THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

SPRING 1985 VOLUME 12 NUMBER 1

SPECIAL EVENT ! A new trophy will be awarded at:

VGS' TWELTH ANNUAL PRESENTATION OF STUDENT PAPERS

SATURDAY MAY 4, 1985 8:50 A.M.

WARNER BUILDING IN THE HEMICYCLE MIDDLEBURY COLLEGE

DIRECTIONS: From the center of Middlebury village, drive west on VT 125. The Science Center is the first large college building on the left. Use the large parking area east of the building by the loading dock. Warner Building is a short walk northwest of the Science Center.

CONTENTS PAGE

PRESIDENT'S LETTER

The spring meeting with the presentation of student papers is upon us once again. There has been an addition to the program this year as the executive committee has decided to create a trophy for the best undergraduate student presentation. This award will be a rotating trophy to be held by the winner's school until the next competition. The trophy will be engraved with the student's name and school. The previous winners will be added so that the list will be complete. I hope you will be there for the unveiling.

The winter professional paper presentation was a real success. About 65 people attended one or both sessions. The talks were good and everyone found something of interest.

The professionalism of the Society must be starting to show as the State of Vermont has asked for our advice. The Society is sending Craig Heindel as our representative to a study group that will make a recommendation on the so called "threshold criteria". These criteria relate to the way wastewater is disposed of by spraying or subsurface discharge. The executive committee has charged Craig with working towards regulations that make sense in hydrologic terms. Craig would appreciate any input from the membership. You may call him at 658-0820. This item will be discussed at the spring meeting and all members are urged to attend.

The executive committee has approved several new members. I want to remind you of our membership contest and encourage you to get out and recruit someone. Please let us know who you have signed up so we can keep track.

The annual meeting will be October 5. Fred Larsen will lead the trip and present his work on Lake Hitchcock. Please put this date on your calender now, as it will be a great trip.

Roger B. Thompson, Jr.
President

SPRING MEETING PROGRAM

May 4, 1985
Warner Building Hemicycle - Middlebury College

REGISTRATION (no fee): Coffee and donuts 8:15

MORNING SESSION: Brewster Baldwin, Convener

1. Paul Jensen: Geochemistry of sediments in the Ottauquechee Formation and Taconic sequence 8:50
2. Michael Goldfinger: Metasomatism of Greenstones associated with small-scale shear zones near Camels Hump, Central Vermont 9:10
3. Christopher Beck: Rare earth elements in apatite associated with magnetite ore of the Mineville District, NY 9:30
4. Adair Mali: An intrusive and metamorphic history in the Adirondack Mountains, Elizabethtown Quadrangle, NY 9:50
5. Crispin Prahl: Bedrock geology of the western Lincoln massif and associated cover rocks, North Ripton, Vt. 10:10
6. Gregory Koop and Hugh Rose: Stratigraphy and structure of the Jeffersonville area, north-central Vt. . 10:30
7. Frances Cole: Structure and microstructure beneath the Champlain thrust 10:50
8. Susan Johnson: Petrology and structural deformation of the Cheshire Quartzite, East Middlebury, Vermont . 11:10
9. Ruth Lohmann: Structure and petrology of the basal contact of the Cheshire Quartzite, East Middlebury, Vermont. 11:30
10. Gilbert Riley: Deformation of quartz and feldspar in a Precambrian granulite 11:50

Poster display: Tectonic geology of the Lincoln Massif and eastern cover sequence, central Vermont.
V. DelloRusso, E. Lapp, S. O'Loughlin, C. Prahl

LUNCH 12:10

EXECUTIVE COMMITTEE MEETING (bring brown bag lunch)

AFTERNOON SESSION: Barry Doolan, convener

11. Michael Stevens: A seismic analysis of the Grenville and Appalachian Provinces 1:30
12. Douglas Hillman: The Rockledge Formation: A possible carbonate slope deposit. 1:50
13. Denah Lehmann: Paleoecology and diagenesis of uplifted Pleistocene reefs, north coast of Jamaica, W.I. 2:10
14. Gary Oakley: Origin of wave-cut notches on calcium-carbonate shorelines, Jamaica, W.I. 2:30
15. Sarah Dunlap: Effects of Rio Bueno sediments on Coral Reef, Jamaica, W.I. 2:50
16. Joshua Klein: Measurements of submarine sediment creep in three channels, Jamaica, W.I 3:10
17. Paul Bierman: Deglaciation of northwestern Massachusetts and southwestern Vermont 3:30
18. Tamra Browne: Heavy metal distribution through a soil profile of the Winooski River flood plain . . 3:50
19. Marjorie Ulin: Methods for measuring soil loss on agricultural fields. 4:10
20. Jonathan Durning: Shallow seismic survey of the Middlebury aquifer 4:30

AWARD OF PRIZES and TROPHY 5:00

RARE EARTH ELEMENTS IN APATITE ASSOCIATED WITH MAGNETITE ORE OF THE MINEVILLE DISTRICT, NY

Beck, Christopher M., Department of Geology, Middlebury College, Middlebury, Vermont 05753

Apatite found as an accessory mineral in the magnetite deposits in the Mineville District, Essex County, New York was studied for rare earth abundances. This study served as the background for a feasibility study concerning the economic feasibility of re-working the tailings piles in Mineville.

The apatite studied came from two tailings piles, #5 and #7, which were from the first and last magnetite separation processes. Samples from pile #7 show that the total amount of cerium, yttrium, neodymium, europium, and lanthanum (REEs studied) averages 3.47% (element weight percent). This is somewhat lower than the widely used values of 11.14% rare earth oxides (REOs). Those values are probably inflated, due to presence of very fine, non-recoverable grains of REE-bearing bastnaesite and monazite.

An analysis of the apatite determined a negative correlation between the phosphorus content and the total REEs studied. This indicates that there will be a high REE content with low phosphorus ores, an important fact for further an economic feasibility study. This is in direct conflict with previous studies conducted on these apatites (Williams, 1964?, and MCKeown and Klemic, 1956).

DEGLACIATION OF NORTHWESTERN MASSACHUSETTS AND SOUTHWESTERN VERMONT

Bierman, Paul, Department of Geology, Williams College, Williamstown, MA 01267

This abstract is printed on page 26.

HEAVY-METAL DISTRIBUTION THROUGH A SOIL PROFILE ON THE WINOOSKI RIVER FLOODPLAIN

Browne, Tamra D., Department of Geology, Middlebury College, Middlebury, VT 05753

To assess potential human impact on the environment, this reconnaisance study analyzes the distributions of antimony, chromium, nickel, selenium and titanium through a soil profile located on the Winooski River floodplain. The studied profile is part of the Limerick silt loam series and is 200 cm thick. 19th and 20th century over-bank deposits compose the upper 110 cm. In the lower 90 cm, mottling evidently indicates the soil was in place by or before the early 18th century.

Element concentrations are defined using spectrophotometric methods. Titanium is immobile, and so its constant distribution through the profile indicates a natural origin for the heavy metals, some of which are mobile in the soil. In addition, X-ray diffraction shows that the heavy metal distribution of each sample is independent of the mineralogy. Results indicate pedogenic processes rather than anthropogenic inputs control the heavy-metal distribution through the profile.

STRUCTURE AND MICROSTRUCTURES BENEATH THE CHAMPLAIN THRUST

Cole, Frances, Department of Geology, Middlebury College, Middlebury, VT 05753

The kinematic history of the Trenton aged Iberville Shales immediately beneath the Champlain Thrust in west-central Vermont was determined using analyses of outcrop-scale structures and by application of calcite microfabric analyses. Contoured stereographic plots of bedding, cleavage, lineation, and fold axis orientations from southern Snake Mountain, northern Snake Mountain, Vergennes, and Charlotte, Vermont indicate east-over- west thrusting in at least two stages of motion, with local extension preceding the later increment of westward transport. An early-developed, regionally pervasive NNE-striking cleavage (associated with NNE-striking fold axes) is truncated locally by vertical N-striking extensional calcite veins, which have been subsequently offset along reactivated cleavage surfaces during the later period of movement. At southern Snake Mountain, the later stage of slip is represented by an undulating calcareous slickenside surface of east-trending a-lineations and north-trending b-lineations which truncate the cleavage.

"Compression axes" (Turner and Weiss, 1963), determined geometrically from universal-stage measurements of e-lamellae and c-axes in calcite from the late-formed slickenside surfaces, have a preferred orientation which corresponds with the east-west compression suggested by the east-trending a-lineations in the outcrop and hand sample. This relationship suggests that twin gliding on the e {0112} plane was locally a principle mechanism of calcite deformation during the late stage of motion; e-lamellae and c-axes in calcite from aggregates involved in the early stage cleavage-forming event have more complex orientation patterns, as a result of late strain superimposed on the earlier strain.

Finally, a pattern of successively more intense deformation of microstructures and outcrop structures to the north supports the idea that displacement on the Champlain Thrust dies out to the south.

EFFECTS OF RIO BUENO SEDIMENTS ON CORAL REEF, JAMAICA W.I.

Dunlap, Sarah C., Department of Geology, Middlebury College, Middlebury, VT 05753

A tremendous variability exists in the carbonate environment of the north coast of Jamaica. Here, the narrow fringing reef incorporates coral growth and waste dispersal in a self-organizing system. Local environmental parameters modify these systems. Terrigenous influx onto the reefs is generally low, allowing lush growth.

In the center of this north coast, Rio Bueno flows onto the coral reef. The river's headwater sand is about 70% aragonite; sand at the mouth is about 40% aragonite. This material was traced out into the Bay to determine distribution of river sediment and to gauge the effect of sediment on coral growth. River sand is bimodal from headwaters to bay and grades downstream from low-Mg calcite to the high-Mg calcite of reef sands. All of the fine sediment on the reef must have come from the river, because at nearby Discovery Bay, where there is no river, the reef sand is unimodal.

The reef environment is indeed unique here. Coral growth is lush in spite of the heavy sediment load of the river effluent. This is due to distinct reef morphology, selective coral growth types, and cleansing ability of the corals.

SHALLOW SEISMIC SURVEY OF THE MIDDLEBURY AQUIFER

Durning, Jonathan C., Department of Geology, Middlebury College, Middlebury, VT 05753

A shallow seismic survey was undertaken to map the buried till east of the Town of Middlebury's well, and to determine the usefulness of seismic testing in the glacial deposits of the Middlebury environs.

A variety of glacial deposits flank the Green Mountains in the Champlain Valley. To the north of the study area, a lateral moraine till ridge rises above the surrounding sand and gravel deposits, paralleling the mountain front. A few miles south (near the village of East Middlebury) there is a similar till ridge. In the area under consideration, a terrace extends out from the mountains and then south, enclosing a small valley. Alluvial sediments and gravels cover the surface.

The 30 seismic lines of this study were carried out to determine if a till ridge exists under the terrace. Seismic velocities were used both to identify materials and to calculate their depths from the surface. Well-log data and the results of previous seismic work in an adjacent area were incorporated into the final cross-sections and contour map of the till surface.

The results indicate that a till ridge does in fact exist below the terrace. The ridge seems to lie beneath the outer north-south margin of the terrace and drops off sharply at the southern end. Furthermore, a bench of till was found on the mountain front.

METASOMATISM OF GREENSTONES ASSOCIATED WITH SMALL-SCALE SHEAR ZONES NEAR CAMELS HUMP, CENTRAL VERMONT

Goldfinger, Michael, Department of Geology,
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Fifteen greenstone samples representing transitional strain profiles across three small scale-shear zones were analysed geochemically for progressive metasomatic alteration. Six samples from the Gillett Pond Greenstone (Shear Zone #1) show a coarse-grained albite-hornblende (femaghastingsite)- epidote- chlorite- sphene +calcite assemblage with porphyroblasts of a hornblende-chlorite intergrowth. Samples from greenstone bodies of the Stowe Formation, Shear Zone #2 and Shear Zone #3, are moderately to highly schistose and contain actinolite- albite- chlorite +sphene +calcite +apatite assemblages. Strain of samples at each shear zone was determined by measuring amphibole alignment. An electron microprobe was used to analyze major element chemistry, and XRF analyses were performed to determine trace-element concentrations for all samples. The independent effects of regional metamorphism (strain) and pre-orogenic submarine hydrothermal alteration were considered as the relevant factors when examining geochemical variations. The geochemical trends discerned are best explained by a primary fluid alteration at sea floor followed by syn-stress and/or post-stress secondary fluid alteration where increasing shear results in increased fluid passage.

Epidotization, the primary fluid alteration, has produced calcium and strontium enrichment as well as mobility of iron and the alkali elements in the greenstones. During subsequent regional metamorphism, secondary fluids, which have substituted magnesium for calcium in the bulk rock, resulted in an increase of actinolite and chlorite phases at the expense of of epidote. Strontium occupying Ca^{2+} in the epidote was more incompatable with the secondary fluid than was the epidote structure as a whole. Secondary fluids have also remobilized the alkalis, resulting in the instability of albite. Small-scale shear zones are avenues for reactive fluid migration in greenstones which result in chemical equilibration between rock and fluid and subsequent instability of dominant phases. The immobile trace elements, TiO_2, Zr, and Y, were not affected by either alteration episode.

THE ROCKLEDGE FORMATION: A POSSIBLE CARBONATE SLOPE DEPOSIT

Hillman, Douglas, Department of Geology,
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The Upper Cambrian Rockledge Formation is found in discontinuous north-south trending outcrops within the eastern basinal sequence in both the Milton and St. Albans quadrangles of northwestern Vermont. In this report the Rockledge Formation is recognized as a carbonate apron deposit that consists of 5 lithofacies that are defined by field relationships and thin section petrography. These lithofacies and associated

environmental interpretations include: 1) Massive Coarse Sandstones (channelized mass sediment flow deposits, near base of slope; 2) Sandy Conglomerates (debris flow deposits, within channels at base of slope); 3) Argillaceous Conglomerates (debris flow deposits, interchannel regions); 4) Banded Turbidites (low-density turbidites, preserved in interchannel regions); 5) Laminated Siltstones (levee deposits adjacent to channels); and 6) Massive Structureless Micrites (possible dilute channelized flows of peri-platform ooze).

The allochthonous sediments and clasts that comprise the six lithofacies are thought to be derived from the Winooski Dolomite, a unit that was synchronously deposited on the western shelf sequence. Evidence for this interpretation is based on: 1) lithologic similarity; 2) biostratigraphic correlations between the shelf and basinal sequences; and 3) paleocurrent data indicating a westerly source.

GEOCHEMISTRY OF SEDIMENTS IN THE OTTAUQUECHEE FORMATION AND TACONIC SEQUENCE

Jensen, Paul, Department of Geology,
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This study compares the bulk chemistry of the stratigraphically equivalent(?) Cambrian-Ordovician Ottauquechee Formation and the Taconic Sequence. A graphitic black phyllite from the Ottauquechee and a black carbonaceous slate from the Taconics were selected for comparison. Samples were analyzed for SiO, Al_2O_3, TiO_2, FeO, MgO, MnO, CaO, Na_2O, K_2O, P_2O_5, BaO, Cr_2O_3, Ni, Nb, Zr, Y, Sr, Rb, and Pb.

Average element concentrations and inter-element correlation coefficients, along with AFM, Alk-M-A, Nb-Zr-Y, and BaO-Sr-Rb ternary diagrams, indicate that the Ottauquechee phyllite and the Taconic black slate differ significantly in chemical composition. Differences in metamorphic grade cannot account for these chemical differences. Concentrations of diagenic elements such as Mn and Ni, along with the abundance of TiO_2 found in the Taconic slate indicate that the Taconic slate was located closer to a terrigenous source than the Ottauquechee phyllite.

The petrology of these rocks suggests the opposite. Quartzite beds are thicker and more abundant in the Ottauquechee than in the Taconic sequence. The Ottauquechee phyllite beds have numerous laminae that may have been quartz silt. Geochemically, the ratio of SiO_2/Al_2O_3 is higher in the Ottauquechee than in the Taconic sequence, suggesting that its protolith was a more mature sediment.

PETROLOGY AND STRUCTURAL DEFORMATION OF THE CHESHIRE QUARTZITE, EAST MIDDLEBURY, VERMONT

Johnson, Susan L., Department of Geology,
Middlebury College, Middlebury, VT 05753

The structure of 1 km of E-W exposure of Lower Cambrian Cheshire Quartzite in East Middlebury is much more complex than previously reported. The area of study is located in the

transition zone between the Champlain Valley and the Green Mountains at the Green Mountains Front. Previous work concluded the structure of the Cheshire Quartzite in this area to be either the eastern upright limb of a syncline or cut by high-angle reverse faults and overturned structures.

Exposures of the Cheshire are divided into three domains, each separated by high-angle reverse faults. The eastern domain is characterized by argillaceous quartzite sparsely interbedded with thin beds of phyllite. Deformation consists of upright, parallel, second-generation folds trending north, folded primary cleavage trending north, and truncated and stacked beds from the Upper Cheshire. The central domain contains a greater percentage of phyllite. Deformation includes two cleavages, small-scale, similar, north-trending folds overturned to the west in quartzites, and west-verging recumbent intrafolial folds in phyllites. The western domain contains argillaceous quartzite with sparse, thin interbeds of phyllite. Deformation is mild: gentle, small-scale folding of phyllitic beds and stacking of dismembered quartz/feldspar veins. Microprobe and microscope work revealed the Cheshire experienced substantial temperature and pressure conditions, far more than can be explained by simple burial and reverse faulting.

MEASUREMENTS OF SUBMARINE SEDIMENT CREEP IN THREE CHANNELS, JAMAICA W.I.

Klein, Joshua B., Department of Geology, Middlebury College, Middlebury, VT 05753

The rate of sediment creep in three submarine channels off the north coast of Jamaica was studied from January 1984 to January 1985. Using SCUBA equipment, divers fixed transect lines and in-channel marker stakes and observed their movement over time. Measuring down-slope linear movement and angular rotation, an average annual rate of 3.82 cm of creep within the top 30 cm of sediment was calculated. This figure was then used to calculate an average volume of .99 m^3 of sediment creep per year per channel. Using the volume of creep calculated for the three study channels as a basis, and approximating the number of submarine channels with the use of aerial photographs, a crude estimate of 6100 m^3 of sediment creep off the north coast of Jamaica was made.

STRATIGRAPHY AND STRUCTURE OF THE JEFFERSONVILLE AREA, NORTH-CENTRAL VERMONT

*Koop, Gregory W. and Hugh S. Rose, Department of Geology, University of Vermont, Burlington, VT 05405

The study area was mapped at a scale of 1:5,000 and lies along the west flank of the Green Mountain Anticlinorium (GMA) in the southern part of the Jeffersonville 7 1/2 minute quadrangle. Three distinct tectono-stratigraphic sequences of

rocks are exposed across the study area. They are from west to east: 1] black carbonaceous slaty phyllites with interbedded quartzites, dolomites, quartz-chlorite granulites, and locally, marbles; 2] silvery-green quartz-muscovite schists, with varying quantities of magnetite, albite and chlorite; 3] silvery-green quartz-muscovite-chlorite-albite±magnetite schists [similar to unit 2] interbedded with unit 1 rocks to the west and an amphibole-bearing greenstone to the east; 4] carbonaceous rusty and non-rusty medium to coarse-grained muscovite-albite schists, with numerous quartz stringers.

Units 2 and 3 correspond to the Underhill Formation and unit 4 to the Hazen's Notch Formation of Doll and others [1961]. Unit 1 has been interpreted by previous workers as a unit within the Underhill Formation or as the Ottauquechee Formation. We interpret the unit 1/unit 2 contact to be a fault which predates F2/S2 deformation. All tectonic assemblages have been deformed by three periods of folding. The first two are interpreted to be Taconian in age, and result in the formation of well developed schistosities, axial planar to tight and isoclinal folds. The third event, presumably Acadian in age, is coeval to the formation of the GMA. It is characterized by open folding of shallow plunge and is associated with well-developed spaced cleavage. The unit 1/unit 2 assemblage is truncated to the east by unit 3 along a presumed fault. The unit 3/unit 4 contact appears in all cases to be gradational where mapped. Although study of the relationships between structure and Taconian metamorphism are presently underway, preliminary analyses suggest that units 1 and 2 have been metamorphosed to a maximum of biotite grade whereas units 3 and 4 have been subjected to garnet grade during F1/S1 time.

*Presenter

PALEOECOLOGY AND DIAGENESIS OF UPLIFTED PLEISTOCENE REEFS, NORTH COAST OF JAMAICA, W.I.

Lohmann, Denah, Department of Geology,
Middlebury College, Middlebury, VT 05753

The stair-step topography of the north coast of Jamaica is the result of tectonic uplift, glacio-eustatic fluctuations, and reef growth. The uppermost terrace, 35 meters above sea level, is cut on the Hope Gate Formation. The Hope Gate is flanked by the Falmouth Formation, whose upper surface is a terrace 5 m above sea level. These terraces are well developed from East Discovery Bay to West Rio Bueno Harbor. The Falmouth was deposited during the Sangomman Interglacial, approximately 130,000 ybp. Similarly, the older Hope Gate was deposited during the high eustatic conditions of the Yarmouth Interglacial, perhaps 230,000 ybp.

Facies of the Falmouth are very similar to those of the modern fringing reef system off the north coast. The lagoonal facies of the poorly lithified Falmouth rocks includes molluscan calcilutites, muddy calcarenites, and well-washed skeletal calcarenites. Facies deposited in the reef framework include the **Acropora cervicornis** zone, the zone of mixed coral heads, and the **Acropora palmata** zone. No facies

representative of the forereef slope environment is present. The thick units of zoned coral facies formed during stable sea level, whereas the upper Falmouth records marine regression.

Following uplift from the marine environment, the carbonate sediments underwent diagenetic changes, according to X-ray diffraction analysis. Recent sediments are not lithified and consist of high-magnesium calcite and 64-94% aragonite. Falmouth rocks, except for a one-meter, spar-cemented caprock, are poorly lithified limestones. Dolomitization has commenced in the Falmouth, though dolomite and high-Mg calcite are minor, and aragonite percentage remains very high. The Hope Gate rocks, characterized by significant amounts of dolomite, contain no high-Mg calcite; a mollusc retains 94% aragonite. It is concluded that high-Mg calcite is the least stable of the $CaCO_3$ polymorphs, followed by aragonite and low-Mg calcite.

