (the Anita shear zone) tuncates S1 and separates high pressure rocks from Paleozoic cover rocks to the west. Both the Anita shear zone and S1 are reactivated by regional strike-slip faults that include, from west to east, the Alpine fault, the Pembroke fault and the Harrison-Kaipo (HK) fault. This latter fault zone forms the eastern boundary of the granulite belt. At the southern end of the HK fault zone, en echelon dextral faults strike to the NE and offset lithologic contacts in a step-wise geometry. At its northern end, this fault zone curves to the north, and intersects and merges with the NE-striking Pembroke fault. Faults at this intersection accommodated reverse displacements. Elsewhere, the dominant NE-striking fault zones record bulk dextral strike-slip kinematics. Our data strongly suggest that northernmost Fiordland was affected by a regional-scale Late Tertiary dextral transpressional restraining bend formed by curved faults that separate the Fiordland granulites from weakly unmetamorphosed rocks to the north, west, and east. Our data also suggest that final Late Tertiary exhumation of the granulites in northern Fiordland was controlled by dextral transpressional tectonics and erosion. This mechanism contrasts with the granulites of south-central Fiordland where exhumation processes involved mid-Cretaceous ductile normal faulting. In contrast to the north, sourthern Fiordland was dominated by extensional tectonics. These results show that processes leading to the exhumation of lower crustal granulites in Fiordland were highly variable within the belt, and had widely different effects on its evolution across the region.

MINERALOGICAL EVIDENCE FOR HYDROTHERMAL ORIGIN OF THE BRANDON RESIDUAL FORMATION AND THE EAST MONKTON KAOLINS

Andrew Nichols, Geology Department,
Middlebury College, Middlebury, VT 05753

The Brandon Residual Formation (Brandon, VT) and the East Monkton kaolins (East Monkton, VT) are part of a discontinuous chain of kaolin deposits trending along the Green Mountain Front from Bennington to Monkton, Vermont. The unlithified sediments of the Brandon Residual Formation unconformably overlie the contact between the Cambrian Cheshire Quartzite and Dunham Dolomite, and are associated with extensive lignite deposits. Paleobotanical evidence derived from fossil flora found within the lignite deposits indicates an Early Miocene age and a climatic environment similar to that of the present day Gulf Coast, USA. The kaolin deposits therefore may be linked with an intense weathering environment. The East Monkton kaolins are found entirely within the Cheshire Quartzite, and may be associated with the weathering of phyllitic layers within the quartzite.

X-ray diffraction (XRD) analyses of both oriented and randomly oriented clay samples associated with the Brandon Residual Formation and East Monkton kaolins were performed to assess the origin of the kaolin deposits. XRD patterns show sharp basal peaks indicating that the kaolins are primarily well-ordered, well-crystalline, and show few defects. XRD patterns also indicate a predominance of well-crystalline kaolinite coexisting with minor amounts of potassium feldspar, illitic mica, and plagioclase. Several samples also show R1-ordered illite/smectite (rectorite). SEM analyses show the presence of well-crystalline kaolinite, and more poorly crystalline smectite.

The presence of well-ordered and well-crystalline kaolinite coexisting in apparent equilibrium with illite and potassium feldspar according to the K2O-Al2O3-SiO2-H2O phase diagram, and the existence of R1 illite/smectite in several samples are most consistent with a hydrothermal origin for the Brandon Residual Formation and the East Monkton kaolins. If this is true it implies Mesozoic or Paleozoic origin of the kaolins, and might indicate that Miocene coal forming swamps formed atop a previously existing, clay-rich substrate.

PRESIDENT'S LETTER

Dear Members,

The Northeastern Geological Society of America meeting is over. The presentations, workshops and poster sessions were all very exciting. After this feast of high level intellectual stimulation, the society is turning its attention to April 21 when the student papers will be presented. I hope that you all can make it. The students are working hard to finish their research and I am sure that they will be interesting.

In the realm of pre-college activities, Earth Science Week (Oct 7-13) planning has started. On April 4, several members met to begin planning. You will hear more about that later. The goal is to stimulate interest in studying the earth sciences and to expand public awareness of geology and its role in water and land use decisions, ecological issues, and hazard mitigation. As with the spring student papers meeting, Earth Science Week is designed to support and encourage the study of earth sciences. We all can contribute in some way whether we talk to a class of students or share a favorite field site.

Sincerely,
Shelley F. Snyder
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EARTH SCIENCE WEEK 2001

First call for Earth Science Week volunteers. Here's a sampling of the enthusiastic response to last year's Geologist-in-the-Parks program.