STRUCTURE AND PETROLOGY OF THE BASAL CONTACT OF THE CHESHIRE QUARTZITE, EAST MIDDLEBURY, VERMONT

Lohmann, Ruth C., Department of Geology,
Middlebury College, Middlebury, VT 05753

One-third km east of the junction of Routes 125 and 7 in East Middlebury, Vermont, a 2408-m west-to-east transect of the Green Mountain Front was investigated to determine the nature of the contact between the Cheshire Quartzite and the pre-Cheshire sequence. The pre-Cheshire sequence is traditionally mapped as the Fairfield Pond Member of the Underhill Formation, the Pinnacle Formation, and the Precambrian Mount Holly Complex.

The westernmost 1341 m of the transect is a structurally and lithologically homogeneous unit of gently west-dipping, massive to poorly bedded, white to buff Cheshire Quartzite. Three deformational events are recorded: a first schistosity-forming event (wS1), a second folding event (wS2-wF1), and a third fracturing event (wS3).

The pre-Cheshire rocks in the eastern 1067 m are structurally but not lithologically homogeneous. They constitute a series of steeply east-dipping lithologic units of highly sheared black phyllite, chlorite- sericite- quartz-muscovite schist, and biotite gneiss. The four deformations of these rocks are an early fabric in the gneiss (eS1), a schistosity and veining in the gneiss and schist (eS2), a later folding and schistosity in the gneiss, schist and phyllite (eS3-eF1), and a final shearing event recorded only in the phyllite. This fourth deformation is equivalent to the wS3 event; correlation of earlier events is not established.

All the rocks of the transect, including the Mount Holly, are adjusted to greenschist facies. Calculations show 2 kb of pressure for the Cheshire (S. Johnson, pers. comm.), far more than can be assigned to stratigraphic burial. The Mount Holly retrograded to 3 to 5 kb of pressure. Therefore, the basal contact of the quartzite represents a high-angle fault which juxtaposes two lithologically, structurally, and metamorphically distinct rock units. The structural history of the two implies convergence of two separate terranes, now faulted together.

AN INTRUSIVE AND METAMORPHIC HISTORY IN THE ADIRONDACK MOUNTAINS, ELIZABETHTOWN QUADRANGLE, NY

Mali, Adair P., Department of Geology,
Middlebury College, Middlebury, VT 05753

An area with Grenville-age rocks in the Elizabethtown Quadrangle along the southeastern margin of the Adirondack anorthosite massif was mapped in detail to provide insights into the intrusive and metamorphic history. The area is dominated by four rock types: granitic gneiss, intruded in turn by coarse gabbro, anorthosite, and fine gabbro.

Field relations suggest two separate events of gabbro intrusion. Evidence from thin section and microprobe analyses indicates granulite facies metamorphism that took place at 20 to 30 km. Application of geobarometers and geothermometers to microprobe results yields pressures of 8.3 to 8.9 kb and temperatures of 726° to 789°C. Calculated temperatures generally agree with Bohlen and Essene's (1980) isotherm map of the area.

The presence of two gabbro generations constrains the geologic history, suggesting the following sequence of events: Coarse gabbro was emplaced into granitic material, either at depth (20 to 30 km.), or at shallower levels and subsequently taken down to depth, and subjected to kinematic granulite facies metamorphism. Anorthosite and then fine gabbro were intruded under conditions of static granulite facies metamorphism. Subsequently, the entire package rose to the surface. A later event of prehnite-pumpellyite facies metamorphism with abundant water could have caused depletion of O^{18} along mineral lineations or fracture systems developed during earlier intrusions.

This model differs from Valley and O'Neill's (1982) hypothesis, which argues for shallow emplacement of the anorthosite (< 10 km) to allow for O^{18} depletion by circulating meteoric water. Shallow emplacement of the anorthosite is made less likely by the presence of two generations of granulite facies gabbro that were intruded before and after the anorthosite. This would require raising the package from depth to intrude the anorthosite at shallow levels, putting it back down to depth to attain granulite facies in the fine gabbro, and then raising it to the surface again where it currently rests.

ORIGIN OF WAVE-CUT NOTCHES ON CALCIUM-CARBONATE SHORELINES, JAMAICA, W.I.

Oakley, Gary E., Department of Geology,
Middlebury College, Middlebury, VT 05753

On the limestone coastline of Jamaica, many erosive processes are responsible for the formation of "wave-cut" notches. These include physical abrasion or erosion due to wave action, chemical dissolution by sea water undersaturated with calcium carbonate, and biological disintegration by burrowing and browsing organisms. Various authors have noted

such activities, and their influence on shapes or structures of notches; however, none have discussed how processes differ in particular environments.

This research has found that some erosional processes predominate in certain environments. The notch of the open marine coast extends 4 feet above high tide. It is discontinous and its profile is jagged and shallow. There are few organisms, and there is little range in chemical conditions (pH, salinity, temperature) of the sea water. Direct wave activity has a major influence on the formation of this type of notch. In a quiet lagoonal area, near the Discovery Bay Marine Lab, the notch extends 2 feet, from just below to just above the tidal range. It is highly burrowed, deep, and fragile. Absence of waves and lack of chemical variation indicate that biological destruction is responsible. In a sinkhole, with variably brackish water, there is chemical dissolution below water level; no other processes appear to be involved.

There is a dominance of certain observable activities in these environments. However, sawed rock samples collected from many notched cliffs reveal that intense burrowing and dissolution often exists under smooth algal coatings. This suggests that some hidden processes of "micro-environments" may have a great impact on coastal erosion.

BEDROCK GEOLOGY OF THE WESTERN LINCOLN MASSIF AND ASSOCIATED COVER ROCKS, NORTH RIPTON, VERMONT

Prahl, Crispin, Department of Geology,
University of Vermont, Burlington, VT 05405

The bedrock geology of the western part of the Lincoln Massif, 6.5 miles northwest of Ripton, Vermont, consists of twelve differentiated rock units, of Middle Proterozoic to Lowest Cambrian age. The region is cored predominantly by massive, weakly foliated Mount Holly quartz-feldspar gneiss. A distinctive feldspar augen gneiss and biotite rich gneiss occur locally and provide excellent control for understanding the structure of the basement.

Deformation in the western massif is weak to moderate, resulting in a system of open Paleozoic folds which contain rare shear and fault zones. The relative coherency of the rocks in this area contrast sharply with the sheared and mylonitized basement rocks found in the eastern region of the massif.

The angular unconformity between basement rocks and stratigraphically higher rift clastic rocks is commonly well defined by the younger basal conglomerate. This conglomerate, which contains up to boulder size clasts of Middle Proterozoic gneiss and quartzite, grades upward into the muscovite-biotite Pinnacle metagreywacke. Massive, muscovite and chlorite-rich facies also occur locally within this unit. Lenses of sandy dolomite are interlayered with a chlorite-rich greywacke within 120 feet of the unconformity. These rocks are interpreted as lithic equivalents of the Forestdale Dolomite, described by Tauvers (1982) and DiPietro (1983), found in the upper part of the Pinnacle. These rocks may represent localized shelf

deposits on the uplifted blocks between Late Proterozoic rift basins. Deformation in the cover rocks of the western massif consists of folds and one generation of cleavage that is coeval with the open folds mapped in the basement complex. These rocks have been recrystallized in the lower greenschist facies, with biotite remaining stable throughout. Retrograde features in the Proterozoic rocks may be interpreted as the effect of a later stage of metamorphism superimposed on an earlier and more intensive metamorphic event.

DEFORMATION OF QUARTZ AND FELDSPAR IN A PRECAMBRIAN GRANULITE

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A Precambrian granulite was studied to determine the deformational mechanisms operating on quartz and feldspar contained in the sample. The quartz in the body occurs as syntectonically recrystallized ribbons, separating distinct feldspar shear zones. Typically, the ribbons are one to three grains thick. The feldspar shear zones represent syntectonically recrystallized porphyroblasts. In the majority of cases the porphyroblasts were entirely consumed by the recrystallization process. Typical aspect ratios in the shear zones were 20 to 1.

Universal-stage analysis indicates a complex deformation path for the quartz. Two distinct preferred orientations of the c-axes are found. One preferred orientation is perpendicular to the lineation and in the plane of the foliation (occurring 70% of the time). The other preferred orientation is characterized by a 60 degree lateral migration of the central orientation along the foliation plane coupled with climb out of the foliation plane along two great circles. These c-axes eventually become perpendicular to the fabric. The great circles defining the climb from the foliation plane are assymetric indicating a shear component to the stress. This complex determination may indicate a change in the slip system or deformation mechanism acting in the quartz.

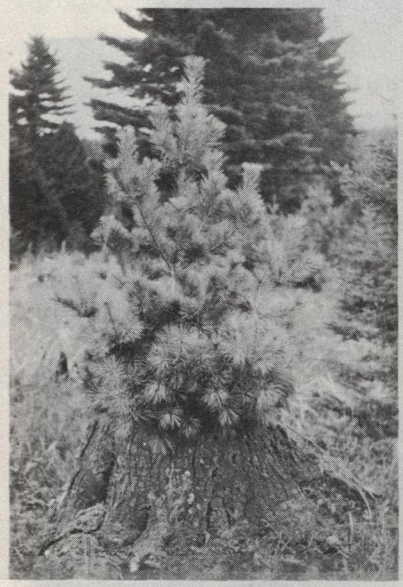
Universal-stage analysis of the feldspar shear zones indicates that superplastic deformation occurs in regions distal from the porphyroblast. This deformation is recorded as progressive deterioration of the initially strong preferred orientation. Textural evidence indicates that the grains recrystallized via sub-grain rotation. For a pressure of 6 Kb, a two-feldspar geothermometer indicates a temperature of deformation around $566^{\circ}C + 30^{\circ}$. Because of constraints imposed by the two-feldspar geothermometer, diffusion can be ruled out as a mechanism that would enhance the grain-boundary sliding. Thus the superplastic deformation most likely occurred by dislocation-climb that enhanced grain-boundary sliding.

[Continued on page 15]

ODDITIES AFIELD

by Charles G. Doll

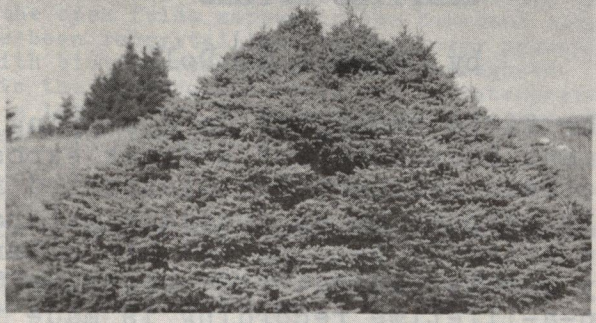
The field geologist on a mapping assignment searching for bedrock exposures is sometimes unexpectedly distracted from his main purpose by an uncommon natural feature silently calling for his attention. Equally quiet, camera-ready response to a once-in-a-lifetime recording is made to share with others. It may be instructive or just amusing, in any event pleasing. The photographs that follow were taken during the course of geologic mapping in the Northeast Kingdom of Vermont.



Second generation.

Bending over backwards.

Huddling spruces.



Curious cows.

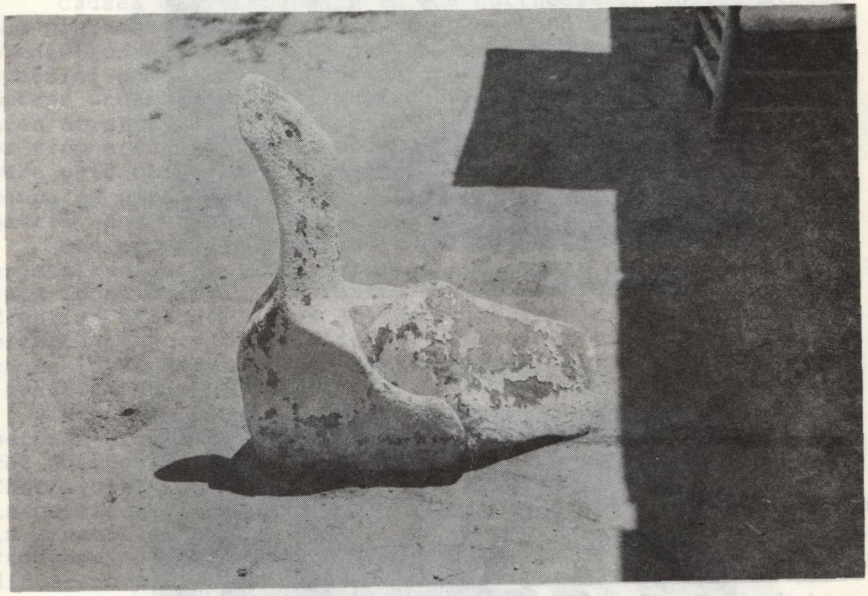
Getting the message.

Relaying the message.

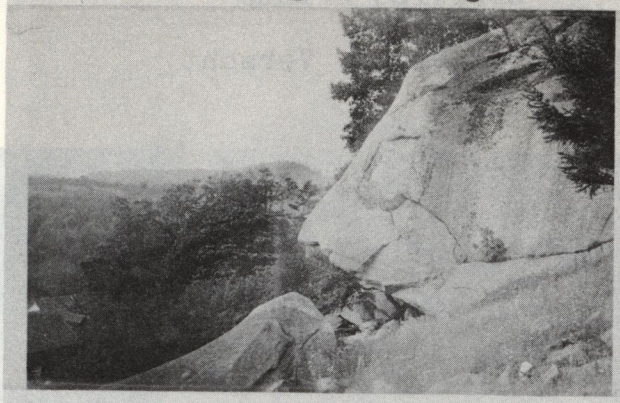
ODDITIES AFIELD

ODDITIES AFIELD

Goose Green, Vermont



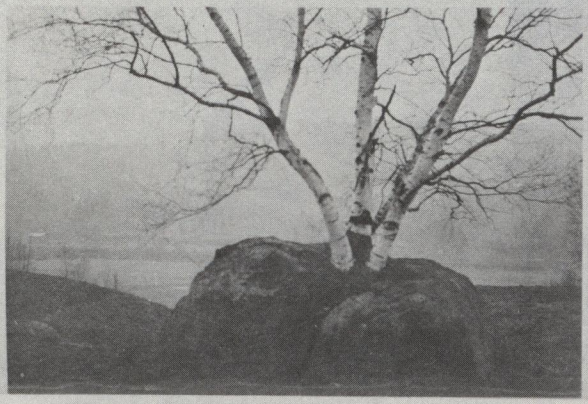
Nature's sculpture in granite.



Watchdog in the hills.

Nature's sculpture in limestone.

The Face.



Potted birches.

A SEISMIC ANALYSIS OF THE GRENVILLE AND APPALACHIAN PROVINCES

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Causes of earthquakes in the northeastern United States and southeastern Canada are not clear and consequently prediction of these earthquakes is nothing less than a guessing game. A project was undertaken to try to get a better understanding of what causes seismic activity in the area of study. Events from areas that are particularly weak or from areas that have undergone distinct tectonic histories were paid close attention. Properties of the crust were compared with properties of the event using a scatterplot matrix, and anything anomalous in the plots was pointed out.

One parameter used in the study was average P-wave crustal velocity. Two types of body waves are generated for each local event. The faster P-wave precedes the S-wave. Creation of these waves at the epicenter is closely connected with the theory of elasticity. The generation of the two waves is explored and properties of the waves are investigated.

Results of the study show no particular correlation between properties of an event and properties of the crust in the northeastern United States and southeastern Canada. The Charlevoix Seismic Zone, in the northern part of the region, is particularly active. This zone shows very anomalous trends in crustal structure where there is activity. The Grenville Province and the Appalachian Province in general show marked differences in structure where there is activity but a detailed study must be undertaken to fully understand what triggers activity in such structurally different areas.

METHODS FOR MEASURING SOIL LOSS ON AGRICULTURAL FIELDS

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This research devises methods for measuring localized erosion on clay soils and evaluates these methods. A study site was selected on a lacustrine clay soil in Addison County, Vermont. The slope is a fall tilled agricultural plot, and the clay content increases down slope. A review of conventional methods for measuring soil erosion, including large scale basin analysis, soil traps, and Gerlach troughs, indicates that these techniques are not suitable for measuring erosion on agricultural clays.

Two types of instrumentation were developed to monitor movement of fine-grained soils on the site: 1. A modified soil trap that collects all sediment, including that with low settling velocities; and 2. a PVC trough system that samples a longer section along slope and includes a flow meter to monitor the volume of sheet flow. A continuously recording rain gauge at the study site provides data on rainfall volume and intensity. Preliminary results will be used to compare Soil Conservation Service estimates of erosion rates derived from the Universal Soil Loss Equation and from volumetric soil loss from rills.

POSTER

TECTONIC GEOLOGY OF THE LINCOLN MASSIF AND EASTERN COVER SEQUENCE, CENTRAL VERMONT

Stanley, Rolfe S., Vincent DelloRusso, Eric Lapp, Sharon B. O'Loughlin, Crispin G. Prahl and Rebecca Dorsey, Department of Geology University of Vermont, Burlington, VT 05405

Detailed 1:12,000 scale-mapping in the Middle Proterozoic rocks of the northern part of the Lincoln massif and the medium grade, pre-Silurian rocks to the east in the Green Mountains shows the following important relations:

1. Fine grained, biotite gneiss and augen gneiss of the western part of the Lincoln massif are deformed into a series of open folds that involve the overlying rift-clastic and quartzite cover. Paleozoic or younger faults are rare.
2. Granitic orthogneiss of the eastern part of the Lincoln massif are intruded by mafic dikes and offset by a system of shear zones, mylonites, and faults that developed during the folding and subsequent westward displacement of the Lincoln massif. One extensive fault zone contains slivers of the basal Pinnacle sequence and represents a major boundary within the massif. This fault zone may correlate with the Hinesburg thrust zone.
3. Mylonitic slivers of Middle Proterozoic gneiss are imbricated with rocks of the Pinnacle Formation along the eastern border of the Lincoln massif. This zone is correlated with the Middlefield thrust zone of western Massachusetts.
4. The eastern eugeoclinal sequence of Pinnacle, Underhill, Mount Abraham, and Hazens Notch formations consists of at least four thrust slices that are overprinted by two generations of folds. Depositional sequences are present within each slice. Most fault zones are sharp, parallel to the dominant schistosity, and display ductile fabrics. Synkinematic mineral assemblages of kyanite-chloritoid grade occur along many of the faults. This suggests that the faults formed at approximately 13 km compared to the shallower conditions inferred for the faults in the Lincoln massif. Isotopic age data suggest that Paleozoic deformation occurred during the Taconian orogeny although younger ages cannot be ruled out.

VGS BUSINESS & NEWS

NEW MEMBERS

The following new members were accepted at executive committee meetings held since the Winter GMG was published:

Gwen Buttles	Burlington, VT
Joseph J. Hayes	Montpelier, VT
Kurt Koella	Kalamazoo, MI
Robert G. LaFleur	Troy, NY
Leah Mach	Moscow, ID
D. Randall Spydell	Hartford, VT
Nancy A. Williams	West Lafayette, IN

CHARLES G. DOLL AWARD

Each year since 1974, VGS has awarded two cash prizes for the best undergraduate and graduate (or two undergraduate) student papers presented at the spring meeting, but we have never recorded the winners names. As a result (as you can see in the following item) we have forgotten who all the winners were. In order to properly recognize the students who participate in the spring meeting presentation of student papers, Barry Doolan has proposed to prepare a trophy which will list all the undergraduate winners since 1974. In the future, names will be added each year and the trophy will be held by the winner's college for the year. The trophy will be unveiled at this year's meeting. The name - "The Charles G. Doll Award for the Best Undergraduate Student Paper".

HELP! - FIND LOST WINNERS

Help! The Executive Committee would like to update some missing records. Who were the undergraduate and graduate recipients of the VGS Best Student Paper Award for the following Annual Spring meetings?: 1974 (the first one sponsored by VGS), 1975, 1976, 1977.
To help you out, the list of participants for these meetings is presented below:

	Undergraduates	Graduates
1974 at UVM		
	Randall Parrish	D. Balmer
	Peter Harris	J. Moore
	J. Roger Bowman	L. Setright
	Paul C. Agnew	G. McHone
	Mark Jennings	J. Detenbeck
	Charles Shearer	
	Jeff Limoge	
	Martha Hewett	
	Deborah Hutchinson	
1975 at Middlebury College		
	Ken Bartlett	J. Noyes
	R. Sc. Munier	T. Acomb
	Peter Moreau	P. Thompson
	Sally Wood	D. Pieratti
	Eric Rosencrantz	
	Ellen Davie	
	Andrew Cohn	
	Roderick Parnell	
	Rod March	
	Robert Peale	
	Matthew Higgins and Jeanneann Rogers	
1976 at UVM		
	K. Cashman	R. Badger
	M.A. Mihalik	
	A.S. Cohen	
	D.N. Reusch	
	J. Rodgers	
	G. Jacobs	
	M. Black	

G. Monrad
P.F. Straley
M. Higgins

1977 at Middlebury College
C. White
T. Loken
S.L. Kenyan
S.W. Bright
M Jakinski and L. Waterhouse
D. Knapp
P. Turner

PUBLIC ISSUES COMMITTEE

Possible Changes in State
Groundwater Discharge Policy

The Vermont Water Resources Board has formed a group of state water resource officials (called the Discharge Policy Study Group, consisting of Bill Bartlett, Canute Dalmasse, Dave Clough, Bill Brierly and Tom Willard) to evaluate the current policies regarding land-based waste disposal and discharge permits, and to propose any policy change if needed.

This Study Group has in turn formed an Advisory Panel consisting of representatives of interested government agencies and organizations, including the Vermont Geological Society. Craig Heindel is representing the Vermont Geological Society on this Advisory Panel.

Meetings of the Advisory Panel have focused on determining which constituents of sewage effluent are of greatest concern to water quality considerations in the State's streams and rivers; what levels of these constituents are acceptable in surface and ground water, measured where; what regulatory changes will be needed to implement any proposed policy changes; and what administrative changes will be needed to handle any regulation changes.

There is essentially universal consensus in the Study Group and the Advisory Panel that wastewater disposed on the land in Vermont will eventually become a discharge to waters of the State, and that current State regulations should be changed to acknowledge this hydrogeologic maxim.

The complication comes when the State attempts to insert this fact into its environmental regulations, because federal law <u>requires</u> that all proposed discharges to waters of the State receive a discharge permit, which means a lengthy and detailed review of their impacts on water quality, and includes public hearings. This process has been a valuable and essential one in dealing with large-scale "point" discharges, by a pipe to a river. However, redefining all land-based wastewater disposal as discharge, including individual domestic septic systems or stormwater run-off systems for small areas might require this same review process for an enormously increased number of applications. Other states have "solved" this regulatory overload by ignoring the hydrogeologic truth -- by not classifying land-based waste disposal as discharge.

This Discharge Policy Study Group is currently wrestling with regulatory methods to provide for rapid "blanket" discharge permits for small-scale groundwater discharges, and for extensive water quality impact reviews of larger-scale discharges.

These new regulations will be proposed to the Water Resources Board this summer. If the Board accepts the proposed changes, the new regulations must then go through the Administrative Procedures Act, which involves approval by the legislature.

The Executive Committee of VGS has asked Craig Heindel to participate in this process, to the extent of determining whether any proposed regulations are in keeping with the Vermont Geological Society's purpose (as stated in our Constitution), which includes "the promotion of the proper use and protection of [Vermont's] natural resources".

Craig is updating the Executive committee and members of VGS who are consulting hydrogeologists on the course of events of the Study Group. Once the final proposed regulations are drafted, he'll be soliciting the opinion of the full membership of the Society, so that a VGS position can be clearly presented at public hearings.

Any VGS member not already on Craig's mailing list, who would like to be, can call him at 658-0820, or write him at 285 North St., Burlington, 05401. Any comments or suggestions for the Study Group would also be welcome.

Submitted by Craig Heindel

EDUCATION COMMITTEE REPORT

[Reprinted from the Special Teacher's Edition]

The Education Committee of the Vermont Geological Society was established as a permanent committee of the Society at the 1984 Annual Meeting. The purpose of the committee is to provide and disseminate geological information for the education of Vermont teachers and laypersons.

This special Education Issue of The Green Mountain Geologist is intended for distribution at the NAGT and VSTA meetings to be held in Vermont this spring. The compilation of previously published GMG articles of interest to Earth Science Teachers into this one special issue is the brainchild of our editor, Jeanne Detenbeck. The Education Committee of the Society views this publication as an excellent example of the type of interaction which should be nurtured between the Society and Earth Science teachers in Vermont.

The purpose of this column is to explore other avenues in which the Society may continue to serve the needs of elementary and secondary Earth Science teachers. The Society is presently undertaking several projects which are directly beneficial to Earth Science teachers. These activities and a few others closely related to the Society are discussed below.

A. FIELD GUIDES. As mentioned on page 24 of this issue of the GMG, the Society will be publishing the first of a series of Field Trip Guidebooks. The purpose of these publications is to enable teachers to run their own field trips with students following the road logs and rock descriptions of the guidebook. The first publication is expected out this summer and will consist of at least 4 field trips. Individual field trips may be purchased in quantity to use by students in the field or the entire set of field trips can be purchased under a single cover.

Plans are presently underway to publish previously run field trips sponsored by the Society over the past ten years. Other field trips of special interest to Earth Science teachers and hopefully submitted by Earth Science teachers could be published in the future. The Education Committee of the Society welcomes suggestions and requests for future publications of field trips of educational significance that could be sponsored by the Society.

B. GEOLOGICAL HISTORY OF VERMONT. The Society has made a commitment to publish an up-to-date summary of the geological history of the bedrock geology of Vermont. Outside of Brewster Baldwin's summary of the plate tectonic evolution of Vermont published in Earth Science (vol. 35, no. 3, Fall 1982) there exists no overview for the layperson which incorporates Vermont geology into the large-scale tectonic evolution of the Appalachian Mountain belt. The proposed publication evolves the geology of Vermont's bedrock in chronological order of its rock types and formations. Descriptions of the rocks as observed in the field are utilized to interpret the environment in which they formed and comparisons made with present day tectonic environments wherever possible. The evolution of Vermont geology involved the entire spectrum of tectonic processes which are observed on the earth today. The publication will therefore not only educate the layperson about Vermont geology but also the concepts of plate tectonics as well.

Work on this publication occupied a large portion of my sabbatical leave activities last year and has continued in spurts thereafter. In the interim period, people interested in incorporating their observations of Vermont rocks into the larger scale plate tectonics settings of the past could address their questions to this column. Perhaps enough response could be generated to make it a regular feature for future issues of the GMG. In addition, the symposium on the Geology of Vermont put together by Fred Larsen and David Westerman of Norwich University for the NAGT meeting April 20th would be an excellent opportunity for anyone interested in learning about Vermont geology.

C. WORKSHOPS AND COURSES. From time to time, courses are available which are specifically suited for Earth Science teachers in Vermont. One we strongly recommend this summer is the field-based Geology of Vermont course which will be taught by Stewart Clark. Stewart, presently on the staff of Mt. Abraham, has extensive teaching experience on both the college and secondary levels. The course is especially suited for Earth Science teachers seeking to sharpen their skills in field observations and mapping techniques as well as the layperson interested in learning more about the geology of Vermont. The course will be taught from June 24 to July 18, 8-12 noon (M,W) and 8-5p.m. (T,TH). Registration can be made through Continuing Education at the University of Vermont.

Last fall, Jeff Pelton, President of the Vermont Science Teachers Association and teacher of earth science at Springfield High School, expressed an interest of having the Society sponsor Field Geology workshops for Earth Science teachers in concert with UVM and VSTA. Discussion of the topic led to proposing that several workshops be conducted in different parts of the state over several summers. The idea that Earth Science teachers would rather participate and would clearly benefit more directly by attending workshops around their own schools is an excellent concept. Russ Agne, of the Education Department at UVM, Jeff and the Education Committee of the Society will likely pursue external funding for such a project next Fall. In the meantime, anyone interested in participating in this program either as a leader or a student should contact Jeff or Barry Doolan.

D. COMPUTERS AND GEOLOGY. Earlier this month Bill Fox, Professor of Geology at Williams College made an excellent presentation at the UVM Spring Seminar Series on the use of personal computers in introductory geological laboratories. He freely allowed copies of his programs to be made and they are available to those who could use them in their courses. Bill has a very sophisticated tutorial on tides, and others involving stereonets, plate tectonics, paleontology, and waves. These programs will be available to the public at the cost of the floppy disks through the NAGT in the near future.

Barry Doolan
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PUBLICATIONS COMMITTEE REPORT

The first VGS Guidebook (Vermont Geology, vol. 4) should be ready about June -- really. Actually, one field trip guide, Thetford Mines area, P.Q., is back from the printer already. Although the intent is to sell the guides in a complete volume, individual field trip guides will be available also. Until we can announce the complete Guidebook, Thetford Mines is available for $2.50 ppd.

This spring, a special edition of the GMG was published for distribution at two teachers' meetings in Vermont (NAGT at Norwich University, April 20 and VSTA in St. Johnsbury, May 4). Its purpose is to acquaint earth science teachers with the work of VGS and, hopefully, to gain some new members. While this special GMG contains some VGS "PR", some reprinted articles and an extensive report from the Education Committee (which has been repeated in this Spring issue, page 18), it also contains an 11 page compilation of Vermont research materials available to earth science teachers. Thanks to VGS members Diane Vanecek and Jim Ashley for providing some of the information used. While this is a limited edition, any left-over copies will be available to VGS members.

Thanks are also due to the Physics Department at UVM (Dr. Lloyd Lambert, Chairman) for the use of their new photo-copier which does a beautiful job of reducing the copy for the Guidebook.

Jeanne Detenbeck, Editor

WINTER MEETING REPORT

The winter meeting was indeed the success that the president has reported in his letter. Although Chuck Ratté will provide a document about organization for the new state bedrock map for the Summer GMG, a few words are due here about the noon meeting to discuss the revision. Rolfe Stanley noted that the Vermont map is now the oldest in New England and he thinks that VGS can do some planning, and lobbying for funds. He reported that when he was working on the Mass. map that they met in the summer to coordinate efforts of individual mapping. He thinks that it is important to publish individual work as it is done, even in black and white. Chuck Ratté noted that we need a reason to get funding for the new map, such as finding storage for high level nuclear waste or to answer environmental questions. He estimates that it costs $25,000 to get a 7 1/2 min. quad mapped. We also need the new base map from the USGS. Wallace Bothner from UNH noted that we need to lobby the legislature to show need for funds. In NH, geologists have compiled a new map independently with very little funds, but with that done, the USGS will do the printing.

The feature, **GEOLOGIC PROJECTS IN VERMONT** which was to have been concluded in this issue has been postponed to the Summer GMG due to space limitations.

EXECUTIVE COMMITTEE MINUTES 2/16/85

Barry Doolan moved that Craig Heindel be appointed to the Public Issues Committee to represent VGS on the Threshold Criteria Advisory panel that is being formed by the State to discuss the issue. He is to report back to the Executive Committee so as to allow VGS a chance to establish a position on this important question. J. Detenbeck seconded. We may need a letter to consultants about the threshold criteria to inform them of VGS participation.

The next Executive Committee meeting will be held at John Malter's, March 20. The NAGT at Norwich is to be held April 20 and VSTA day is May 4.

The treasurer recommends some names should be dropped from the mailing list. Hall, Pratt and Elliot are removed from the mailing list. The treasurer reported a balance of $1167.16.

Submitted by
Larry Becker, Secretary

DEGLACIATION OF NORTHWESTERN MASSACHUSETTS AND SOUTHWESTERN VERMONT

Bierman, Paul R., Department of Geology,
Williams College, Williamstown, MA 01267

Field mapping in the Berkshire mountains and Hoosic River valley shows that retreat of the latest Laurentide ice sheet occurred by downwasting over the highlands and stagnation-zone retreat in the valleys. Primary striations and streamlined features indicate ice flow direction from 320° to 340°, oblique to major valleys that trend north or west; secondary, low-level striations indicate valley-parallel flow. Ice contact and glacialfluvial deposits are found primarily below 1700' on lower valley walls and valley bottoms, whereas till mantles upland outcrops of schist, phyllite and quartzite. Stratified, fine-grained materials indicative of lacustrine deposition are mapped primarily below 1000'. The sequence of deposits suggests retreating ice ponded a glacial lake (Lake Bascom) in the northward draining Hoosic River valley. Melt and meteoric water spilled south into the Housatonic drainage through a 1050' spillway at the SE corner of the lake; erosion lowered this spillway to a stable 1000' level. As retreating ice uncovered successively lower outlets to the NW, the lake drained into the Hudson Valley. Although upper levels can be assigned bedrock spillways, some lower levels require the presence of ice to provide base level control.

Evidence for moraines is sparse; ice-contact zones, heads of outwash, and the position and elevation of ice marginal drainages delimit the history of deglaciation. Altitudes of non-ice contact deltas determine specific lake stages. Delta sediment volumes suggest ice retreat in the upper Hoosic valley was rapid; larger sediment volumes at lower levels suggests low level, possibly ice dammed stages were more persistent.

MINERAL OF THE QUARTER

PYROLUSITE GROUP
THE MANGANESE OXIDES

Is it a Fossil or Isn't it?

Perhaps you have found an intricate black fern-like pattern on the surface of a rock such as the Dunham Dolomite of the Monkton Quartzite and wondered if it could be a fossil. With a little research you can find that both of these rocks are Cambrian in age and land plants did not appear before the Devonian Period some 200 million years later. The mineral responsible for these black pseudo-fossils is pyrolusite, a form of manganese oxide. Water moving through rocks bearing iron and manganese minerals is drawn into minute fissures in these rocks and often leaves behind these dendritic patterns. They are black when formed from pyrolusite and brown if formed from iron minerals in the water.

We have found this mineral in a black soot-like layer in the clay varves of an old glacial lake bed now high and dry in Moscow, Vermont, where it is being excavated for road-fill for the town of Stowe. Black streaks of this mineral also appear in the Hoover Street quarry and on the dolomite exposed along I-89 on the way to St. Albans.

The pyrolusite group of minerals is very common. Their chief occurrence is in sedimentary deposits. They are often formed by the weathering of other Mn-bearing rocks and deposits and can often form greatly enriched masses after the other constitutients of the rock have been carried away by solution.

The manganese oxide minerals are used for removing the green color from glass - manganese forms a pink color in glass thus masking the green due to the presence of iron. They are also used to make numerous chemicals and dry cell batteries.

Submitted by Ethel Schuele

MEETINGS

MAY 4 **VGS SPRING MEETING**
Annual presentation of student research papers at Middlebury College. Program and abstracts page 3.

MAY 4 VERMONT SCIENCE TEACHERS ASSOCIATION
Annual meeting at the Fairbanks Museum, St. Johnsbury, VT. For more information contact: Jeffrey Pelton, Springfield High School, Springfield, VT 05156

AUG 3&4 SIXTH ANNUAL CHAMPLAIN VALLEY GEM AND MINERAL SHOW
Saturday, (10AM to 6PM) two speakers are be Charles Ratté, State Geologist who will present "A Geological Travelogue of the Caribbean" and Steven Chamberlain of Syracuse University speaking on "The Role of Microbes in the Formation of Minerals". On Sunday (10AM to 5PM) Dr. Chamberlain will speak on "The Minerals of New York State". The show will be held in So. Burlington H.S.

OCT 5 **VGS FALL FIELD TRIP AND ANNUAL MEETING**
Fred Larsen will give us a guided tour through(?) Lake Hitchcock. Banquet will be held in the White River Junction area.

GREEN MOUNTAIN GEOLOGIST
VERMONT GEOLOGICAL SOCIETY
BOX 304
MONTPELIER, VERMONT 05602

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

ADDRESS CHANGE ? Send it to the Treasurer at the address above, please.

SHELBURNE, VT
APR 23
PM

FIRST CLASS

Diane Vanecek
17 Sumner Street
Northfield, VT 05663

THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

SUMMER 1985 VOLUME 12 NUMBER 2

Go back in time with us
to the edge of an ancient sea, during a

SUMMER FIELD TRIP

"The Cambrian Platform in northwestern Vermont"
with UVM's Charlotte Mehrtens

SATURDAY, AUGUST 24, 1985

9:30 A.M.

(see page 3 for details)

CONTENTS PAGE

IMPORTANT - IN THIS ISSUE!

The State Geologist's Annual Report includes proposed legislation creating the State Geological Survey Division, budget, and program narrative.

ALSO - The organization for the remapping of Vermont's bedrock and surficial geology.

PRESIDENT'S LETTER

Dear Members;

It has been a good spring for geology in Vermont. The student paper presentation of eighteen papers covered the geologic spectrum. This annual event is becoming more popular each year. The schedule ran from 8:50 to 5:00 this year so if we have any more presenters in the future we will need an alternate schedule. I hope that we will arrange a schedule for next year that will allow participation by students from Norwich University. One disappointment I have each time I attend this event is the limited attendance of our membership. These talks are really excellent. I would be interested in any suggestions on what changes you think would make this event more attractive to you.

The legislature has passed two laws that will have long term positive effects on our environment. The underground storage tank bill and the correlative rights bill will be valuable tools in the fight to protect our ground water as they establish the legal framework to require responsible use of the resource. These bills have also created a few new positions for geologists in state government and as these people will have lots of questions I expect there will be some more consultants in business soon. The climate looks good for those of you thinking of a career move.

Just one last reminder, we are in the middle of a membership drive. The top recruiter will receive a free meal at the annual meeting October 5, 1985, and everyone who signs up at least one member will receive a MacDonald's gift certificate. We will be wrapping this up in September so you have about one month to find your meal ticket.

I hope you are having a good summer and will be able to attend the field trip on August 24, 1985.

Roger Thompson, Jr.

MEETINGS

AUG 24 — **VGS SUMMER FIELD TRIP**
see page 3

SEPT 27-29 — New York State Geological Association Annual Meeting, Saratoga Springs, N.Y. (Richard Lindemann, Dept. of Geology, Skidmore College, Saratoga Springs, N.Y. 12866; 518/584-500)

OCT 4-6 — New England Intercollegiate Geologic Conference, annual meeting and field trips (Robert Tracy, Dept. of Geology and Geophysics, Yale University, New Haven, CT. 06520; 203/436-1188).

OCT 5 — **VGS FALL FIELD TRIP AND ANNUAL MEETING**
Fred Larsen will give us a guided tour through(?) Lake Hitchcock. Banquet will be held in the White River Junction area. Details in Fall GMG out in mid-Sept.

SUMMER FIELD TRIP

TOPIC: The Cambrian Platform in northwestern Vermont

LEADER: Charlotte Mehrtens, University of Vermont

DATE: SATURDAY, AUGUST 24, 1985

TIME OF DEPARTURE: 9:30 A.M.

ASSEMBLY POINT: Department of Geology (Perkins Hall), University of Vermont. Park in the lot adjacent to Perkins Hall off Colchester Ave. Car pooling can be arranged from here if necessary.

FIRST STOP: The quarry on Route 2 just east of the Sandbar Wildlife Refuge and causeway to South Hero.

LUNCH: We will be at Salmon Hole (parking area can be seen on Riverside Drive, Burlington (Routes 2 & 7) a few hundred feet from the Winooski Bridge). Bring a brown bag lunch or climb the hill to the deli on Colchester Ave.

LAST STOP: The trip will end at a field stop in St. Albans.

The purpose of this field trip is to visit selected outcrops of the Cambrian platform (Dunham, Monkton, Winooski and Danby Formations) and adjacent basinal sequences (Rockledge and Skeels Corners Formations) in northwestern Vermont. Stops chosen for this field trip illustrate the criteria used to determine the depositional environments of each unit. The field trip will also stress how facies distribution and thickness variations have been used to reconstruct Cambrian platform geometry in northwestern Vermont.

Copies of the preliminary guide for this field trip will be available at cost on the day of the trip.

VGS BUSINESS & NEWS

NEW MEMBERS

The following new members were accepted at executive committee meetings held since the Spring GMG was published:

Vincent DelloRusso	N. Williston, VT
Nancy Huelsberg	Worcester, VT
David Schermerhorn	Poultney, VT
Sharon Tangerman	Burlington, VT
Glen Harrington	Norwich University

COMMITTEE ON NOMINATIONS

The Committee on Nominations, Craig Heindel, Winslow Ladue and Jack Drake, has submitted the following slate of candidates to be elected at the Fall 1985 annual meeting:

President	Steve Goldberg
Vice President	Carolyn Merry
Secretary	Charlotte Mehrtens
Treasurer	Dave Westerman
Board of Directors 2-year term	Steve Revell

SPRING MEETING REPORT

There were nineteen student papers presented at the spring meeting of the Vermont Geological Society. The papers ranged in topic from the warm waters of the Jamaican coast to deglaciation of Hoosic river valley. The judges, Dave Westerman, Alan Liptak and Shelley Snyder, chose as the best student presenters Paul Bierman, Williams College, Deglaciation of Northwestern Massachussetts and Southwestern Vermont, and Douglas Hillman, University of Vermont, The Rockledge Formation: A possible carbonate slope deposit. The judges felt that three other papers should recieve honorable mention. They are Crispin Prahl, University of Vermont, Bedrock geology of the western Lincoln massif and associated cover rocks, Ripton, Vt; Denah Lohmann, Middlebury College, Paleoecology and diagenesis of uplifted Pleistocene reefs, north coast of Jamaica, W.I.; and Joshua Klein, Middlebury College, Measurements of submarine sediment creep in three channels, Jamacia, W.I.

Submitted by Shelley Snyder

REMAPPING VERMONT

Proposed Organization for Remapping Vermont's Bedrock and Surficial Geology

Director: Charles A. Ratté, Vermont State Geologist

Advisory/Project Review Committee:
- Rolfe Stanley, U.V.M.
- Fred Larsen, Norwich
- Norm Hatch, U.S.G.S.
- Chris White, Consultant
- Charles Ratté, State Geologist, ex-officio

Regional Project Coordinators - responsibilities include:
- a) developing geologic study/mapping plan for assigned region
- b) final compilation of regional map and state map
- c) coordination and communication among project supervisors and field mappers in region.

Project Supervisors - responsibilities include:
- a) develop and staff individual geologic study/mapping projects within a region or regions
- b) directly responsible for work of field mappers and final products of individual projects
- c) maintain close communication with the regional coordinator.

Regions	Coordinators
Eastern Vermont Silurian-Devonian N of north end of Chester Dome	Norm Hatch
Eastern Vermont S of 43° 45' latitude E of 72° 45' longitude	Chris Hepburn
Central Vermont Pre-Silurian Metamorphic Complex Lamoille River and Missisquoi River Transects	Barry Doolan
Central Vermont Pre-Silurian Metamorphic Complex White River and North to Winooski and Lamoille River Transects, including Lincoln Precambrian massif	Rolfe Stanley
Central Vermont Glens Falls 1° x 2° area	Jim Thompson
Central Vermont Green Mountain Precambrian and adjacent areas South of 43° 5' latitude to Mass. border, including Taconic Region	Nick Ratcliffe
Western Vermont Carbonate Platform	Charlotte Mehrtens
Other Topical Studies	
Taconian Line Corridor	David Westerman
Metamorphic Petrology	Jo Laird
Isotopic Studies	John Sutter
Economic Geology	

Note: Individuals may serve in several positions. For instance a regional coordinator may actually supervise and conduct his own individual field mapping projects in conjunction with his coordinating responsibilities.