"What a day on Ascutney! A good time was had by all! My educational objectives for my students were accomplished completely and beyond! We received some very positive feedback from the teachers of Flood Brook, Elm Hill and Sherburne schools. All in all about 85 students, parents and teachers filed through my students' stations which covered topics ranging through volcanoes, mineralogy, weathering, erosion xenoliths and more. The weather was so bad it was great! Several of the teachers said that they would like to do this again."

"The program was very useful and interesting to me and my students. We loved it! It even interested my students in becoming geologists."

"Have you set times and locations for next fall? I am interested in attending this program next year. Please let me know the dates and places as soon as possible."

"I wanted to thank you again for this wonderful program. The three geologists that worked with us were incredible."

We need you to make this happen again! Please contact Marjie Gale (241-3608) if you can spend a day in a park with some great kids during the week of Oct. 7-13, 2001.

Vermont Geological Survey Website:

www.anr.state.vt.us/geology/vgshmpg.htm

Check out some geologic scenery in the Montpelier Quadrangle:

www.anr.state.vt.us/geology/glacialmontp.htm

STATE GEOLOGIST'S REPORT

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Many thanks to the Geology Department at the University of Vermont for hosting the Geological Society of America Northeast Section 36th Annual Meeting. Tracy Rushmer, General Chair of the meeting, Andrea Lini, Technical Chair, and their colleagues did an excellent job coordinating all aspects of the meeting. The official hosts for the meeting were: University of Vermont, Middlebury College, Norwich University, Vermont State Colleges at Johnson, Lyndonville, and Castleton, the State University of New York at Plattsburg, the Vermont Geological Society, and the Vermont Geological Survey. 850 geoscientists convened at the Sheraton to share results of current research through both oral presentations and poster sessions. Topics discussed in symposia and theme sessions included geologic aspects of environmental problems in the northeast, paleobiology, climate change, tectonics, glacial processes, magmatism, and education.

In terms of the Survey, we were active at this year's meeting, participating in a variety of sessions as well as exhibiting maps and hazard information at our booth. Stephen Wright (UVM) and Larry Becker (VGS) co-convened a special symposium on glacial processes in honor of Fred Larsen, recently retired professor from Norwich University. Keith Klepeis (UVM) and Marjorie Gale (VGS) co-convened a special symposium on fault zone evolution and convergent tectonics in honor of Rolfe Stanley. Barry Doolan (UVM), Jon Kim (VGS), Sebastien Castonguay (GSC) and Alain Tremblay (INRS) co-convened a session on the geologic evolution of the northern Appalachians. Jon was the lead author on three papers, one on radionuclides co-authored with Larry, one on mafic complexes in Vermont co-authored with Marjie and Jo Laird, Peter Thompson, and Wallace Bothner, contract mappers from the University of New Hampshire, and one on geochemistry co- authored with Ray Coish of Middlebury College. Jon and Marjie were also co-authors on a poster focused on the geology of Belvidere Mountain and Tillotson Peak presented by Jo Laird, Wally Bothner, Peter Thompson, and Thelma Thompson. Finally, both Jon and Marjie served as judges for student

presentations, and the Survey, in conjunction with the US Geological Survey and the University of Vermont, posted a draft of the new bedrock map during the Map Blast. This was the first opportunity for other geologists to see the current draft of the bedrock map for the entire state.

It was rewarding to see presentations from Survey contractors and the quality of research conducted by student mappers funded through Statemap and the AASG Mentored Student Program. Stephen Wright and students Andrew Bosley (AASG program), Megan McGee (AASG program), Ian Hodgon and Adam Spangler presented a talk summarizing their investigations in the Jeffersonville area (site of the 1999 landslide), Fred Larsen presented a talk and poster on his recent mapping in the Montpelier area, and David DeSimone and Alan Baldvieso from Williams College presented a poster on applied hydrogeology in the Arlington quadrangle. Lori Barg and George Springston focused their poster session on land use and channel evolution in the Great Brook Watershed.

The meeting provided the opportunity to attend a variety of talks, to learn about current geologic problems and issues being addressed at universities and other surveys, and to connect with our colleagues from the northeast. Thanks again UVM and GSA.