All projects will be reviewed and approved by the advisory committee. Each project should be designed with a maximum two year completion time. Each project will be expected to produce a map product at a scale of 1:25,000 or larger capable of being published in a black and white format. The map should be accompanied with a descriptive text of the geology of the area covered.

5 year plan for COGEOMAP cooperation 1985 to 1990

	PROJECT(S)	VT. INPUT	U.S.G.S. INPUT
1st year 1985-85 (FY85) Completed	Northfield Quadrangle		
	Surficial	2000	
	Bedrock	2000	
	Southern Vermont Project	2000	
		$6000 Total	$6000 Total
2nd Year 1985-86 (FY86)	Northfield Quadrangle Southern Vermont Project Gilson Mount Quadrangle Western Vermont Carbonate Project		Equivalent time, etc. involving services of Nick Radcliffe starting regional study.
		$9000 Total	Total $ equivalent = $9000
3rd & 4th Years*	Additional projects depend on submittals and approvals	$20,000 Total	Equivalent in U.S.G.S. personnel, i.e. the involvement of Nick Ratcliffe approaches full time.
5th & 6th Years*	Additional projects depend on submittals and approvals	$30,000 Total	Equivalent in U.S.G.S personnel, i.e., the involvement of Nick Ratcliffe approaches full time.

* Increases depend on Agency priorities and Budget Guideline restrictions.

STATE GEOLOGIST'S ANNUAL REPORT

LEGISLATION

The legislation, to officially create the Vermont Geological Survey as an integral division within the Agency of Environmental Conservation, and to update and coordinate all previous legislation pertaining to the State Geologist, stalled in the House Government Operations Committee. This bill, **H.81** will be reintroduced to the 1986 General Assembly. This bill is printed in its entirety in this issue of the GMG for your scrutiny. Any comments or suggestions you might have should be sent to:

Office of the State Geologist
State Office Building Post Office
Agency of Environmental Conservation
Montpelier, VT 05602

H.81

Introduced by Mr. Faris of Barnet

Subject: Executive; the state geological survey division; creation

Statement of purpose: This bill proposes to establish the state geological survey division within the agency of environmental conservation; to provide that the state geologist shall be director of the division; and to revise and update the statutes relating to the state geologist.

AN ACT RELATING TO THE STATE GEOLOGIST

It is hereby enacted by the General Assembly of the State of Vermont:

Sec. 1. 3 V.S.A. § 2802(a)(7) is added to read:
(7) The state geological survey division.

Sec. 2. 3 V.S.A. § 2854(d) is added to read:
(d) After consultation with the executive committee of the Vermont Geological Society, the secretary shall appoint the state geologist who shall be director of the state geological survey division.

Sec. 3. 3 V.S.A. § 2879 is added to read:
§ 2879. GEOLOGICAL SURVEY DIVISION
The state geological survey division is reconstituted within the agency of environmental conservation. The state geological survey division shall coordinate and conduct the geological work of the agency of environmental conservation including the enhancement and support of earth resource related programs conducted by the agency. The state geological survey division shall conduct earth science research for the agency of environmental conservation.

Sec. 4. 10 V.S.A. § 105 is added to read:
§ 105. FUNDING; COOPERATIVE PROGRAMS; CONTRACTS AND GRANTS
The state geologist shall submit a separate budget to the secretary for the geology programs within the budget of the agency of environmental conservation. The state geologist, with the approval of the secretary, may enter into cooperative programs and contracts, and accept grants in behalf of the state for the purpose of conducting and continuing the topographic, geologic, and mineral resource mapping of the state and related research.

Sec. 5. 10 V.S.A. § 106 is added to read:
§ 106. PUBLICATIONS AND RECORDS OF THE STATE GEOLOGICAL SURVEY
The state geologist shall maintain the highest possible quality of geologic work conducted for the state and shall, with the approval of the secretary, select those works that are worthy of publication. The state geological survey division shall make available to the public on a regular basis results of the scientific work being conducted by its personnel. The state geologist shall prepare a biennial report of the activities of the state geological survey division.

Sec. 6. 10 V.S.A. § 107 is added to read:
§ 107. RESPONSIBILITIES
The state geological survey division shall:
(1) provide for a continued and improved survey of the geology, mineral resources, and topography of the state;
(2) provide geologic information, consultation and education to government, industry, and other institutions, organizations, and citizens regarding the state;
(3) provide scientific and technical information and advice regarding the management of mineral resources on state owned lands; and
(4) cooperate , where possible, by providing geologic expertise and advice to those conducting regulatory programs for the state.

Sec. 7. TRANSITORY PROVISION
The position of state geologist shall be a classified position subject to the rules and regulations of the classified personnel system , under 3 V.S.A., chapter 13. The state geologist in office at the time of the effective date of this act shall continue in office, in a classified position of comparable salary.

Sec. 8. REPEAL
3 V.S.A. § 2877(c) (relating to appointment of the state geologist); and 10 V.S.A. §§ 101, 102, and 104 (relating to geologic surveys and reports) are hereby repealed.

BUDGET

The 1985 expenditures and the 1986 budget for the State Geologist's Office are presented in aggregate form below:

	FY 1985 (actual) year completed 6/30/85	FY 1986
REGULAR PROGRAM		
Personal Services (includes salaries for permanent, temporary and contractural employees)	$ 49,000.00	$ 59,000.00
Operational	5,000.00	7,000.00
U.S.G.S. Cooperative Programs (topographic mapping and slope stability project)	13,000.00	10,000.00
Encumbered Funds	3,000.00	
Subtotal	70,000.00	76,000.00
D.O.E. HIGH-LEVEL RADIATION WASTE GRANT		
Contractural Services	30,000.00	37,000.00
Operational	14,000.00	33,000.00
Indirect costs	5,000.00	
Subtotal	49,000.00	70,000.00
U.S.G.S. MINERAL RESOURCE DATA SYSTEM GRANT		
Personal Services	11,000.00	7,000.00
Operational	5,000.00	3,000.00
Indirect costs	3,000.00	
Subtotal	19,000.00	10,000.00
Total Expenditures	$138,000.00	$156,000.00

FISCAL YEARS 1986/1987 BUDGET
PROGRAM NARRATIVE

Regular Program

A. DESCRIPTION OF THE PROGRAM

1. Mission and Structure

The goal of the State geological organization is to provide the best, most contemporary, most accurately analyzed and interpreted geological information possible to those who seek and require such information. The State Geologist was first appointed by Governor William Slade in 1844 under the authorization of Public Act No. 12 - An Act to Provide for a Geological Survey of the State. The initial duty of the State Geologist as stated in Section 3 of this Act "to commence and prosecute a thorough geological survey of the State" ...continues to be the mission of the State Geologist. Although outmoded by modern necessity (and in need of revision) Sections 101 through 104 of 10 V.S.A. Chapter 7 describe the mission and duties of the State Geologist. This legislation authorizes the State Geologist to enter into contracts with the U.S. Geological Survey for the purpose of producing topographic maps. The most current legislation (3 V.S.A. Section 2877(c) Chapter 51) places the State Geologist in the Planning Division of the Agency of Environmental Conservation and states that "the state geologist shall be appointed by the Secretary, with the advice of the Vermont Geological Society. The position shall be an exempt position." Effective September 1, 1983 by order of Brendan Whittaker, Secretary, Agency of Environmental Conservation (memo dated 8/31/83) the position of State Geologist was transferred to the Secretary's Office.

Historically the position of state geologist was held as a part-time duty of the Chairman of the Geology Department at the State University. In 1976 the position became full-time and the office was moved from the University at Burlington to the Agency of Environmental Conservation in Montpelier. Whereas research was the main focus of the position prior to 1976 the attempt now is to recognize the need for continued research and field studies but also to infuse the knowledge gained from research into the line (applied) functions of this and other agencies of government. The program has also become more responsive in recent years to the needs of private industry and the general public. Thus the goal of the State Geologist's Office is to strike a balance between meeting the immediate needs of the applied sciences and at the same time keep the information base current through continued research, field and laboratory studies.

Requests for geological information emanate from every segment of the population ranging from those requiring information regarding the proper soils for on-site sewage disposal to those concerned about locating a high-level nuclear waste repository.

In order to accomplish the stated mission (goals) of a state geological organization the Vermont State Geologist's program is structured to conduct the following major activities:

ADMINISTRATIVE, EARTH RESOURCES, GEOLOGIC FIELD STUDIES, TOPOGRAPHIC MAPPING, GROUND WATER ADVISORY, SPECIAL PROJECTS.

For details and sub-program activities information the State Geologist's Office maintains a 10-year plan schedule. Interested parties may obtain a copy of this schedule on request.

The program is currently staffed by the State Geologist (full-time, appointed position), one staff geologist/information officer (temporary), two consultants (supported by special grants - D.O.E. and U.S.G.S.) and a shared secretary.

2. Program Goals and Performance Measures

The State Geologist's Office does not perform a regulatory function. Vermont's State Geologist Office provides geological services and information (regarding Vermont geology) to federal, state and local government, industry and the general public. Geologic information must be gathered through research, field and laboratory studies. The goal a state geological organization must achieve is that of maintaining a program involving multiple projects devoted to the acquisition of the best possible geological information by applying the most modern geological concepts and technologies in a continuous effort to understand the complexities of the natural environment. There has been no major effort for 20 years to improve the geological base for Vermont.

Current decisions are being made on geologic information gathered, mapped and interpreted in the 1950's and 1960's. It is time (long overdue) to look at Vermont's geologic framework anew employing the theories and concepts that have developed in the past 10-15 years, to involve new, young, vigorous professionals whose expertise far exceeds that of his predecessor and whose abilities to employ new technologies are real and ready to go to work.

Geological mapping programs with ever-increasing detail and the incorporation of third (in depth) dimension information are critical in order to meet the demands for geological information required for modern day decision making. A geological survey must include all subdivisions of geological information gathering: bedrock and surficial deposits, structural geology, metallic and non-metallic ore mineral potential, geohydrology, fossils, metamorphism, earthquake potential, engineering and slope stability studies, and interpretation of geologic history and crustal stability.

Indicators of success or failure of the performance of geological work fall into two categories, one is production and the second is the utility of the geologic product. The product is the geological publication, the map, the laboratory results, the interpretation, descriptions, anaylses, recommendations. The utility of the product can be measured to some degree in

the popularity of sales and requests for information. There has been very little State support for publications in the past 10 years or more yet publication sales over the past 5 years has doubled. No long term records have been kept regarding requests for geologic information, however in recent years an attempt has been made to account for all phone, mail and walk-in type requests. Requests run in the neighborhood of 5-10/day. Time consumed in answering requests varies from a few minutes in a phone conversation to several hours preparing and compiling information for a major user. Our temporary geologist, Diane Vanecek, has been assigned the position of "information officer" and most of her time is consumed in providing information type services.

Interest in Vermont geology by industry, federal government, etc. is an indicator of the success or failure of a geological program. Recent figures released by the U.S. Geological Survey show the following expenditures in Vermont (in thousands of dollars):

	Actual FY'82	Estimated FY'83	Estimated FY'84
January 1983	1778	1801	2321

	Actual FY'83	Estimated FY'84	Estimated FY'85
January 1984	2518	2278	2155

3. & 4. Environment, Trends, Problems, Opportunities

Much of what has been accomplished to date (i.e., in my tenure of office as the State Geologist, September 1976 to present, 8 years) has been accomplished "by going public", by letting people know we exist, by making our services available wherever and whenever they have been needed. Trying to develop a viable budget that will allow more than day to day survival has been difficult with the restrictions placed on budget increases by past administrations. With the help of outside funding some additional accomplishments have been made. I am now convinced that in order to accomplish my goals, the goals that should be the state's goals, will require the provision of sufficient state funds that can be used to attract additional (in at least equal amounts) federal or other outside funds. Our performance so far can best be described as a "fight to stay alive". Unless the state is willing to commit itself to a progressive geological program there is little need for a State Geologist Office because it can no longer honestly conduct business as usual with a 20-year old data base. Such an office will gradually become a hoax and an embarassment to the State. Major challenges face the State that will require the best possible geological information on which important, critical decisions must be made, to name a few:

> proper protection of Vermont's groundwater; proper disposal of waste including domestic, hazardous, low and high-level nuclear; protection of mountain-side development from landslide hazards; control of erosion and sedimentation; protection and environmentally compatible development of the State's mineral resources.

(High-Level Nuclear Waste (HLW) Grant

1. Mission and Structure

a. Purpose: The program exists because the Federal Department of Energy (D.O.E.) under the authority of P.L.97-425, The Nuclear Waste Policy Act of 1982 is searching for a high-level nuclear waste repository site in 17 states in the eastern U.S.A. Vermont is one of those states. The Nuclear Waste Policy Act provides funding to involved states if they wish to develop a program to keep abreast of (overview) developments as the federal search progresses. Vermont, through the State Geologist's Office has chosen to maintain an overview program utilizing available D.O.E. (federal grants).

b. History: The D.O.E. search for a HLW repository in crystalline rock actually started in 1981 prior to the passage of P.L.97-425. Vermont made its first application for funding an overview program in May, 1981. The Joint Fiscal Committee approved the first grant for $53,000.00 on October 23, 1981. The program has continued through supplements to the original grant by D.O.E. amounting to an additional $52,000.00.

c. Population Served: This program is of interest to every citizen of the State. At this point in time the program has advanced to what is termed the "Regional Characterization Phase". My superiors and the Vermont State Nuclear Advisory Panel have chosen to not involve the public through informational meetings, etc. However, all program documents that have reached the "final" form are public documents. The "Area Characterization Phase" is scheduled to begin in September, 1985. If Vermont is selected for area level studies actual field work will be conducted in the state. The public interest will be very evident at this juncture.

d. Major Activities: The major activities are listed below and described in item (1) on Form 15 where the Consultant/Coordinator duties are outlined:

1. Attendance at all D.O.E. informational and working group meetings; usually 5/year.
2. Review of all geologic, environmental, screening methodology, etc. reports.
3. Organization of review and response process.
4. Developing State recommendations.
5. Publishing appropriate geologic reports.

e. Subprograms: None

f. Organization and Staffing: The program director is the State Geologist. He is assisted by a part-time Consultant/Coordinator who is under contract to the state. Subcontractors are hired as needed for expert review or other tasks. The State Geologist reports directly to the Secretary of the Agency of Environmental Conservation,

and as directed by the Secretary to the Vermont State Nuclear Advisory Panel.

2. Program Goals and Performance Measures

a. Major Goals: The goal is to be continually informed regarding the progress of the HLW program, particularly as it affects the State of Vermont. The program also intends to infuse State interests and concern into the program with the intent to influence technical decision in a direction favorable to protecting the state's environment, and the health and safety of its citizens. To date our input to the Siting Guidelines (along with 16 other states) has influenced significant changes particularly in those guidelines related to the geohydrology of crystalline rocks, and the influence of earthquakes and faults on the structural integrity of a repository.

b. Performance Indicators:

1. Final draft of D.O.E. Siting Guidelines as approved by the Nuclear Regulatory Commission (N.R.C.).
2. Final draft of the Regional Geologic and Environmental Characterization Reports.
3. Final draft of the Region-to-Area Screening Methodology Document.
4. D.O.E. Mission Report.
5. Final draft on Area Recommendation Reports.

These critical reports have been, are in the process of being, or will be reviewed by the principals of this program. Our comments and recommendations for revision will have a significant bearing on how the Federal Program affects Vermont.

3. Environment and Trends

This Federal Crystalline Rock Program should have an overwhelming effect on the social, economic, political, environmental, demographic concerns of the state. If Vermont reaches the "Area Characterization Phase" (and it is quite likely in my opinion that it will) the HLW issue could be the major issue facing the governor and legislature in the late 1980's. The Regional Characterization Phase has identified 12 crystalline rock areas within the state that have characteristics of interest to the project. The screening methods so far lean heavily toward areas of low population, transportation access, and little or no federal or state parks and recreation areas. Several of the 12 areas in Vermont have proper rock characteristics fit the favorable screening criteria.

4. Problems and Opportunities

The major problem this program faces is one of keeping technical issues free of political influence. At this point in time, the program is attempting to conduct the best possible technical evaluation and has been successful in steering clear of the political pressures. At the same time, decision makers

(i.e., those in politically oriented branches of government) should be kept informed. The State Geologist reports the progress of the HLW to the Secretary of the Agency of Environmental Conservation and the Vermont State Nuclear Advisory Panel.

Mineral Resources Data System Grant

1. Mission and Structure

The purpose of this grant is to develop a complete, accurate file for the metallic mineral deposits of the State of Vermont. The data will be entered on the Mineral Resource Data System computer at the U.S. Geological Survey's National Center in Reston, Virginia. The data will remain on file in the State Geologist's Office. The computer system is "user friendly" and the data can be accessed by government, industry, etc.

2. Purpose of New Budget Request

The purpose for seeking additional funding in FY 85-86 is to extend the data gathering to the non-metallic resources of Vermont so as to complete the file on all of Vermont's mineral resources.

This is the first opportunity the State Geologist's Office has had to gather in one, easily accessible format all of the basic mineral resource information for the state. The information file includes:

a. Mineral commodity;
b. Nature of the deposit, i.e., vein occurrence, disseminated, limestone replacement, etc.;
c. Land ownership;
d. Mineral rights ownership;
e. Geologic setting; and
f. Economic potential.

3. History

The first grant was approved by the Joint Fiscal Committee on February 22, 1984. The program started in June, 1984. The first phase (metallic mineral occurrences) will be completed in December, 1984. The second phase (non-metallic mineral occurrences) to be supported by this second grant request is intended to start in January, 1985 and be completed in December, 1985.

This first grant was operative for 2 weeks on FY 84 and will be completed in FY 85. The program had not been previously budgeted.

Charles A. Ratté
State Geologist

GEOLOGIC PROJECTS IN VERMONT

This is a continuation of the listing of geologic projects in progress in Vermont which appeared in the Fall 1984 and Winter 1985 issues of the GMG . Before the USGS project list is completed, however, we want to mention two new projects which are being financed by the Vermont Geological Survey:

Western 1/2 of the Gilson Mt. Quadrangle, northern Vermont; Barry Doolan, University of Vermont.
Northwestern Vermont Lithofacies Study, St. Albans to Highgate Springs; Charlotte Mehrtens, University of Vermont.

U.S.G.S. GEOLOGIC DIVISION ACTIVITIES IN VERMONT

This completes the listing and includes updating (as of July 15, 1985) of some projects listed previously. Note that the Vermont State Geologist has the complete listing including the project numbers should you be interested. Dates listed are start/estimated completion.

REGIONAL GEOLOGIC ACTIVITIES

Lewiston 2-degree Quadrangle, Maine, New Hampshire, and Vermont; N. L. Hatch, 1978/1985. A geologic map of the Lewiston 2-degree quadramgle will be submitted to formal publication in FY 1985.
Postglacial Uplift in the Northeast United States; Carl Koteff, 1981/1985. An uplift profile of glacial Lake Hitchcock in Connecticut, Massachusetts, New Hampshire, and Vermont of over 250 km has been established, along with definition of 5,000 year delayed response to uplift that began about 14,000 years B.P.
Geology of the Glens Falls 2-Degree Quadrangle (CUSPMAP); J.B. Thompson, Jr., 1982/1985. Field work was begun in FY 1983 to resolve stratigraphic and structural problems in critical areas of the Glens Falls quadrangle.
Thickness and Character of Glacial Overburden (Dakotas to New England) (R); D.R. Soller, 1983/1986. During FY 1985, the drafting of both the surficial geology and the thickness contours will be completed for the eastern part of the study area.
Geochronology, and Igneous Petrogenesis (R), J. G. Arth, 1981/continuing. Studies will focus on post-tectonic plutons along a transect of the major tectonic units of northern New England. Plutons of northern Vermont, northern New Hampshire, and southern Maine will be examined to determine their crystallization age, cooling history, petrologic and chemical character, isotopic signatures and potential mineral resource potential. These studies should clarify the internal fractionation history of the magmas, the nature of the source terranes, and the isotopic character of the crustal blocks underlying the plutons. Rb-Sr geochronology studies of four plutons in northern Vermont will be completed and geochemical studies will continue.

Paleozoic Conodont Studies, Appalachian Basin; A. G. Harris, 1983/1985. Laboratory studies and biostratigraphic and biofacies analysis of recovered conodonts will be conducted on previous sample collections. Revised conodont alteration index maps of the Appalachian basin will be compiled.

Exposed Crystalline Rocks of the Eastern United States as Potential Hosts for Radioactive Waste Repositories; N.J. Trask, 1982/1987. This project has been expanded, at the request of the Department of Energy, to review detailed compilations of the geology and hydrology of the North-Central, Northeastern and Southeastern United States in order to develop an exploration strategy for the study of crystalline rock masses for radioactive waste disposal.

Devonian Rocks of the Connecticut Valley Trough, Vermont; N.L. Hatch, 1985/1989. Fieldwork in the Randolph and Woodstock 15-degree quadrangles has determined that the western belt of the Gile Mountain Formation is indeed stratigraphically as well as structurally above the surrounding rocks of the Waits River Formation.

GEOCHEMICAL AND GEOPHYSICAL ACTIVITIES

Tectonics of New England; Warren Hamilton, 1981/1983.

Central and Eastern U.S. Tectonics; M. F. Kane, 1982/1983.

Geophysical Analysis of Glens Falls Quadrangle; D. L. Daniels, 1982/1986.

Radiometric Age Data Bank (R); R. F. Marvin, 1981/1986.

Sherbrook-Lewiston 2-Degree Quadrangle, New Hampshire-Maine-Vermont Geophysics (CUSMAP); F. C. Frischknecht, 1979/1984.

Remote Sensing of Glens Falls 2-Degree Quadrangle; N. M. Milton, 1981/1984.

EARTHQUAKES, VOLCANOES, AND ENGINEERING STUDIES

Analysis of Landslide Mapping in the United States; E. E. Brabb, 1982/1987. Landslide inventory and landslide susceptibility maps for one or two states (Illinois, Oklahoma, Vermont, Missouri and Montana are leading candidates) will be prepared as models for other states.

Probabilistic Estimation of Long-Term Earthquake Ground Motion in the Eastern United States; S. T. Algermissen, 1982/1985. Seismic sources concentrated in linear trends or very small areas and source areas in which large, low-angle ruptures occur will be addressed in this effort.

Slope Stability, Green Mountains, Vermont; C. A. Baskerville, 1983/1985. Field vane shear penetrometer tests were run in FY 1984 on over two dozen slides in Hardwick, Caledonia County and Castleton, Rutland County, and numerous locations in Windsor County. Most of the work was concentrated in Windsor County, including numerous slides around the reserviors of the North Hartland and North Springfield flood control dams. Collected samples are being analyzed

Geology of Interactions Among Volcanoes, Glaciers, and Water, R. B. Waitt, 1984/1987. Reconnaissance investigations will be underway in the Green Mountains, Vermont, and White Mountains, New Hampshire. Samples were collected in Vt.

Repeat Magnetic Surveys; J.D. Wood, 1973/continuing. Repeat magnetic surveys were completed in FY 1984 in Burlington, Vermont.

Mechanics of Rock Slope Movement in New England; F.T. Lee, 1985/1989. A literature search for geological information on rockslides and rockfalls in the Cheshire Quartzite and schists of the Underhill Formation in western Vermont, rock units that are landslide prone on a regional basis will be conducted in FY 1985. Known or suspected unstable rock slopes will be deliniated on airphotos and topographic base maps and inspected. Displacement monitoring and tiltmeter equipment and piezometers and precipitation gages on two or three critical slopes will be installed. Detailed structural measurements at monitoring sites, periodic readings of monuments and gages, and initial evaluation of measurements will be in progress. Structural and monitoring data will be plotted on appropriate maps, cross sections, and graphs. Liason with concerned individuals and agencies, particularly the Vermont Geological Survey and the Vermont State Forest and Parks Department will be developed and maintained.

Materials Effects of Acid Rain; Malcolm Ross, 1984/1990. The objective is to determine the mineralogical changes in building stones that have undergone exposure to various geochemical weathering processes for various periods of time. Shelburne Marble quarried near Danby, Vermont and sawn at Proctor, Vermont is one stone being used. Prepared slabs were placed at weather monitoring stations in Raleigh, N.C., Washington, D.C., Chester, N.J. and Huntington Wildlife Forest, N.Y. Whole rock and X-ray refraction surface chemical analyses will be used as controls. In addition analysis of all mineral components will be made. It will be important to characterize the silicate inclusions within the stone (layer silicates, pyrite, etc.) that appear to be points where particularly destructuve weathering takes place.

MINERAL RESOURCES ACTIVITIES

Geochemical Exploration in the Glens Falls 2-Degree Quadrangle (CUSMAP); K.C. Watts, 1982/1986. A zone of strong base- and precious-metal anomalies in stream-sediment concentrates have been found parallel to the talc-belt on the east flank of the Green Mountain anticlinorium. The belt of anomalies covers a considerable distance; it will be further investigated in 1985. Gold has been found in panned glacial tills south of the syenitic pluton of Mt. Ascutney.

Massive Sulfides of New England; J.F. Slack, 1979/1985. Chemical and isotopic (oxygen, hydrogen, boron) studies on tourmalinites from massive sulfide deposits and tourmalinites in Vermont will continue in 1985. Reports being prepared: gold in stream sediments from the Orange County copper district, east-central Vermont; mantle lead in the massive sulfide deposits of Orange County, Vermont; and lead-isotopic studies and gold content of New England massive sulfide deposits

Mineral Resource Appraisal of Glens Falls 2-Degree Quadrangle; J.F. Slack, 1982/1986. Topical geologic studies of Elizabeth copper, Cuttingsville gold and Brandon lead-zinc in Vermont will continue.

Diagenesis of Authigenic K-Feldspar in Lower Paleozoic Carbonate Rocks of the Appalachian Basin; P.P. Hearn, 1985/1986. Sampling is planned in Vermont.

Sherbrooke-Lewiston 2-Degree Quadrangle, Maine- New Hampshire-Vermont (CUSMAP); W.A. Bothner, 1979/1985. Significant was a resampling of fossil-bearing low-grade metamorphic rocks that provided a suite of far better preserved graptolites. Those specimens, never before recognized, are now being examined, and have the potential of requiring major stratigraphic and structural revision in the Connecticut Valley-Gaspe Synclinorium. Additional geologic and geophysical work is planned in FY 1985 in the northern and central metavolcanic belts along the Connecticut River. New isotopic ages and detailed mapping, with complimentary magnetometer traverses, will be used to subdivide a previously considered single metavolcanic belt. Equally important is the determination of the extent of the metasedimentary rocks, using these newly found fossils, within the Connecticut Valley-Gaspe Synclinorium in both northeastern Vermont and westernmost New Hampshire.

ENERGY RESOURCES AND MARINE ACTIVITY

Uranium Resources in Plutonic Rock, Northeastern United States (R); E.L. Boudette, 1981/1985. Consultation services to a New England medical-geological consortium investigation on the human tolerance of isotope 222 radon levels in ground-water supplies will continue.

REPORTS PUBLISHED BY THE U.S. GEOLOGICAL SURVEY

Mineral resource potential map of the Lye Brook Wilderness, Bennington and Windham Counties, Vermont, R. A. Ayuso and D. K. Harrison, 1984.

Zinc, lead, and barite deposits occurring in Paleozoic rocks, east-central United States, S. H. B. Clark and C. L. Neeley, 1983.

Trace element analyses of tourmalines from Appalachian-Caledonian massive sulfide deposits, N. M. Conklin and J. F.Slack, 1984.

Correlation chart for Precambrian rocks of the Eastern United States, D. W. Eankin and others, 1983

Geochemical analyses of samples from the Bread Loaf Roadless Area, Washington and Addison Counties, Vermont, M. S. Erickson and others, 1984.

Index faults of Cretaceous and Cenozoic age in the Eastern United States, D. C. Prowell, 1983.

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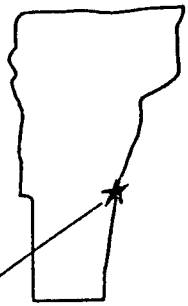
THE GREEN MOUNTAIN GEOLOGIST



QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

FALL 1985 VOLUME 12 NUMBER 3

The date has been changed
but the field trip is the same!!

FALL FIELD TRIP

GLACIAL HISTORY OF THE
HARTFORD-HARTLAND-LEBANON AREA, VT-NH
with Fred Larsen, Norwich University

Saturday, OCTOBER 19, 1985 9:30 A.M.

Meet at McDonald's on RT 12A, West Lebanon.
See page 3 for details, page 4 for an introduction.

ANNUAL BANQUET & MEETING

6:30 PM Dining Room, Holiday Inn, White River Jct.

IMPORTANT:
We need your banquet reservations by **OCTOBER 16.**
See page 9 for dinner menu and reservation information.

CONTENTS PAGE

PRESIDENT'S LETTER

Dear Members;

The annual meeting is upon us once again. October 19th we will have a great field trip along the Connecticut River to explore the remains of Lake Hitchcock, which will be followed by the annual meeting and banquet at Holiday Inn. We did have to, at the last minute, change the date of the meeting to avoid a conflict with N.E.I.G.C. which changed their date after our calender had been set. I know this will disrupt your schedule and hope that you will still be able to attend.

Dave Westerman won our membership contest. The membership drive helped us add 22 new members for 1985 compared to about eight in each of the past two years. This is a good start and if the rate can be sustained, it will allow our organization to grow and better serve our members' needs. We have begun some ambitious publishing projects of field guides which strain our resources. As a larger organization the projects would be easier to handle, so keep up the good work.

One problem the executive committee has been dealing with recently is our finances or the lack of them. We have invested much of our bank balance in publications which we find sell slowly. There seems to be a demand for this information and we expect to sell most of our stock but as we add more items to our stock we tie up more and more of our capital. We want to discuss ideas at the annual meeting for dealing with this problem. Suggestions so far include raising dues, seeking sustaining corporate memberships, selling minerals and publications at the gem show, and having a raffle with a nice mineral as the prize. Please come to the meeting with some thoughts on how the Society should proceed.

See you at the field trip.

Roger Thompson, Jr.

FALL PROGRAM

TOPIC: Glacial History of the Hartford-Hartland-Lebanon Area, VT-NH.

LEADER: Fred Larsen, Norwich University

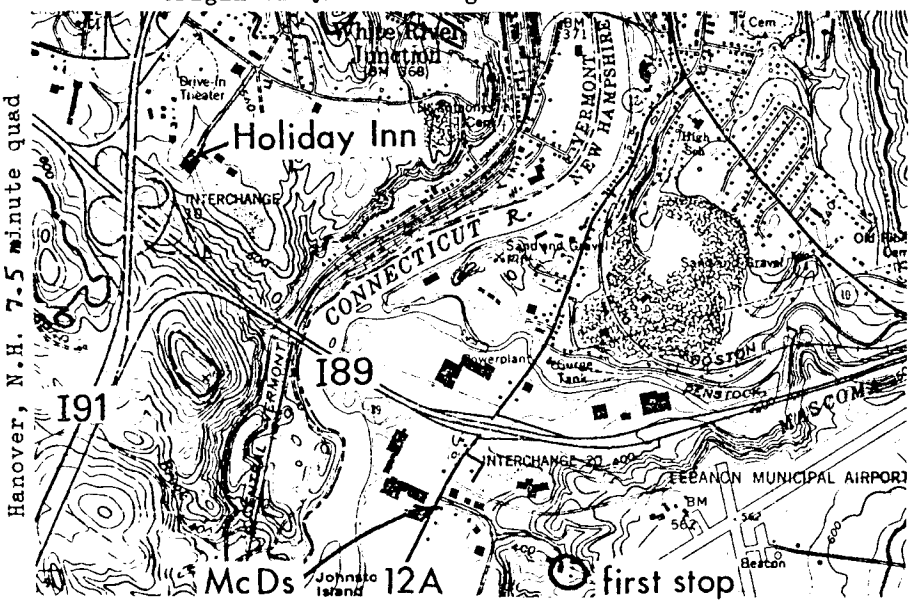
DATE: SATURDAY, OCTOBER 19, 1985

TIME OF DEPARTURE: 9:30 A.M.

ASSEMBLY POINT: East end of the parking lot at McDonald's Restaurant on N.H. RT 12A, 0.25 of a mile south of Exit 20, I-89, West Lebanon, New Hampshire.

FIRST STOP: Located 0.4 of a mile ESE of McDonald's. We will be there at least one-half hour.

TOPICS: Glacial Lake Hitchcock, Connecticut Valley esker, origin of Quechee Gorge.



DIRECTIONS TO BANQUET: From either I-89 or I-91 take the White River Junction Exit. Proceed east from the exit 200-300 yards to the first set of lights. Turn south on Sykes Avenue. Go about 300 yards and turn west at the **Holiday** Inn sign.
From White River Junction go south on Route 5 towards the Interstate and turn as described above.
Note: If you find Howard Johnson's you are WEST of I-91!!

5:30: Social Hour
6:30: Dinner in dining room of Holiday Inn at White River Junction. Please make reservations - page 9.
7:30: Annual meeting in the Depot Room.

SEE PAGE 9 FOR BANQUET RESERVATION INFORMATION.

The following article is reproduced as an introduction to Fred's fall field trip. It is reprinted with permission from Window of Vermont, Summer 1985, a travel magazine published in Woodstock, Vermont.

THE LAST GREAT ICE SHEET AND THE ORIGIN OF QUECHEE GORGE

Frederick D. Larsen
Norwich University
Northfield, Vermont

Nineteen thousand years ago all of Vermont was deeply buried beneath a continental ice sheet that covered most of North America. The ice sheet was the result of a climate that was colder than that of today. Each winter more snow fell than melted away each summer. Year by year, for several thousand years, there was a continuous accumulation of snow over much of the northern half of North America. Ice, the main constituent of fluffy little snow flakes, is easily deformed when buried several hundred feet and tends to flow away from centers of snow accumulation at high latitude and high elevation. Small glaciers and ice caps steadily grew larger and developed into a hugh ice sheet that extended over five million square miles.

New England, located at the margin of the ice sheet, was completely covered by ice that generally moved from northwest to southeast. In Maine, the ice moved out into the ocean and scoured the rocky floor of the Gulf of Maine. At its maximum extent the ice margin was on Long Island and on or near Block Island, Martha's Vineyard, and Nantucket Island. In Vermont at this time, basal ice was streaming southeast obliquely across all of the highest peaks in the Green Mountains. Rock particles of all sizes imbedded in the ice left their mark in the form of striations and grooves that trend S 40° E along the crest of Mount Mansfield. This indicates that ice moved southeastward from the Champlain Valley, across the "grain" of the Green Mountains, and toward the Connecticut Valley.

Striations in valley bottoms generally run parallel or nearly parallel to the main trend of the valleys. However, there is a fair amount of scatter of measured striation directions implying that basal ice flowed over and around rock knobs both in the valley bottoms and on the ridges. A north-south striation by itself does not tell us whether the former ice sheet was moving north or south. Other evidence must be sought in order to determine the actual movement direction. One technique involves the observation of rock knobs that have been smoothed by abrasion by rock particles on the up-glacier side and have been made into an irregular, often stair-step, shape by glacial plucking on the down-glacier side. Such knobs called roches moutonnees by the French, clearly indicate that the sense of motion of the former ice sheet in Vermont was toward the southeast.

Another technique to determine the sense of motion, north or south, of the last ice sheet is one that I have used with my students at Norwich University. To use the words of Dr. Stephen Reed, M.D., who studied the Richmond boulder train in western Massachusetts in 1845, "If you were travelling along a country road and saw apples strewn about on the road, and if after awhile you came to a cart half filled with apples and its rear gate down, you would have no doubt where the apples on the road came from."

Such it is when an ice sheet moves over a unique type of rock such as a small area of light-colored granite surrounded by dark-colored metamorphic rock. A zone of granite boulders, a so-called boulder train, will extend from the source area in the direction of ice movement. My students have collected many salmples of 100 pebbles each around the Barre Granite in central Vermont. By plotting on a map the percent of granite pebbles at each locality and by drawing lines of equal percent we have been able to determine that the last ice sheet moved south-southeast over the Barre Granite. Thus there is ample evidence that the last ice sheet moved over Vermont from northwest to southeast.

About 19,000 years ago, when the ice sheet was at its maximum extent, the climate became warmer. The summer sun melted not only all the snowfall from the previous winter but also some of the glacial ice that had accumulated over thousands of years. In effect, the economy of the ice sheet became negative, that is the wastage of the ice by melting was greater than the accumulation of snow that fell during the winter months. At first, the margin of the ice sheet retreated slowly northward from its position on Long Island. The ice sheet was still actively moving forward while the ice margin was retreating.

Eventually, after several thousand years of melting, the ice sheet became much thinner over the Green Mountains, and then an event occurred that dealt a death blow to the ice sheet in New England. The event was the rapid extension of an arm of the ocean into the St. Lawrence Valley of Quebec. The ocean water, aided by two tidal cycles each day which raised and lowered the edge of the highly crevassed ice, acted like a knife as it cut off the flow of ice from Quebec into northern New England. The ice in Vermont lost its push from the north and essentially died in place, a process we call stagnation. Narrow tongues of ice that occupied the valley bottoms in Vermont rapidly melted from north to south and by 12,500 years ago the last ice age in Vermont was over. Except for a salty estuary in the Champlain Valley known as the Champlain Sea and a few lakes in the Connecticut Valley the landscape of Vermont was essentially that of today. Of course, the forests had not yet come back, they were creeping in slowly from the south.

What does all this have to do with Quechee Gorge? Basically, it was the weight of the ice sheet pushing down the earth's crust in New England that supplied the first of two conditions necessary for the formation of Quechee Gorge. The

second condition was the accidental blocking of the drainage from the ice sheet at Rocky Hill, Connecticut, that resulted in a lake known as glacial Lake Hitchcock.

When the margin of the retreating ice sheet was located at Rocky Hill, about 8 miles south of Hartford, Connecticut, meltwater streams flowing from the ice formed a large deposit of sand and gravel right across the present-day path of the Connecticut River. The deposit, known as an ice-contact delta because it was formed in contact with the ice, became an effective dam when the ice margin retreated northward and meltwater drainage from the ice was diverted over a spillway at New Britain, about 6.5 miles northwest of the Rocky Hill deposit. The situation was similar to a modern man-made dam on the Connecticut River where the path of the river is blocked by an earthfill dam composed of loose material and the river is diverted over a concrete or bedrock spillway that erodes slowly.

As the ice margin retreated, it was accompanied by a northward expanding Lake Hitchcock that occupied the Connecticut Valley. After several thousand years, when the ice margin had retreated to northern Vermont, Lake Hitchcock stretched from its dam at Rocky Hill to West Burke, Vermont, a distance of 200 miles. It also extended into the lower part of each valley that today is occupied by a tributary of the Connecticut River. Streams flowing into Lake Hitchcock formed deltas that mark the former shoreline of the lake. Eventually, Lake Hitchcock drained when the dam at Rocky Hill was breached by erosion. The draining of the lake probably resulted from water seeping through the dam over a long period of time. This eventually resulted in a rapid outburst of water similar to, but much larger than, the Teton dam disaster in Idaho in 1973.

After the draining of Lake Hitchcock, the land rebounded or moved up because of the removal of the weight of the ice sheet. We know this because the deltas that have formed in Lake Hitchcock now occur in a plane that rises 4.5 feet per mile toward N 20° W. In other words, Lake Hitchcock formed when the land was still depressed by the weight of the ice, and when the land rebounded to its original position, the former shoreline of Lake Hitchcock was tilted up on the north. The reason the shoreline was tilted up on the north is that there was more ice to the north which thereby caused more crustal depression and hence more rebound in that direction.

When the retreating ice margin was located just north of the present site of Quechee Gorge, an ice-contact delta similar to Rocky Hill delta, but much smaller, was formed by metlwater streams from the ice flowing into an arm of Lake Hitchcock that extended into the valley of the Ottaquechee River. Similar kinds of deltas were built thoroughout the Connecticut River basin during retreat of the ice. The original delta extended completely across the Ottaquechee Valley and probably was higher than the sandy plain crossed today by U.S. Route 4 just east of Quechee Gorge.

As the ice margin melted back from the north side of the Quechee delta, meltwater from the ice had to flow across the top of the delta in order to reach Lake Hitchcock. In doing so, this stream moved laterally across the delta and eroded off some of the original deposits. The stream could not erode deeply because its downcutting was controlled by the level of Lake Hitchcock located right at the south end of the Quechee delta.

In time, Lake Hitchcock drained when the Rocky Hill dam was breached. The stream that we know today as the Ottaquechee River was flowing south on the west side of the Quechee delta. As Lake Hitchcock lowered, the Ottaquechee River was able to quickly cut down through the loose sand and gravel of the Quechee delta until it struck solid ledge. Downcutting by the river slowed abruptly when the ledge was encountered but nonetheless it continued. The Ottaquechee River had gained a foothold and, using abrasive tools as all streams do, it cut the lower V-shaped portion of Quechee Gorge in solid bedrock just like a chain saw cutting through a hardwood log. From the bridge over the gorge one can observe that the upper part was cut in loose, sandy material and that the lower part was cut in bedrock.

How long did it take for the Ottauquechee River to cut the gorge? First, it must be pointed out that the river is still cutting down, and that the gorge is a youthful stream valley. This is shown by the straightness of the gorge, by the steepness of the stream path, and by the numerous rapids in the floor of the gorge. Remember, when a stream becomes older it flows in curving loops known as meanders, its gradient becomes low, and rapids are uncommon. It can be inferred from evidence gained elsewhere that Lake Hitchcock drained about 13,000 years ago. Thus Quechee Gorge is about that old. Downcutting by the Ottaquechee River through the sandy delta took only a few days or a week at most, but downcutting through the ledge took practically all of the 13,000 years.

As we view the spectacular physical landscape that is Vermont which is epitomized in Quechee Gorge, we sometimes decry the spread of ski slopes, superhighways, junkyards, and condominia. We should be reminded that we live in an interglacial age, and that in another 10 to 15 thousand years a future ice sheet will wipe the slate clean.

VGS BUSINESS & NEWS

STUDENT WINNERS FOUND

Two sources have confirmed the names of winners of our early VGS best students paper awards. Bob Badger dropped us a line and the treasurer consulted the cancelled checks, and what do you know! It appears that we did not award prizes in 1974 and 1975, but in 1976 the winners were Glenn Monrad and Robert Badger both of UVM and in 1977 Douglas Knapp of UVM took the prize. The Charles G. Doll Award plaque has been hanging in the UVM Geology Department and should be sent down this semester to Williams College who we hope will send up more students with research papers next spring.

SUMMER FIELD TRIP

Twenty-one people attended the summer field trip on August 24 when we travelled the familiar roads along the Champlain Valley carbonate platform. As Char Mehrtens showed us how to examine the environments of deposition of the different rock facies and explained the interpretation as it relates to the Cambrian-Ordovician shoreline, the development through time of the carbonate platform and adjacent basin became a reality. See page 19 for some pictures.

FROM THE EDITOR

The order blank for the first Guidebook is on page 11 of this GMG. The field trip guides are substantive and I thank the authors for their efforts. There are still a number of past field trips for which I expect to have guides submitted within the next year, so you can expect Guidebook 2 in due time!

EXECUTIVE COMMITTEE MEETINGS

There was no room in the last GMG to publish the minutes from the meetings of March 20 and May 4, 1985. Since then we have met on September 25, 1985. Although there is not enough room left here either, some of the topics which have engaged our discussions are: first and foremost, the need to generate funds for our publishing program and other activities; methods by which we can attract new members, particularly by contacting new audiences who have not heard of us but whom we know would be interested; a plan to share the many duties that have fallen to the treasurer with the secretary; a report from Craig Heindel as our representative on the Advisory Panel on Water Discharge Policy and the Executive Committees' charge to him to make sure that a scientifically hydrologically correct report is produced; planning for the summer and fall field trips and banquet; and discussion to establish the price for the Guidebook 1.