RADIONUCLIDE UPDATE

The State Geologist and Jon Kim represented the Division at a Health Department sponsored meeting on radionuclides in drinking water in the Milton/Colchester area. Our part of the meeting focused on the studies completed to date using existing information and our plans for field work and testing this summer. The Division also received questions about how we will identify areas of concern in other parts of the State. We did learn that some wells were tested for radionuclides in the 1980's that did not show elevated levels then but now exceed standards. The Division announced that we would be looking for cooperation on access to property and well testing. The Health Officers will help us with local access. The work will better define areas of concern and locate regions with negligible radioactivity as potential aquifers. The following abstract, presented at NE GSA, summarizes current issues concerning radionuclides in groundwater in Vermont.

GEOLOGIC CONTEXT OF ELEVATED RADIONUCLIDE OCCURRENCES IN NW VERMONT

By Jonathan Kim and Laurence Becker,
Vermont Geological Survey

Elevated naturally-occurring radionuclide levels have recently been found in bedrock water wells from Milton/Colchester, and St. George, Vermont. Although both areas are found in the Champlain Valley geologic province, the geologic "landscape" of the Milton/Colchester radionuclide problem is significantly different than that of St. George.

A cooperative study in 2000 between the Dept. of Health, Geological Survey, and towns of Milton and Colchester was initiated in response to the discovery of elevated gross alpha levels in private bedrock water wells in a new Milton housing subdivision. Since previous radiometric studies in the Milton/Colchester area (e.g. USGS, 1951; NURE, 1976; Whitten, 1988) had identified general areas of elevated radioactivity within the Clarendon Springs Formation (CSF), additional radiometric analyses were conducted on wells within or in close proximity to the CSF; eight well clusters were subsequently identified that exceed EPA gross alpha standards. Secondary radiometric testing has implicated the ^{238}U decay series in this problem.

Uranium-bearing minerals in the Cambro-Ordovician Clarendon Springs Formation dolomites have both primary and secondary origins. Detrital zircon, apatite, monazite, and sphene can be found disseminated throughout the dolomite in certain locations whereas secondary sphalerite, galena, and pyrite are found associated with fractures (Parker, 1988; Whitten, 1988). The highest radiometric readings are related to secondary U-bearing minerals occurrences (Parker, 1988; Whitten, 1988). The northern extension of the Hinesburg Synclinorium (HS) folds the CSF and is truncated by the Champlain and Hinesburg thrusts to the west and east, respectively.

The St. George Trailer Park (SGTP) lies near the convergence of the Paleozoic Hinesburg Thrust Fault and the Mesozoic St. George Normal Fault. These faults primarily juxtapose Cambrian metasedimentary rocks (Fairfield Pond Fm and Cheshire Qtzite) with Ordovician Limestones (Bascom Fm). The primary water supply for the SGTP was found to have elevated gross alpha levels in 1999; this bedrock well appears to have penetrated an outlier of the Hinesburg Thrust. Reconnaissance bulk-rock geochemistry of lithologies surrounding the SGTP

demonstrate that the Fairfield Pond Fm phyllite and Cheshire Quartzite have Th abundances that significantly exceed those of average continental crust. Syn and post-tectonic fluid migration along these major fault zones is inferred to be responsible for concentrating radionuclides in some bedrock wells.

VGS CALENDAR 2001

April 21: Spring VGS Meeting, Norwich University, Northfield, VT

April 21: Student research grant money awarded

July 10: Deadline for articles and news items for Summer GMG

July 21: Spring/Summer Field Trip

Sept. 10: Deadline for articles and news items for Fall GMG

Sept. 18: Publish Fall GMG

Sept. 21-23: NEIGC in New Brunswick

Oct. 7-13: Earth Science Week 2001

Nov. 5-8: GSA in Boston

VGS SUMMER FIELD TRIP
Saturday, July 21, 2001

George Springston and Lori Barg will lead a trip "Surficial Geology and Fluvial Geomorphology of the Great Brook Watershed, Plainfield, VT." Bring lunch and be prepared to cross the brook several times.

Meet in downtown Plainfield at 9:30 am. Specific meeting place and directions will be in the summer issue of GMG. Please pre-register with George at 241-4232(w) or 454-1220(h).

TREASURER'S REPORT

March 23, 2001

Dear President and Board:

The financial condition of the Society remains strong. Please see the attached Income Statement for the period January 1, 2001 through March 23, 2001. The checking account balance is $3,347.97 as of March 23, 2001. All bills received by me have been paid and are reflected in the above balance. I welcome feedback and suggestions from the Board and membership.