FALL BANQUET RESERVATION

Please make your reservations for the fall banquet as soon as possible. We must have your reservations by **OCTOBER 16.**

EITHER

Indicate the number of meals and your choice of entrees on this page and mail it to:

Roger Thompson
RD #2
Woodstock, VT 05091

OR

Call Roger at: [802] 457-3898
between 6 & 9 P.M.

DINNER MENU
Choice of:

Roast Top Sirloin of Beef with Brown Gravy ☐
$10.95 plus 15% gratuity and 6% Vt tax

Roast Vermont Tom Turkey with Sage Dressing ☐
$9.50 plus 15% gratuity and 6% Vt tax

Meals include choice of Soup du Jour, fruit cup or onion soup; fresh salad/choice of dressing; vegetable; potato; rolls; coffee, tea, soft drink or milk; dessert.

5:30 Social Hour
6:30 Dinner in the dining room of the Holiday Inn at White River Junction.
7:30 Annual meeting in the Depot Room.

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VERMONT GEOLOGY VOLUME 4 GUIDEBOOK 1

This is the first of a Vermont Geology series containing VGS sponsored field trip guides.

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Brewster Baldwin
Roger Laurent
Barry Doolan
31 pages 15 figures

B. Geology of the Guilford Dome Area, Brattleboro Quadrangle Southeastern Vermont
J. Christopher Hepburn
9 pages 1 figure

D. The Crown Point Section, New York
Brewster Baldwin
Charlotte J. Mehrtens
14 pages 5 figures

E. The Cambrian Platform in Northwestern Vermont
Charlotte J. Mehrtens
21 pages 10 figures

VGS members $9.00 ppd.
Non-members $10.00 ppd.

Individual field trip guides are available at the following rates: A - $3.50; B - $1.50; D - $2.00; E - $3.00.

Please send me____copies of Guidebook 1.
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Amount enclosed: $_____
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If you will not be attending the VGS annual meeting on October 19, 1985 at 7:30 P.M. in the Depot Room of the Holiday Inn at White River Junction, please complete this ballot and return it in an envelope with the word "BALLOT" in the lower left corner and your name and address in the upper left corner to:

Larry Becker, Secretary
Vermont Geological Society
Box 304
Montpelier, Vermont 05602

It must be received before **OCTOBER 18.**

BREW'S BASH to honor Brewster Baldwin

It is not often in one lifetime that a person has the opportunity along with both the talent and concern for others that permits him to influence the lives of many. Furthermore, in our society we don't always gather together in order to recognize those who have thus enriched our lives. Brew's Bash on September 21 at the Middlebury Breadloaf Campus was a marvelous exception. Organized by Peter Coney and Lucy Harding, this all-day meeting featured a symposium by 21 former students and faculty on an impressive variety of topics. Not only was every region of the U.S. represented, but also western Canada and France. One-year old Daniel Brewster Badger was also present, evidence of the true affection felt for Brew. At the end of a long day of talks was a banquet attended by more that 80 fans. Many tributes were given to Brew including two very similar ones by Peter Coney and Rolfe Stanley. Rolfe's speech follows:

"First of all, I want to thank you for allowing me to say a few words about our honored guest. As you might know I am not affiliated with Middlebury. My comments tonight, however, represent the feelings of the rest of the geological community in Vermont. I have known Brew for 22 years as a friend and colleague in Vermont geology. We do both share something in common - we graduated from a small college down the road and somehow that tradition has kept us in New England most of our professional life.

These festivities have really been impressive. Congratulations to the organizing committee, for they have selected an outstanding way to honor Brew - a symposium of former students and faculty. There is a spirit of gratitude, respect and appreciation permeating these activities which is hard to beat. I can't think of a better present, Brew, than the very existence of this gathering. I have always been amazed at how well the Geology Department has done in terms of facilities and faculty. Somehow I think it has something to do with one individual, who is in last analysis "Mr. Geology at Middlebury College".

Brew - You and I go back a long way. We have both had the privilege of developing a small geology program into one that has gained respect and recognition. Somehow, however, you have faired far better than me. You have turned a bit gray and I have solved the problem in another way!

As you remember, Brew, we met 22 years ago in what was then a two room department in one of your older buildings on campus. Bruno Schmidt had just retired and I was fresh out of graduate school, wet behind the ears and looking for a job. As things turned out I went to UVM and Peter Coney came to Middlebury. That was perhaps one of your best decisions. From then on Middlebury was on the move into the 20th century. Peter was then followed by a number of young, bright people: Dave Folger, Roger Laurent, John Creasy, Tom Davies, David Clague, Bill Glassley, and, of course, your present faculty.

Through the years Middlebury grew in stature and reputation. Many of your graduates are now active professionals as illustrated here today. Many of the faculty have moved on to bigger and better positions, although it is hard to imagine a better academic environment than Middlebury.

What is important here, Brew, is that you have provided an atmosphere of inquiry and excitement where people could develop intellectually and professionally. You were always willing to listen, to learn, to try something new. What impressed me is your attitude - you were just like the student - bright eyed and enthusiastic as the pace of our scientific revolution rolled on.

Well, I have probably gone on far too long for some of you. I find it difficult to find the right words at times like this. But, Brew, I want you to know that you have made a major mark on geological education in New England. Your contribution to Vermont geology is noteworthy. Whatever you do in retirement, please don't give up your association with Middlebury or Vermont geology. We need your enthusiasm and wisdom."

RECENT PUBLICATIONS

Roadside Geology of New York by Bradford VanDiver
Paperback $12.95 + $1.00 postage
August 1985 397 pages
ISBN 0-87842-180-7

Mountain Press Publishing Company
P.O. Box 2399
Missoula, Montana 59806

For a number of years I have been intrigued by the Roadside Geology series published by Mountain Press but could only dream about using them on some future trip because they were all for western states. This summer they published one closer to home: Roadside Geology of New York. Although "that still ain't Vermont", it should be of interest to many Vermont geologists who travel in New York or who live along its border. As the title implies, the geology is treated road by road (mostly major ones) and the author acknowledges an actual travel mileage of 10,000 miles in logging the approximately 4600 miles of road log! After a brief introduction about rock types and physiography of the many distinct provinces in the state, the plate tectonic interpretation of New York's geologic history is discussed. With the exception that Ordovician block faulting in the Adirondacks is used to interpret a reopening of the proto-Atalantic between the Taconic and Acadian orogenies, the story is similar to that told by Vermont geologists.

Each chapter gives an overall picture of the region being travelled before each road traverse is discussed. The text is generously illustrated with photographs, geologic maps, geologic cross sections, schematic diagrams and stratigraphic columns. Bedrock maps are used almost exclusively because bedrock exerts the strongest influence on the large-scale topography. Glacial features are not forgotten, however, and interesting tidbits of natural history and New York State history are told in passing.

Minerals - Foundations of Society by Ann Dorr
Paperback $4.00 + $1.00 postage
April 1984 56 pages

League of Women Voters of Montgomery County, Maryland, Inc.
12216 Parklawn Drive
Rockville, MD 20852
[301] 984-9585

This Maryland chapter of LWV has taken up the challenge of educating the public about mineral resources. The narrative of this booklet, written in nontechnical language, gives an overview of U.S. mineral resources, describing their origin, distribution, use and significance. The text explains complex economic, political and social issues involved in mineral exploration and development, and outlines current and future supply and demand problems. It is illustrated by examples, graphs, maps and tables. The major aim is to identify problems and to bring them to the attention of the public so that mineral facts will be taken into account as decisions are made on a very wide range of issues.

To complement the booklet, the League has assembled two different slide programs. One is designed for classroom use or study groups and includes the booklet mentioned above, a two part slide program (each 45 minutes in length) including discussion and activities, a guide to the presentation with questions and activities, a printed script keyed to slides and the booklet, and a cassette tape of the script. The cost is $85.00.

Submitted by Jeanne Detenbeck

MINERAL OF THE QUARTER

GOLD

Probably because of the high price of gold per ounce on the world market there appears to be renewed interest in panning gold in Vermont streams.

Historically speaking, gold panning has been done in Vermont since the mid 1800's. At the time of the California gold rush someone in Plymouth, Vermont discovered that placer gold was available in Broad Brook. Many Vermont farmers left their plows and took up placer mining. Canny Yankees that they were, it did not take them long to discover that they had made as much money farming (which was easier work, too) and the gold rush in Vermont was over.

Actually, a number of streams that come from the tops of Vermont's mountainous spine will yield gold flakes in return for a hard day's work. Those places where the black magnetite sand collects are the proper spots to try panning for some flakes. Many people take this dark material home and use a magnet to separate it from the garnets and the possible gold flakes. One panner whose finds I have seen recently, came up with some pretty nice garnet crystals as well as a small amount of gold after a weekend at Gold Brook.

Among the locations where gold has been reported are:

Rock River in Newfane and Dover;
Black River in Plymouth;
Williams River in Ludlow;
Ottaquechee River in Bridgewater;
White River in Stockbridge and Rochester;
Third Branch of the White River in Braintree;
Mad River in Warren, Waitsfield and Moretown;
Shady Rill Brook in Wrightsville;
Minister Brook in Worcester;
Little River in Stowe and Waterbury;
Gold Brook in Stowe;
Lamoille River in Johnson;
Gihon River in Eden;
Missisquoi River in Lowell and Troy.

Happy hunting!

Submitted by Ethel Schuele

Seen at the Summer Field Trip

Char shows the thickness of a Cambrian storm deposit in the Danby Formation.

At an outcrop on the Winooski River below the Champlain Mill.

GREEN MOUNTAIN GEOLOGIST
VERMONT GEOLOGICAL SOCIETY
BOX 304
MONTPELIER, VERMONT 05602

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Montpelier, VT 05602

THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

WINTER 1985 VOLUME 11 NUMBER 4

JOIN US AT THE 8TH ANNUAL WINTER MEETING
WHERE VGS WILL PRESENT 2 SYMPOSIA

BEDROCK RESEARCH IN THE PRECAMBRIAN OF THE GREEN MOUNTAINS AND SURROUNDING COVER

AND

GROUNDWATER ISSUES IN VERMONT

KEYNOTE SPEAKER

REGINALD LAROSA
Water Resources Department

"STATUS OF GROUNDWATER"

Saturday, February 16, 1985 9:00 A.M.
Angell Lecture Center
University of Vermont, Burlington

Directions: Park in lot adjacent to Ira Allen Chapel and walk south around the Votey Engineering Building to Angell Lecture Hall - the cantilevered building.

CONTENTS PAGE

PRESIDENT'S LETTER

The Winter Meeting with professional paper presentations is shaping up nicely. The meeting will have a half-day each on recent bedrock research and ground water issues. The ground water talks should be particularly timely as the talks will focus on issues that will or should be under legislative consideration this year. I hope that you will review the schedule, attend the meeting, and participate in the discussion. The society will be issuing a press release and contacting the legislators directly. The general public is invited and with some of the talks dealing with "hot" topics, I would like to see a good turn out. Bring a friend.

The exexcutive committee has been burning the midnight oil, well alright the ten o'clock oil, thinking of ways to increase membership. We think the best way is for each member to recruit the people they come into contact with. We have an incentive program to make this a little more palatable. The person who recruits the most new members and has them submit completed application forms by September 15, 1985 will have a free meal at the annual banquet. Everyone else who finds at least one new member will be presented with a dollars worth of MacDonald's gift certificates.

The Annual Meeting will feature Fred Larsen's guided tour of Lake Hitchcock. The trip will end with the banquet in the White River area. Details will be in the next GMG. This should be a great trip for softrock types so don't forget to hold October open.

I would also like to try to organize some special interest field trips for small groups during the warm months. Please let me know if you either have a trip you would like to lead or one you would like to go on. Call me at 457-3898 or let me know at the Winter Meeting.

The executive committee would also like to have more people attend the committee meetings. We would like to have 2 or 3 different people attend each meeting with a view towards more active involvement by the members. There are some good projects that are not being done because there are not enough people. There are big and small projects that can be tailored to the amount of time you can spend. Give me a call if you would like to get involved.

Roger Thompson

WINTER MEETING PROGRAM

Saturday, February 16, 1985
Angell Lecture Center B106
University of Vermont
Burlington, Vermont

REGISTRATION (no fee): Coffee and donuts 8:30

MORNING SESSION: BEDROCK RESEARCH IN THE PRECAMBRIAN OF THE GREEN MOUNTAINS AND SURROUNDING COVER

Opening remarks: Rolfe Stanley, Convener 9:00
1. C. Mehrtens: Shallowing-up cycles in the Dunham Dolomite (Lower Cambrian) and Monkton Quartzite (Lower Middle Cambrian) in Western Vt 9:10
2. E. Downie: Paleozoic deformation in the Green Mountain massif, Wallingford Quadrangle 9:30
3. P. Karabinos: Thrust faulting in the Green Mountain massif 9:50

BREAK

4. R. Stanley and others: Tectonic geology of the Lincoln massif and eastern cover sequence, central Vermont 10:30
5. J. Laird and W. Bothner: Geologic history of pre-Silurian mafic schist in Vermont: petrologic, isotopic and structural constraints 10:50

MEETING: REVISION OF THE BEDROCK GEOLOGIC MAP OF VERMONT: FUTURE PLANS Room 200 Perkins Geology . 11:30

LUNCH: (Brown bag or local restaurants)

AFTERNOON SESSION: SYMPOSIUM ON GROUNDWATER ISSUES IN VERMONT

Opening remarks: Roger Thompson, Convener 12:45
Keynote speaker: Reginald LaRosa
"Status of Groundwater" 1:00

6. S. Goldberg: Waste water application methods and soil treatment 1:30
7. T. Broido and W. Ladue: Monitoring groundwater quality adjacent to herbicide applications in Vermont 1:50
8. C. Stone and others: Groundwater flow patterns near a river and near a stream in the Northeast Kingdom 2:10
9. J. Noyes and J. Nelson: Contaminant transport modeling in Vermont geologic environment 2:30

BREAK

10. C. White and B. Baldwin: Correlative groundwater rights 3:05
11. A. Alsup and G. Simmons: Ground penetrating radar . . 3:25
12. G. Simmons and others: Magnetometry and earth penetrating radar investigations at a hazardous waste dump, New Hampshire 3:45

EXECUTIVE COMMITTEE MEETING 4:10-5:00
Open as always to all members.

ABSTRACTS

GROUND PENETRATING RADAR

Alsup, S.A., S.A. Alsup & Associates, 7 Parsons Street, P.O. Box 1457, Gloucester, MA 01930
Simmons, Gene, GEOSS, Geoscience Services of Salem, 180 North Policy St., Salem, NH 03079

Ground penetrating radar, or GPR, is now used extensively for the exploration of the earth to depths as great as 200 feet. At many locations it is the ideal method for "seeing" pipes, cables, bedrock topography, faults, fractures, clay layers, stratigraphy, buried containers, and many other features.

This short paper contains a general introduction to the topic followed by many field examples acquired by us during the past 10 years in running about 250,000 feet of GPR profiles under a variety of conditions. We attempt to indicate the shortcoming as well as the strengths of this relatively new geophysical method.

The instrumentation for GPR consists of the following components: Transmitter, Receiver, Antenna, Recorder, Oscilloscope, and Power source.

The possible applications of GPR are legion and include the following: (1) Construction, (2) Excavation, (3) Hazardous waste sites, (4) Sanitary land fills, (5) Siting of critical facilities, (6) Archaeology, (7) Landslide investigations, (8) Geology. At hazardous waste sites and sanitary landfills GPR is used for:

- locating containers (drums, tanks, even trucks);
- mapping of contaminants in the subsurface;
- profiling the top of bedrock;
- determining the condition of bedrock;
- interpolating conditions between boreholes (stratigraphy in particular);
- locating faults that do not reach the ground surface; and
- monitoring the progress of any contaminants in the subsurface.

The requirements for satisfactory application include the following: (1) sharp contrasts in electrical properties, (2) suitable (low) electrical conductivity of the ground, and (3) appropriate depths. The conductivity of a target can be either greater than, or less than, the conductivity of the ground; only a difference in conductivity is necessary.

In this paper, we show **typical field** examples to illustrate:

- Profiling over fresh water
- Profiling to determine stratigraphy/rock structure
- Profiling at land and hazardous waste sites
- Profiling for pipes, conduits and utilities.

MONITORING GROUNDWATER QUALITY ADJACENT TO HERBICIDE APPLICATIONS IN VERMONT

Broido, Thomas J. and Winslow H. Ladue

See page 11.

PALEOZOIC DEFORMATION IN THE GREEN MOUNTAIN MASSIF, WALLINGFORD QUADRANGLE

Elizabeth A. Downie, Amherst College, Amherst, MA 01002

Recent mapping in the Wallingford Quadrangle of southern Vermont has been initiated in conjunction with the USGS Glens Falls 2° Quadrangle project. Thus far work has been concentrated on the Precambrian Mt. Holly sequence in an attempt to subdivide it into mappable units (at a scale of 1:24000) and to trace major Paleozoic structures through the Green Mountain massif. No macroscopic structures of Precambrian (Grenville) age have yet been recognized, although all minor structures deform an earlier foliation and some minor folds have orientations not seen in the late Precambrian-early Paleozoic cover sequence on the west side of the massif. The present distribution of lithic types arises from two major Paleozoic events involving crustal shortening. The earlier event (Ordovician Taconic orogeny?) was marked by strong west-southwestward movement and the formation of overturned to recumbent folds and thrust slices locally involving Lower Paleozoic cover rocks typical of the Eastern Vermont Sequence. Quartz rods, mineral foliations, lineations, and crystallographic preferred orientations, minor fold axes, and boudinage generally are congruent with the major structures of this event, although rotation of early structures during progressive deformation and later folding have complicated the minor structural pattern. Thrusts are marked by mineral streaming and shear zones showing cataclasis and dynamic recrystallization. The later major event (Devonian Acadian orogeny??) involved upright to slightly overturned folding of earlier structures and the development of crenulation cleavage in the schistose rocks and fracture or spaced cleavage in quartzitic rocks and gneisses. High-angle normal faults showing W-side-down movement are most common along the west side of the massif near apparently unconformable contact with cover rocks.

Textures and microstructures indicate that the peak of Paleozoic metamorphism (resulting, for example, in the growth of garnet, chlorite, and chloritoid in high-alumina rocks) preceded the earlier deformation. The rocks were then transported to shallower tectonic levels. Growth of chlorite in quartzofeldspathic gneisses and epidote-actinolite in amphiboles was concurrent with the formation of the spaced cleavage of the later event.

WASTE WATER APPLICATION METHODS AND SOIL TREATMENT

Goldberg, Steven P., Division of Protection, Department of Water Resources and Environmental Engineering, Agency of Environmental Conservation, Montpelier, VT 05602

The Federal Water Pollution Control Act Amendments of 1972 focused attention on the necessity of developing wastewater management techniques which were not only cost effective but environmentally sound. Land application of wastewater has been promoted as a most viable alternative to direct discharging to rivers and lakes. Vermont leads in land based modes of dis-

posal. While our surface water quality has greatly improved as a result, increasing attention must be directed to the effects of waste disposal on groundwater, the source of most Vermonters' drinking water.

This paper will focus on the various land-based wastewater disposal technologies now employed in Vermont and the resulting contaminant contributions to the soil. The role of the unsaturated soil zone as the final stage in wastewater treatment and as the last protective medium for our groundwater is discussed.

THRUST FAULTING IN THE GREEN MOUNTAIN MASSIF

Karabinos, Paul, Department of Geology,
Williams College, Williamstown, MA 01267

Recent mapping in the Rutland and Rochester 15' quadrangles in Vermont at the north end of the Green Mountain massif (GMM) indicates that thrust faulting contributed greatly to crustal shortening. Several major thrust sheets are composed of 1 b.y. old Grenville basement rocks and their unconformably overlying cover rocks of Late Precambrian to Cambrian age. The unconformity is commonly marked by basal conglomerates; this relationship is well displayed along the northeastern margin of the GMM. Faults separating these westwardly transported thrust sheets are marked by repetitions of coherent basement-cover rock sequences, stratigraphic truncations, and major shear zones up to 30 m thick. Cover rocks in thrust sheets within and along the western margin of the GMM are lithically very similar to the Tyson and Hoosac Formations on the east side of the GMM. At the latitude of Rutland, VT the western boundary of the GMM is a major thrust fault carrying basement and cover rocks of eastern affinity over the western shelf sequence (WSS) of Late Precambrian to Ordovician age. However, to the south from Clarendon, VT to the southern end of the GMM, the boundary between the GMM and the WSS appears to be an unconformity with only minor faulting. The major thrust at the western margin of the GMM to the north probably swings southeastward into the basement terrane, separating the massif into a northeastern, highly transported portion and a southwestern, relatively autochthonous portion. The age of thrusting is not well constrained, but it was probably Taconian based on correlation with the Berkshire massif in MA.

GEOLOGIC HISTORY OF PRE-SILURIAN MAFIC SCHIST IN VERMONT:
PETROLOGIC, ISOTOPIC, AND STRUCTURAL CONSTRAINTS

Laird, Jo and Bothner, Wallace A., Department of Earth
Sciences, University of New Hampshire, Durham, NH 03824

Petrologic studies of pre-Silurian mafic schist in Vermont reveal that high-pressure facies series metamorphism is preserved in the Tillotson Peak area north of the Belvidere Mountain asbestos body. Medium-high-pressure facies series metamorphism occurred on both the east and west flanks of the Green Mountain anticlinorium (GMA) in north-central Vermont, and medium- to medium-low-pressure metamorphism occurred farther

south on the east side of the GMA. $^{40}Ar/^{39}Ar$ isotopic studies show that the high- and medium-high-P metamorphism is Taconian. Widespread greenschist facies overprint may be Acadian. Medium-P metamorphism is Taconian in central Vermont west of the GMA and Acadian in southeastern Vermont. Petrographic relationships suggest Taconian metamorphism may also be preserved in southeastern Vermont, but only Acadian radiometric ages have been obtained east of the GMA.