Sincerely,
Kristen L. Underwood

Income and Expenses
1/1/01 through 3/23/01

INCOME	
Total Dues	$280.00
Dues-Family	$40.00
Dues-Institution	$0.00
Dues-Member	$240.00
Dues-Student	$0.00
Interest	** $2.71
Publications	$22.00
Student Research Grant Contributions	$225.00
TOTAL INCOME	$529.71
EXPENSES	
Post Office (stamps, GMG Distribution)	$0.00
Minuteman Press (GMG Publishing)	$131.20
Earth Science Week Poster Awards	$0.00
Student Res. Grants (VGS Spring Mtg)	$0.00
TOTAL EXPENSES	$131.20
TOTAL INCOME – EXPENSES	$398.51

** Interest income earned 1/28/01 through 3/23/01 not reflected in this total.

The Society gratefully acknowledges the generous contributions to the Student Research Grant funds received from the following members during the **first quarter of 2001**: Lawrence W. Gatto, Barbara L. Hennig, Jeanne Detenbeck, Alexis P. Nason, Larry Becker, and Jeff Hoffer. THANKS!

Vermont Geological Society Student Research Grants

are designed to aid our future geologists investigate Vermont's geo-history.
Help the VGS to promote a deeper insight into Vermont Geology.
Students receiving assistance through the program will present their research results at the VGS Spring Meetings. Your generosity will help cover a lot of terrane!

To contribute to the **VGS Student Research Grant Program**, clip or copy this form and send it, along with your check or money order made payable to VGS, to:

Kristen Underwood, Treasurer, Vermont Geological Society
Department of Geology, University of Vermont
Burlington, Vermont 05405-0122

- *I'VE ENCLOSED MY TAX-DEDUCTIBLE CONTRIBUTION TO BE DEDICATED TO THE **VGS STUDENT RESEARCH GRANT PROGRAM.***

TOTAL GIFT: ***$***_____

*NAME:*_____

*ORGANIZATION:*_____

*ADDRESS:*_____

*CITY:*_____ *STATE:*_____

GEOLOGY HUMOR LINKS ON THE WEB

www.ic.ucsb.edu/~georx/geohumor.htm

home.earthlink.net/~bcrabtree/n7e.html

www.crocoite.com/faultline/

www.marshfield.k12.wi.us/science/museum/jokes.htm

www.earthsciences.uq.edu.au/~geosciences/jokes.html

EDITOR'S CHOICE!

www.esci.keele.ac.uk/geology/howlers.html

VERMONT GEOLOGICAL SOCIETY DUES STATEMENT 2001

Dear VGS member:

Membership dues for 2001 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 ASAP (due date was March 31, 2001). 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:

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: _____

Vermont Geological Society Annual Student Paper Meeting 2001
Abstract Addendum

The Silurian Braintree Complex, Vermont: Bimodal Plutonism West of the RMC

Dagan Murray
Norwich University

The Braintree Complex in central Vermont intruded Cambro-Ordovician rocks, west of the Richardson Memorial Contact (RMC)/ Taconian line, prior to the deformation and metamorphism of the Acadian orogeny. Preliminary radiometric dates around 430 Ma (Ratlcliffe, 2000) provide a Silurian age for the complex.

The overall shape of the complex is elliptical trending N-S parallel regional fabric, with a length of 2.5 miles and a maximum width of 1 mile. Mafic rocks occur along the western margin as discrete masses seperated by septa of country rock. Rock types include gabbro, diorite and quartz diorite, with late trondhjemite and tonalite dikes. Granite constitutes the central and eastern portion of the complex

Seventeen samples were collected or which six were suitable for petrographic and chemical analysis, four mafic samples from the southern portion of the complex and two representative granite samples. The mafic rocks show a range of grain size and abundance of phenocrysts. Original igneous textures are not well preserved due to the extensive metamorphic reactions that produced blue-green amphibole, clinozoisite, albite, biotite, and chlorite, generally after primary hornblende and intermediate plagioclase. Silica content from all available analyses show a range from 49 to 62 wt % SiO_2; samples of this study are olivine ± nephaline normative.

The granite has very uniform texture throughout, is rich in K-spar (approximately 2:1 K-spar to plagioclase modal ratio), and is classified as a 2 feldspar, 2 mica granite. The body shows only modest variation in the modal abundances and whole rock chemistry. The rocks are peraluminous with 0.13 to 0.49 normative corundum, and an aluminum saturation index (ASI) of 1.3. The granites are silica rich with 70 to 74 wt % SiO_2. Acadian metamorphic effects, with albite altering to sericite and biotite to chlorite, were weak.

Ti-Zr-Y ratios of the mafic series plot in the MORB-island arc tholeiite field, following a progressive eastward Y enrichment across Vermont. These rocks plot both in continental and orogenic fields on Pearce et al (1984) Al-Fe-Mg discrimination. Taken all together, the petrographic and chemical data suggest that the mafic portion of the complex formed from mantle-derived magmas that evolved by fractionation and mixing in the lower crust before emplacement at their current exposure level. In contrast, the granite appears to be a continental crust melt product emplaced as a homogeneous intrusion, which crystallized without much fractionation.

A Total Magnetic Field Survey of the Braintree Complex, Vermont

Nathan P. Donahue, Norwich University

A ground survey of the total earth's magnetic field was carried out during the winter of 2001 using a proton procession magnetometer. The purpose was to better define the contacts and extent of the igneous bodies both laterally and in cross section by generating a magnetic contour map and cross sectional model. The complex is located in the southern Roxbury and northern Randolph 7.5 minute quadrangles just west of the Taconian Line, and consists of both felsic and mafic bodies approximately 2.5 mi. long (N-S) and 1 mi. wide surrounded by a variety of Ordovician greenish-gray quartzites, phyllites, schists and greenstones of the Mississiquoi Formation.

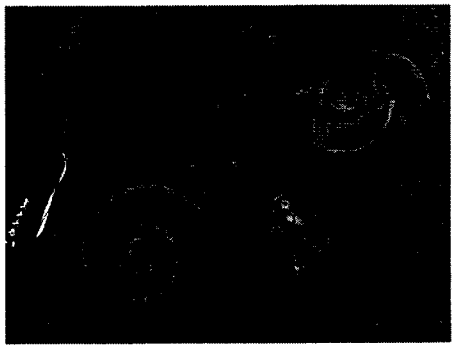
These magnetic readings were averaged at each of 115 stations (1 per 1,000,000 sq. ft). Data was corrected daily for diurnal variations by typical correction methods and then adjusted to a permanent base station for the duration of the study. Direct magnetic susceptibility via proton procession magnetometer were obtained for five samples, 2 felsic ranging from 5.20×10^{-5} to 2.13×10^{-6} and the 3 mafics showing generally higher susceptibilities of 1.84×10^{-4} to 7.86×10^{-5}. The susceptibility of the surrounding country rock was not measured however the contoured data does reveal it is an order of magnitude or greater than that of the mafic rocks.

A magnetic contour map was generated for negative and positive anomalies by setting 0 gammas at 54650, the approximate field strength at the felsic contact. The felsic body on average produces a distinct negative anomaly but ranges from -150 to +120 gammas. The mafic rocks produce a positive anomaly over all, yet range from -60 to + 380 gammas. The country rock is highly variable, due to differing lithologies, with negative and strongly positive anomalies, averaging 300-500 gammas. Anomaly strengths vary from north to south within both igneous bodies; the mafics produce multiple peaks of steep gradients along the west-central portion of the complex, and slight negative anomalies in the southwestern portion of the complex. Shallow negative gradients in the northern portion of the granite steepen toward the south and culminate in a concentric steep negative anomaly at the southern tip of the felsic body. The map suggests that the felsic body is thinnest in the northern portion and thickest in the south; the strong negative anomaly may represent a feeder system. Two magnetic profiles were made across the southern end of the complex, one from a detailed ground survey with station at 100 ft. intervals and another from the magnetic contour map. These profiles, along with geologic map data and measured susceptibilities constrained a computer generated model which also suggests the thickening of the body at the southern end. Relative dimensions of the mafic and felsic bodies in this cross section suggest that the mafic body is thin at the western margin, perhaps even wedge shaped, and the felsic body is at least as thick as it is wide and is also thin at its western contact. to test the feeder system hypothesis of the felsic body and actual dimensions of the igneous bodies more sophisticated techniques such as multiple detailed ground surveyed profiles with closer station intervals, in situ field measurement of susceptibilities, and computer modeled profiles combined with other geophysical techniques will necessary.

The Jeffersonville landslide site was a favorite stop on our fall field trip, 2000.

In the summer of 1999 we visited the marble quarry at Danby.

JOIN US FOR THE SUMMER FIELD TRIP TO GREAT BROOK
JULY 21, 2001



Maclurites magnus, Isle LaMotte

Charlotte Mehrtens, trip leader, discusses the Chazy Reef at Isle LaMotte with Les Kanat, Tania Bacchus and students on our fall field trip in 1998.

Stephen Wright led our Fall 2000 trip in the Jeffersonville area.

Stephen tells Helen to leave the concretions alone!

Helen Mango and Tim Grover brought a group of students from Castleton State College.