Detailed mapping confirms that the high-P mafic and felsic rocks at Tillotson Peak compose a coherent stratigraphic package. Contacts are gradational and parallel; mafic and felsic rocks interfinger at the outcrop scale. Ultramafic pods are probably tectonic slivers into the stratigraphic package. Faults within the package are indicated locally by moderate to intense shear and by truncation of layering (some of which is bedding). They do not appear to be regional in extent, and fold styles are the same across these faults. Early isoclinal folds (F1) are refolded about gentle southwest- to west-plunging, mesoscopic and probably macroscopic, nearly reclined folds (F2). Map pattern indicates later broad folding about an essentially north-south axis (F3).

The distribution of glaucophane- and omphacite-bearing mafic rocks at Tillotson Peak is greater than recognized previously. The infolded and stratigraphic character of the high-P mafic and felsic rocks argue against an intrusive or olistolithic origin for the mafic rocks. However, the package of high-P rocks may be a tectonic sliver bounded on the east and west by strongly sheared quartz+plagioclase+white mica+graphite schist.

SHALLOWING-UP CYCLES IN THE DUNHAM DOLOMITE (LOWER CAMBRIAN) AND MONKTON QUARTZITE (LOWER-MIDDLE CAMBRIAN) IN WESTERN VERMONT

Mehrtens, Charlotte, Department of Geology,
University of Vermont, Burlington, VT 05405

Shallowing-up cycles (SUC) are recognized in both Dunham Dolomite (Lower Cambrian) and Monkton Quartzite (Lower-Middle Cambrian) in western Vermont. In both units the shallowing-up cycles are similar to the "muddy" shallowing-up cycles described by James (1978), which developed by progradation of tidal flats onto the adjacent platform.

In the Dunham Dolomite, shallowing-up cycles occur in the Peritidal Facies where they are only 1 meter thick and consist of bioturbated dolomite and silty dolomite capped by cryptalgalaminites and intraformational conglomerates. This sequence is interpreted as representing bioturbated low intertidal muds overlain by stromatolites and rip-up clasts of the high intertidal or supratidal. Shallowing-up cycles are also present in the Subtidal/Open Shelf facies of the Dunham Dolomite. These cycles are thicker than those in the Peritidal (6-10 meters) and they exhibit two types of patterns. In the first, bioturbated dolomite becomes progressively more silt-rich approaching an abrupt contact with the sedimentary-boudinaged dolomite and silty dolomite of the Peritidal Facies. The second pattern is characterized by bioturbated dolomite of the Subtidal Facies in

sharp contact with overlying Peritidal Facies without an intervening gradational interval. Both of these shallowing-up cycles are interpreted as resulting from progradation of inter- and possibly supratidal sediments into the adjacent subtidal.

Shallowing-up cycles in the Monkton Quartzite were described by Rahmanian (1981) as consisting of mixed siliciclastic and carbonate sediments. These sediments occur in a cyclic repetition of, in ascending order, subtidal siliciclastic sands overlain by mixed siliciclastic and carbonates of the tidal flat and capped by carbonate high inter- and supratidal sediments. Cycles are 5-10 meters thick.

The SUC of the Dunham Dolomite and Monkton Quartzite are similar in the environments represented: subtidal sediments are capped by intertidal and possible supratidal deposits. Also, the SUC in both the Dunham and Monkton are not laterally traceable across their respective platforms. They are interpreted as being the result of autocyclic processes, that is, variable sedimentation rates in the inter-, supra- and subtidal environments. It is interesting to note that cycles are produced from tidal flat progradation regardless of sediment composition (siliciclastic versus carbonate).

CONTAMINANT TRANSPORT MODELING IN VERMONT GEOLOGIC ENVIRONMENT

Noyes, Jeffrey E. and Nelson, Jeffrey A., Wagner, Heindel, and Noyes, Inc., 285 North Street, Burlington, VT 05401

One of the analytical tools which has not been routinely utilized in Vermont involves groundwater modeling of contaminant movement in subsurface environments. Our presentation will discuss the use and abuse of a contaminant transport model and how it can be utilized by professionals to enhance their evaluations of contaminant problems. The presentation will discuss the use of the United States Geological Survey's two dimensional convective transport model, its benefits and limitations in a "typical" Vermont sand and gravel aquifer.

MAGNETOMETRY AND EARTH PENETRATING RADAR INVESTIGATIONS AT A HAZARDOUS WASTE DUMP, NEW HAMPSHIRE

Simmons, G. and Mann, J., GEOSS, Inc.
180 North Policy Street, Salem, NH 03079
Alsup, S., S.A. Alsup & Associates, Inc.,
7 Parsons St., P.O. Box 1457, Glouster, MA 01930

Over 1800 magnetometer stations and several thousand linear feet of Earth Penetrating Radar (EPR) traverses were used in a known hazardous dumping area of about 7.5 acres for location of buried metallic material and for general subsurface reconnaisance. EPR data were used primarily for location of "safe" test boring locations and reconnaisance, and the magnetometer data for delineation of locales of subsurface metallic concentrations. A contour map of total magnetic field intensity for the site was constructed to plan for staging, excavation, and temporary storage areas. Estimation of the probable number and burial depth of drums (primary potential metallic

targets) was make by comparison of the anomaly shape and intensity of the field observed in the vicinity of surface drum concentrations with the intensity and shape in areas where no surficial evidence of burial was present.

Ten test boring locations were successfully sited where penetration through the dump materials was made without encountering metallic debris. Individual total field anomalies in the staging and storage areas were then delineated further by detailed magnetometry, and the sources of anomaly removed by hand excavation. Test pit excavations in areas where the total field implied drum burial exposed drums approximately in the concentrations and at the depths originally estimated. The total number of drums excavated differed modestly from the original estimates, and discussion of the reasons for the difference is given. Re-investigation of the site is in progress to establish complete removal of the subsurface ferromagnetic sources.

TECTONIC GEOLOGY OF THE LINCOLN MASSIF AND EASTERN COVER SEQUENCE, CENTRAL VERMONT

Stanley, Rolfe S., Vincent DelloRusso, Eric Lapp, Sharon B. O'Loughlin, Crispin G. Prahl and Rebecca Dorsey, Department of Geology
University of Vermont, Burlington, VT 05405

Detailed 1:12,000 scale-mapping in the Middle Proterozoic rocks of the northern part of the Lincoln massif and the medium grade, pre-Silurian rocks to the east in the Green Mountains shows the following important relations:

1. Fine grained, biotite gneiss and augen gneiss of the western part of the Lincoln massif are deformed into a series of open folds that involve the overlying rift-clastic and quartzite cover. Paleozoic or younger faults are rare.
2. Granitic orthogneiss of the eastern part of the Lincoln massif are intruded by mafic dikes and offset by a system of shear zones, mylonites, and faults that developed during the folding and subsequent westward displacement of the Lincoln massif. One extensive fault zone contains slivers of the basal Pinnacle sequence and represents a major boundary within the massif. This fault zone may correlate with the Hinesburg thrust zone.
3. Mylonitic slivers of Middle Proterozoic gneiss are imbricated with rocks of the Pinnacle Formation along the eastern border of the Lincoln massif. This zone is correlated with the Middlefield thrust zone of western Massachusetts.
4. The eastern eugeoclinal sequence of Pinnacle, Underhill, Mount Abraham, and Hazens Notch formations consists of at least four thrust slices that are overprinted by two generations of folds. Depositional sequences are present within each slice. Most fault zones are sharp, parallel to the dominant schistosity, and display ductile fabrics. Synkinematic mineral assemblages of kyanite-chloritoid grade occur along many of the faults. This suggests that the faults formed at approximately 13 km compared to the shallower conditions inferred for the faults in the Lincoln massif. Isotopic age data suggest that Paleozoic deformation occurred during the Taconian orogeny although younger ages cannot be ruled out.

GROUNDWATER FLOW PATTERNS NEAR A RIVER AND NEAR A STREAM IN THE NORTHEAST KINGDOM

Stone, Chris, John Amadon, Tom Moye, and Harold Garahedian, Department of Water Resources and Environmental Engineering, Agency of Environmental Conservation, Montpelier, VT 05602

Monitor wells, mini-piezometers and well points were used to evaluate groundwater contamination at two sites in the Passumpsic River valley. Both sites occur in an area that is underlain primarily by lacustrine sands. Although they are separated by more than 2000 feet, they are both hydraulically connected to a small stream which acts as a conduit moving contaminants from one site to another. One site is a landfill, located along the upper reach of the small stream. The other site is near the mouth of the stream on the flood plain of the Passumpsic River. Three regimes of groundwater flow have been identified at the two sites from data collected in November and December 1984. At the site adjacent to the Passumpsic River, groundwater movement parallels the flow of the river. Three elements are responsible for this pattern of movement: a power dam, a buried valley and a losing stream. In the area of the landfill, regional groundwater flow is toward the river, as would be expected from existing hydrogeologic information. However, in an area where chemical dumping had occurred within the landfill, contaminated groundwater is moving not towards the river, but towards the small stream. An impermeable layer of limited extent appears to be responsible for this non-regional flow pattern.

GROUNDWATER CORRELATIVE RIGHTS

White, Christopher M., White Geohydrology, Inc., 52 Seymour St., Middlebury, VT 05753
Baldwin, Brewster, Department of Geology, Middlebury College, Middlebury, VT 05753

Vermont's judicial history has supported the common law doctrine of absolute ownership viz. groundwater. This is essentially the law of "whoever has the biggest pump wins" and is the doctrine of allowing the land owner to contaminate his groundwater however he pleases, even if it does degrade his neighbor's water supply. It becomes the doctrine of absolute non-ownership, because no one is accorded any protection against his neighbor's activities.

This doctrine was first established in 1843 in the English case of Acton v. Blundell. The court opinion considered the movement and nature of groundwater to be unknowable and unpredictable and therefore the court was not able to equitably reach a decision regarding groundwater allocation. The most recent affirmation of these findings in Vermont was in 1973 in Drinkwater v. State. Many state regulations are entirely inconsistent with these findings of court, but up to this year the legislature has balked at trying to correct this inconsistency statutorily.

Several alternative doctrines exist which might be considered for statutory adoption. Among these are riparian rights, prior appropriation, and correlative rights. It is this last

one that appears most appropriate, given modern knowledge of hydrology. Correlative rights states that the rights of a groundwater user shall be co-equal with those of other groundwater users. The co-equal rights are to be balanced by various factors generally considered in tort law which serves in civil cases other than breach of contract.

The proposed statute before the Vermont House is co-sponsored by Betty Nuovo and Henry Carse and has been given conceptual approval by the Vermont Geological Society (VGS). It was written by several VGS members with help from many quarters within the State. It adopts the doctrine of correlative rights and lists several of the the factors normally considered in tort law. The bill assigns only liability for groundwater use; it does not actually assign groundwater. It also recognizes the inherent link between groundwater and surface water. And it is flexible enough to accommodate the potential repercussions of new technologies, such as heat pumps.

MONITORING GROUNDWATER QUALITY ADJACENT TO HERBICIDE APPLICATIONS IN VERMONT

Broido, Thomas J. and Winslow H. Ladue, Vermont Department of Health, Division of Environmental Health, 60 Main Street, P.O.B. 70, Burlington, VT 05402

The protection of groundwater from contamination is an important concern due to the large amount of herbicides applied to Vermont soils and the large percentage of the population using groundwater as a source of drinking water. A literature review was prepared which included the chemical and physical properties, toxicological studies and groundwater contamination histories of atrazine, bromacil, diuron, picloram, triclopyr and 2,4-D. A field study was conducted to monitor groundwater quality adjacent to electric transmission, highway and railroad right-of-ways which were treated with herbicides. No herbicides were detected in groundwater. Several methods for the assessment of groundwater contamination were reviewed, and two analytical techniques were chosen for further evaluation. These techniques could be used to evaluate routine chemical applications, accidental spills and leaks. By using the information gathered in the monitoring study and the modeling techniques, Vermont's groundwater resources can be better protected.

VGS BUSINESS & NEWS

TREASURER'S ANNUAL REPORT January 16, 1985

1984 Treasurer's Report

Beginning Balance Jan 1, 1984.....$1557.31

1984 Income			
Dues	1127.00		
Interest	75.46		
Vermont Geology Sales	358.00		
Total Income	1560.46	+	1560.46
1984 Expenses			
Postage	317.40		
Printing/Xeroxing	1772.68		
Office Supplies	247.29		
Wntr. Mtg. expenses	23.50		
Student Prizes	50.00		
Postal Box Rent	20.00		
Service Fees	5.95		
Guidebook Sales in J.Detenbeck reimburse.	-4.00		
Total Expenses	2432.82	-	2432.82

Year End Balance Dec 31, 1984.....$684.95

Respectfully submitted,

David S. Westerman

David S. Westerman
Treasurer

NEW MEMBERS

The following new members were accepted at executive committee meetings held since the Fall GMG was published:

Bruce Cox	No. Springfield, VT
Norman L. Hatch, Jr.	Reston, VA
Brad Jordan	Northfield, VT
H. Douglas Klemme	Bondville ,VT
Roger Miller	Norwich, VT
Donald Wernecke	St. Johnsbury, VT

CENTERFOLD IN THE GMG ??

Not a provocative one, of course, but it did get your attention! Members will find two items folded in the center of this GMG. The membership application form will be handy when you locate that potential VGS member. (For more than one recruit, just use your neighborhood copying machine.) Write your name in as sponsor, if you want credit in our contest (see the President's Letter on page 2 for details). Applicants are not required to have a sponsor, however. Ask the applicant to complete the form and mail it along with a check for one year's dues ($10.00, or $5.00 for students, made out to the Vermont Geological Society) to:

David Westerman, Treasurer
Vermont Geological Society
Box 304
Montpelier, VT 05602

Also, take some time to read over the updated version of the VGS Constitution and Bylaws and become familiar with the workings of the Society, whether your duties are present ones or in our future.

LOST

The Treasurer gets upset when mail is returned from an active member's post office with a "forwarding order expired" message. In the latest case we have "lost" William Stockwell of Lakewood, Colorado. If you know his current address, please write VGS. Don't let this happen to you. Notify the Treasurer of a change of address when you move. Thanks.

CALL FOR PAPERS - SPRING MEETING

The 12th annual VGS Spring Meeting for the presentation of student research papers will be held **May 4, 1985** at Middlebury College. Students from any college or university who are engaged in research of Vermont or Vermont-related geology are encouraged to participate. Undergraduate or graduate students should submit abstracts **no later than APRIL 15, 1985** to:

Dr. Brewster Baldwin
Science Center - Geology
Middlebury College
Middlebury, VT 05753

Abstracts should be limited to 300 words. Fifteen minutes will be allotted for each talk, followed by a 5 minute question period. The Society awards a cash prize to each of the best undergraduate and graduate student papers.

GROUNDWATER WATCHDOG COMMITTEE

Groundwater Correlative Rights

Now that the House leadership has sorted itself out, several key people have arisen who will be important to contact about the groundwater correlative rights bill, H.30. The game plan, as I understand it, is to have the bill start in the House Natural Resources Committee which is chaired by a lawyer, Stephen Reynes, D-Pomfret. After that Committee, the route is uncertain. Agriculture will almost certainly want to review the bill and the chair of that Committee is Robert Starr, D-Troy, a fourth-term legislator. The Judiciary Committee may wish to call the bill in for review and the chair of that Committee is Betty Nuovo, D-Middlebury, who is a co-sponsor of the bill. Any of these people would be helpful to contact. Your own legislator would be eager to hear from you, too.

In making your points about the bill, cite your training or education. Any personal groundwater-related experiences you have had or know about in or near your district would also be useful in stating why you feel the way you do about the bill. Be prepared to help "teach" your legislator a bit about groundwater if need be. If you are uncertain about the correct technical answer to a question, don't hesitate to thank them for a good question and say that you'll get back to them with the answer. Above all else, remember that the legislators rely on the public and especially the "experts" in the field to educate them. They have too many bills and too few staff members to do that themselves. In talking to the legislators, you are providing an invaluable service which has an honorable past in our small-scale state government.

Call if you have any questions. I'll find out the answer for you.

Chris White
388-6667

Vermont House Committees

NATURAL RESOURCES

Stephen Reynes D-Pomfret
Harry Pickering D-Arlington
Lixi Fortna R-Warren
Mark MacDonald D-Williamstown
Timothy Burke D-Putney
Don Hooper D-Brookfield
Shirlee Arnold R-Whiting
Alice Basset D-Burlington
Michael Kimack R-Wilmington
Curt McCormack D-Rutland City
Alice Emmons D-Springfield

AGRICULTURE

Robert Starr D-Troy
Elizabeth Dunsmore D-St. Albans Town
Richard Betts R-Chelsea
Roger Kayhart R-Waltham
Leland Simpson R-Lyndon
Keith Wallace R-Waterbury
Jean Duffy D-Milton
Arthur Cota R-Starksboro
Robert Rowley D-Richford
George Stebbins R-Sheldon
Almon Woodward R-Fairfax

VERMONT GEOLOGICAL SOCIETY

CONSTITUTION

AND

BYLAWS

ADOPTED
FEBRUARY 1974

REVISED
OCTOBER 1976
OCTOBER 1977
SEPTEMBER 1979
OCTOBER 1980
OCTOBER 1984

CONSTITUTION AND BYLAWS
of the
VERMONT GEOLOGICAL SOCIETY, INC.

CONSTITUTION

Article I: NAME AND FORM

The name of this organization shall be the Vermont Geological Society, Inc., a non-profit, non-capital stock corporation.

Article II: PURPOSE

The purpose of the Society shall be:

1. To advance the science and profession of geology and its related branches by encouraging education, research and service through the holding of meetings, maintaining communications and providing a common union of its members.
2. To contribute to the public education of the geology of Vermont and to promote the proper use and protection of its natural resources.
3. To advance the professional conduct of those engaged in the collection, interpretation and use of geologic data.

Article III: MEMBERSHIP

Membership in the Society shall consist of Members with full voting rights, and other membership categories not having voting rights in Society proceedings.

Article IV: MANAGEMENT

The affairs of the Society shall be managed by the officers and board of directors elected at regular intervals from the voting membership of the Society. The officers and board of directors constitute the executive committee.

Article V: ANNUAL CORPORATE MEETING

The annual corporate meeting of the Society for the election of officers and board of directors and for such other business as may properly come before the meeting shall be held at such time and place as the executive committee may from time to time prescribe.

Article VI: BYLAWS

Bylaws not inconsistent with this Constitution or with the Certificate of Incorporation shall be adopted at the time of adoption of this Constitution and may be amended as therein provided.

Article VII: AMENDMENTS

Amendments to this Constitution may be made at any annual corporate meeting of the Society by a two-thirds vote of the members voting, due notice having been given each member of such proposed amendment at least four weeks before the annual corporate meeting.

BYLAWS

Article I: MEMBERSHIP

A. Member
Membership shall be open to any person who has a degree in geology or is professionally engaged in geology and whose application, filed in the proper manner, has been approved by the executive committee.

B. Associate Member
Associate membership shall be open to any person or organization interested in geology and its related branches whose application, filed in the proper manner, has been approved by the executive committee. Associate members shall enjoy the same rights and privileges as full members, except that they shall have no vote in Society proceedings nor be able to serve as officers.

C. Student Member
Student membership shall be open to any student interested in geology, whose application, filed in the proper manner, has been approved by the executive committee. Student members shall enjoy the same rights and privileges as full members except that they have no vote in Society proceedings nor be eligible to serve as officers.

D. Lifetime Member
A lifetime membership may be bestowed by the executive committee upon an individual who has made a significant contribution in Vermont geology.

E. Honorary Non-Voting Member
An honorary membership may be bestowed by the executive committee on an individual who has made a significant contribution to the Society.

Article II: DUES

A. Dues for members and associate members shall be $10.00 for each fiscal year.

B. Dues for student members shall be $5.00 for each fiscal year.

C. Dues shall be due during the month of January.

D. Changes in dues shall be recommended by the executive committee, but shall not become effective until voted by the members of the Society.

E. Any member, associate member, or student member whose dues remain unpaid for a one year period and who fails to pay said dues within 30 days after written notification of said arrears shall be dropped from membership.

F. The fiscal year shall be divided into quarters and initial dues for new members reflect the period remaining in the fiscal year.

Article III: FISCAL YEAR

The fiscal year of the Vermont Geological Society shall be the same as the calendar year.

Article IV: OFFICERS

A. The officers of the Vermont Geological Society shall be a President, a Vice-president, a Secretary and a Treasurer. These officers, together with the board of directors, consisting of 3 members, shall constitute the executive committee.
B. The officers shall be elected for a term of one year each and two members of the board of directors for a term of two years each, one being elected each year at the annual meeting. The third member of the board of directors shall serve a term of one year and shall be the immediate past President of the Vermont Geological Society. If there is no immediate past President, the third member of the board of directors shall be elected at the annual meeting.
C. No person, with the exception of charter members, shall be eligible to serve as an officer or a member of the board of directors who has not been a member for at least one full year.

Article V: COMMITTEE ON NOMINATIONS

A. A committee on nominations, consisting of three members, shall be appointed annually by the executive committee at the regular meeting following the annual meeting and shall serve until the regular meeting following the next annual meeting.
B. The committee on nominations shall:
   1. Select one nominee for each office to be filled at the next annual meeting.
   2. Report to the executive committee one month after the spring meeting, the names of nominees, at which time additional nominations will be accepted from members submitted by prior mail addressed to the secretary.
   3. Mail a list of all nominees to all members not less than 30 days prior to the annual meeting.

Article VI: ELECTION OF OFFICERS AND DIRECTORS

A. Method of Election:
   1. Officers and directors shall be elected at the annual meeting.
   2. Voting shall be by ballot at the annual meeting.
   3. Those persons who will not be able to attend the annual meeting may request an absentee ballot from the secretary and shall return this ballot in the envelope provided so as to be received prior to the annual meeting.
   4. Officers and directors shall assume their duties at the close of the meeting at which they were elected.
B. Vacancies in Office:
   1. A vacancy in any office shall be filled for the unexpired term by a person elected by the executive committee.
   2. Voting shall be by ballot if there is more than one nominee for the office.
   3. A two-thirds vote of the members of the executive committee shall constitute an election.

Position Title: _____

Professional or Other Interest In Geology: _____

Related Interests or Specialization: _____

Degrees Received or Expected:

Year	College or University	Subject	Degree

Memberships in Related Organizations: _____

Date: _____ Signature: _____

Sponsored by _____
(optional)

EXECUTIVE COMMITTEE APPROVAL

MEMBER _____
ASSOCIATE MEMBER _____
STUDENT MEMBER _____
DATE _____
BY _____

VERMONT GEOLOGICAL SOCIETY

MEMBERSHIP APPLICATION

Name: _____

Address: _____

_____

_____

Telephone: Home _____ Office _____

On the basis of the qualifications listed below, I hereby request consideration for membership in the Vermont Geological Society in the following category:

Member ____ Associate Member _____ Student Member _____

Employer: _____

Position Title: _____

Article VII: DUTIES OF THE OFFICERS AND DIRECTORS

A. President:

The President shall:

1. Preside at meetings of the Society and the executive committee.
2. Be an ex-officio member of all committees except the nominating committee.
3. Determine the duties of the Vice-president.
4. Coordinate the work of the officers and committees, in order that the objectives of the Society may be promoted.
5. Submit an annual report to the Society at the annual meeting.

B. Vice-president

The Vice-president shall perform the duties of the President in the absence of the ability of that officer to serve, and those duties assigned by the President.

C. Secretary

The Secretary shall:

1. Record the minutes of all meetings of the Society and the executive committee.
2. Be responsible for mailing to each member of the executive committee a copy of the minutes of all meetings of the Society and the executive committee.
3. Conduct such correspondence as the Society, the officers or the board of directors may direct.
4. Notify officers and standing committee chairmen of their election.

D. Treasurer:

The Treasurer shall:

1. Be a member of the budget committee.
2. Collect and record funds in accordance with the approved budget and/or upon direction of the executive committee.
3. Present a financial statement at the annual meeting.
4. Disburse funds and pay all bills by check when approved by the President.
5. Present a financial statement at each meeting and at other times as requested by the President.
6. Close the books at the end of the fiscal year and submit them for audit to the budget committee.
7. Send dues notices to members one month prior to the date they are due.
8. The Treasurer shall be bonded in amounts determined by the executive committee. The expense of these bonds shall be paid for by the Society.

E. All Officers and Directors:

All officers and directors shall:

1. Perform the duties prescribed in the parliamentary authority in addition to those outlined in these bylaws and those assigned from time to time.
2. Deliver to their successors all official material within fifteen (15) days following the close of the annual meeting at which their term of office expires.

Article VIII: REGULAR MEETINGS

A. Regular meetings shall be held three times a year. Normally these will be held during the academic year.
B. A special meeting may be called in lieu of or in addition to a regular meeting.
C. The date, time and place of each meeting shall be determined by the executive committee.

Article IX: ANNUAL MEETING

A. The annual meeting shall be held in the month of October and shall be considered a regular meeting.
B. The date, time and place of each annual meeting shall be determined by the executive committee.
C. The annual meeting shall be the governing body of the Society.

Article X: VOTING BODY

A. The voting body of the meetings shall consist of the members of the Society.
B. Each member shall have but one vote.
C. At the annual meeting twenty-five percent (25%) of the membership shall constitute a quorum, two of whom shall be members of the executive committee. Business may be conducted at other duly warned meetings without a quorum. All meeings shall be warned no less than two weeks prior to the meeting.

ARTICLE XI: EXECUTIVE COMMITTEE

A. Membership
   1. There shall be an executive committee comprised of the officers, two (2) members elected at large, the chairpersons of the four permanent committees and the immediate past President of the Society.
   2. The executive committee shall meet at the call of the President or upon written request of two of its members.
   3. A majority shall constitute a quorum.
B. Duties:
   The executive committee shall:
   1. Perform the duties delegated to it here and also elsewhere under these bylaws.
   2. Transact business referred to it by the membership.
   3. Receive and pass upon plans of work of chairmen of standing committees and authorize and direct the work of each.
   4. Select the time and place of all meetings, including the annual meeting.
   5. Submit to the membership such recommendations as it deems advisable.
   6. Determine the amount and authorize payment of fidelity bonds for the treasurer of the Society.
   7. Take no action in conflict with that of the membership.

ARTICLE XII: PERMANENT COMMITTEES

A. Permanent Committees of the Society:
   1. Four permanent committees are established to promote the purposes and carry out the work of the Society. These permanent committees are:
      Geological Education Committee
      Advancement of the Science Committee
      Public Issues Committee
      Publications/Editorial Committee
   2. Each permanent committee shall consist of a chairperson and his/her appointees.
   3. Any permanent committee may be dissolved or an additional permanent committee established only through 2/3 vote of members voting at any annual meeting of the Society.
   4. A report summarizing the work and findings of each permanent committee must be made by the chair on or before the annual meeting of the Society.

B. Chairpersons of Permanent Committees
   1. Nominations:
      a. Nominations for chair of each permanent committee shall be made by the committee on nominations, and shall be reported by the committee on nominations at the regular meeting prior to the annual meeting.
      b. Additional nominations may be made from the floor of this meeting.
      c. Only a member of the Society, whose consent has been secured, shall be eligible for chair.
   2. Election:
      a. The election of chairpersons of permanent committees shall be held at the annual meeting prior to the election of officers and directors.
      b. A majority of votes cast shall constitute an election.
   3. Term of Office:
      The term of office for chair of each permanent committee shall be three years.
   4. Vacancies:
      Vacancies will be filled by a person elected by the executive committee following procedures outlined in Article VI B. This person will serve until the next annual meeting of the Society.
   5. Duties:
      The chair (or delegate) of each permanent committee is also a member of the executive committee and performs duties as outlined in Article XI B of these bylaws.

Article XIII: COMMITTEES

A. Standing Committees
   1. Standing committees may be created or dissolved by the executive committee as deemed necessary to promote the purpose and carry out the work of the Society.
   2. Each standing committee shall consist of a chairman and such other persons as may be appointed by the executive committee.

B. Nominations for Chairman:
   1. Nominations for chairmen of standing committees shall be made by the committee on nominations, and shall be reported by the committee on nominations at the regular meeting prior to the annual meeting.
   2. Additional nominations may be made from the floor of this meeting.
   3. Only a member of the Society, whose consent has been secured, shall be eligible for nomination for chairman.

C. Election of Chairman:
   1. The election of chairman of standing committees shall be held at the annual meeting prior to the election of officers and directors.
   2. A majority of votes cast shall constitute an election.

D. Duties of Chairmen:
   The chairman of each standing committee shall submit a plan of work to the executive committee for approval.

E. Vacancies in Chairmanships:
   If a vacancy occurs in the chairmanship of a standing committee, the executive committee shall be empowered to fill such vacancies.

F. Special Committees:
   Special committees may be created and appointed by the President or by the executive committee.

G. President Ex-Officio:
   The President shall be an ex-officio member of all committees except the committee on nominations.

Article XIV: AMENDMENTS

These bylaws may be amended at any annual meeting of the Vermont Geological Society by two-thirds of the members voting, due notice having been given each member of such proposed amendment at least four weeks before the annual meeting.

JUDICIARY

Betty Nuovo D-Middlebury
Mary Evelti D-Burlington
Donald Cioffi D-Rutland Town
Chester Taft R-Essex
Amy Davenport D-Montpelier
Ruth Stokes R-Williston
Anne Batten R-Hardwick
Francis Brooks D-Montpelier
Chris Pingert R-Colchester
Timothy Van Zandt D-Springfield
Jane Mendicino R-Essex

PROFESSIONAL COMMITTEE - A REPRISE

Chuck Ratté has submitted this report of the American Association of State Geologists as the "latest national overview of registration and certification of professional geologists". He prefaces the report with these comments:

"I'm not sure how Vermont got mentioned as making an effort in this direction in the past year. My recollection is that the most recent effort toward registry and/or certification was made by an ad hoc committee I appointed in 1981 when I was president (see GMG Winter vol. 7, # 4, p. 6). I don't believe the outcome of that committee's deliberations ever did get reported in the GMG or to the Society and I find no documents in my records indicating the final word from that committee. However if memory serves me correctly the committee's findings were essentially as follows:

1. It was not likely that the legislature would look kindly on yet another bill to establish a registration or certification of a professional discipline.
2. The records of the professional engineers or surveyors did not indicate an effective internal policing capability existed, thus the organizations functioned more as a professional society than as a watchdog over the quality of work performed in the state. It was concluded that it would be equally difficult to carry out disciplinary functions in a small group of registered geologists in Vermont.
3. There was little enthusiasm for voluntarily taking on the time consuming task of formulating a registry law or administering such a law.
4. It was decided that individuals who felt the need to be professionally registered should be encouraged to join the American Institute of Professional Geologists (AIPG)."

JUNE 1984 REPORT OF THE AASG COMMITTEE ON REGISTRATION AND CERTIFICATION

Since the last annual meeting of the Association of American State Geologists, the number of state registration and certification programs for professional geologists has remained static at 10. Arizona, California, Delaware, Georgia, Idaho and Oregon register professional geologists. Alaska, Indiana, Maine and Virginia certify them.* During the year efforts were made to advance registration or certification in Alabama, Arkansas Florida, New York, North Carolina, Oklahoma and Tennesee* and were reported by various sources to have received some degree of consideration in Connecticut, Kentucky, New Jersey, Massachusetts, Pennsylvania, Vermont, West Virginia and Wyoming. Authorizing legislation was passed in Kentucky but

was vetoed by the Governor because of a last-minute amendment concerning a subject unrelated to professional geology. In other states the effort either did not reach the state of proposed legislation, failed to come out of committee, was not called for vote, or failed of passage.

The American Institute of Professional Geologists, which has done an excellent job of keeping State Geologists informed concerning various developments in the field of professional recognition, has stated an official organizational position, somewhat altered within the past year, concerning State registration.

AIPG sponsored two State Registration Administrators' Conferences, one in Washington, D.C., in April 1983 and another in San Francisco in September 1983. Neither was well attended by representatives of the states, but each was apparently successful in identifying major concerns related to the various registering and certifying groups. Reciprocity and comity figured prominently in the discussions. Whether an examination is a part of the State procedure, and whether the examinations are judged to be comparable in coverage and rigor, are major issues. Some states that utilize examinations also register, or did initially register, geologists on the basis of some sort of "grandfather" provision, and this has impeded arrangements for reciprocal status.

It appears that the number of persons registered or certified in a state approaches a plateau after a program has been in place for a few years. In Indiana, as the example best known to the Chairman of this committee, the net number of persons carrying certification increased 159 in number and 46 percent in proportion in the year ending July 1, 1982; 49 in number (less than 10 percent) by July 1, 1983; and only 19 in number (3.4 percent) during the 11 months that have elapsed of the succeeding year. The rate of renewal, which is required biennially in even-numbered years, was high in 1982.

Respectfully submitted,
John P. Patton, Chairman

* The Professional Geologist, September 1983, p.5.

EDITOR'S REPORT

The Guidebook has not been forgotten, and now that the holidays and the excitement of becoming a new grandmother are over, and the Winter GMG is in the mail, authors of the field trip guides will be receiving friendly reminders from me. To be fair, most authors have been delayed in their efforts to provide accurate field area maps and in some cases have independently asked for peer review (so these field trip guides are going to be worth waiting for, folks). I hope we will have the first Guidebook out in time for the spring field season.

A second project I will be looking for help with this spring is a special issue of the GMG for teachers, to be distributed at the April meetings of the National Association of Geology Teachers and the Vermont State Science Teachers Association. This will be prepared in conjunction with the

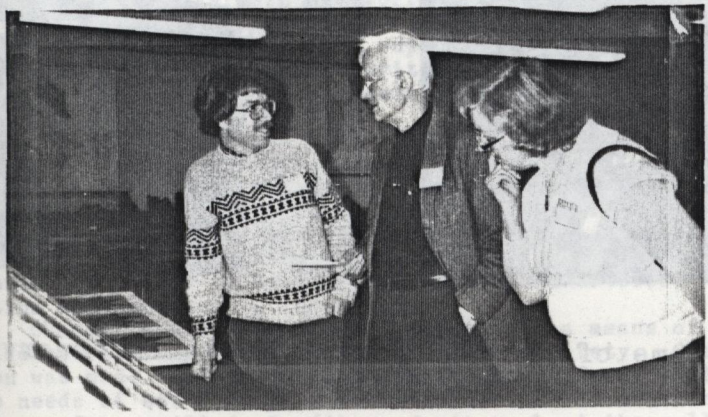
Education Committee. One of the goals of the Society is geologic education, and VGS has the resources to provide useful information to Vermont's earth science teachers if we can just find the means of communication.

The special GMG issue will contain reprints from some past issues, but I would also like to include one article compiled especially for the teachers. This article would be as complete a list as possible of the available resource materials concerning earth science in Vermont. Most obvious of these are the publications of the Vermont Geological Survey, Department of Water Resources, our Society, USDA Soil Service, USGS, and NOAA weather data. If you have in mind some favorite materials along these lines that I can include in this list, please let me know by the end of March.

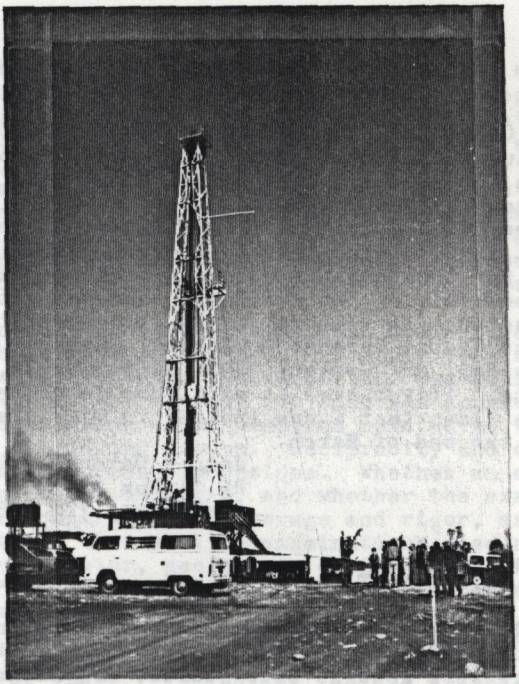
Jeanne Detenbeck VGS Editor
RD 1 Box 1742
Shelburne, VT 05482

FALL FIELD TRIP REPORT

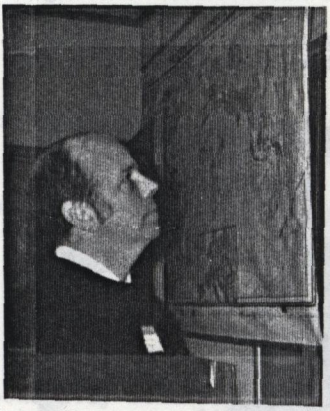
The elements were kind and 35 geologists enjoyed an entirely successful field trip on October 6 in the Fletcher, Vt area. There were genuine blue quartz, convincing pillow lavas, folded folds, a field of graded beds calling for up-direction determinations and a variety of stratigraphic types. Participants came from near and far: UVM, Norwich University, Middlebury College, SUNY Plattsburgh, Boston College, Connecticut and U. Mass. For the second time on a VGS field trip a preliminary field trip guide was available to complement the study of outcrops in the field. The trip started with a visit to the exploratory drilling site in Fairfield. Although an uneasy on-site geologist could not reveal all the good information that a group of curious geologists wanted to know, it was rewarding to see this unusual sight of a big drilling rig in a Vermont farmer's field.

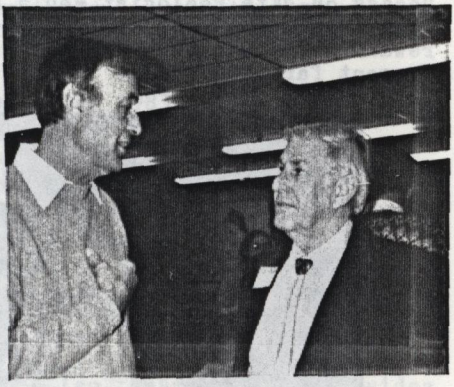


Discussing Dr. Doll's fossils at the 1984 VGS Winter Meeting



Burnor Well #1 in Fairfield , VT., October 6, 1984, 16 days before it was plugged and abandoned.





Some of our VGS Past Presidents observed at the 1984 Winter Meeting

MINUTES OF VGS MEETINGS

ANNUAL MEETING MINUTES 10/6/84

The meeting was opened by the President, Barry Doolan at the Smuggler's Notch Inn. 16 members were present.
SECRETARY'S REPORT: The minutes from the last Executive Committee meeting were accepted as printed in the Fall GMG.
TREASURER'S REPORT: The bank balance is $422.51. Dave notes that we are charged $2.50 each month in which the balance is below $500. Sales of the new Vermont Geology should bring the balance up, however.
OLD BUSINESS
EDITOR'S REPORT: Four issues of GMG were published this year with regular contributions from Ethel Schuele, Chuck Ratte and Shelley Snyder. There is always room for articles from any of the members and they are appreciated. Shelley has been a big help in getting the GMGs out this year.

Volume 3 of Vermont Geology was published this fall. Barry Doolan provided much help with it. 90 advertisements have been mailed to our list of buyers. Advertising is expensive and so this time copies have been sent to Science and Journal of Paleontology, both of whom list books received. Any other ideas would be appreciated.

The first Guidebook is progressing. About 6 field trip guides will be included in this one and a second one should follow in about a year.

Notice of our meetings, which have been sent to colleges for a number of years, seems to have brought some visitors to this year's field trip.

Geotimes was suggested as another possible listing for Volume 3.
NOMINATIONS REPORT: The slate of officers - Pres. Roger Thompson, Vice Pres. Ballard Ebbett, Secretary Larry Becker, Treasurer David Westerman and Board of Directors Shelley Snyder - was accepted.
GROUND WATER WATCHDOG COMMITTEE: Brew Baldwin read the resolution statement printed in the GMG. Chris White wrote the portion of bill H.30 concerning correlative rights in ground water use in Vermont. Farmers are worried that their practice of spreading manure may come under attack as a source of pollution under the law. The Society's support of the resolution will give Brew and Chris some authority in working to get bill H.30 out of committee where it languished at the end of the legislative session.
NEW BUSINESS

Consideration of the ground water resolution: Henry Carse, Chairman of the Natural Resources Committee is in favor of the bill. After the legislature convenes in January, Society members could send letters in support of H.30 to members of the Judiciary and Natural Resources committees. The winter GMG should publish these names and addresses. The resolution was approved by voice vote.

Change in the bylaws was presented as a means of providing guidance for long-term activities in the Society. Clarification was made that the Geological Education Comm. will serve the needs of earth science teachers and the Advancement of the Science Comm. will deal with academic work at the college level. The bylaws were approved by voice vote.

Committee chairpersons were named for election and the formation of a new committee, Stratigraphic Nomenclature, was announced to review changes in nomenclature in Vermont. Chuck Ratte will be chairman. It was noted that Budget and Nominating Committees will be formed by the new Executive Committee. The floor was opened to additional nominations. Vote was made by ballot. The slate was accepted as presented. 18 votes were recorded including absentee ballots.

Discussion of the winter meeting was opened to date and topic. Nothing definite but Jeffrey Pelton suggested that we may want to work with the Vermont Science Teachers Association on a spring meeting. He will be their new President and wants to devote that meeing to earth science.

Roger Thompson as new President asked for a round of applause for the outgoing officers, especially Barry Doolan. Roger would like to have the emphasis on glacial and surficial geology - the practical side of geology- during his tenure. He would also like to have a campaign to recruit more members.

Respectfully submitted,

Jeanne C. Detenbeck

Jeanne Detenbeck, Secy pro tem

EXECUTIVE COMMITTEE MINUTES 11/7/84

Attendance: Barry Doolan, Roger Thompson, Shelley Snyder, Dave Westerman, Jeanne Detenbeck, Chris White, John Malter, Larry Becker

The Minutes of the previous meeting were accepted. Dave Westerman gave a Treasurer's report which indicated a surplus of $536.51. We are up because we sold a lot of bulletins, and from dues and interest. Dave Westerman spoke of the complexity of the bookkeeping system. All agreed reorganization is certainly possible. The Treasurer's report is accepted.

The winter meeting was discussed and Barry Doolan will talk to Rolfe Stanley about having it at Burlington, VT. Papers were encouraged on any topic. The date suggested was February 16, the 3rd Saturday of the month. This seems to be a traditional time. The Cooke Lecture Hall is the likely place, we will have coffee and donuts, projections, etc. The next GMG will be mailed Feb. 1, 1985. Information must be in by January 25th. A dues notice will go out December with a notice of the winter meeting.

A discussion of a State Official coming and speaking ensued. Madeline Kunin will be invited through a letter from the President. The new Secretary of the Agency might take her place. It may be an opportune time for an official speech about groundwater and toxic waste as the new administration begins.

New members accepted include: Don Wernecke, Brad Jordan and Roger Miller.

Discussion of problems with past dues began and people's names still appearing on the mailing list. The policy decided will be that to rejoin, a member should pay for the new year and one year behind because they received the newsletter.

Next meeting set for January to plan for the spring meeting.

Roger Thompson says Fred Larsen would be willing to do the fall field trip on Lake Hitchcock. Roger suggests finishing in the White River area. Jeanne suggested Carpenter House for a banquet.

Roger begins a discussion of mini field trips for interest groups within VGS. We can put a list in GMG (Barry) and discuss next meeting (Roger). A teacher's meeting may be most beneficial (Barry). Jeff Pelton who is now President of the Vt. Science Teachers Association might focus on a meeting for Earth Science Teachers to make them local experts in their region. Maybe an incentive grant to pick 4 or 5 schools to learn about geology of certain areas with field trip stops for local teachers. Thereby, the education Committee can work to develop expertise in outside teachers and professionals. Roger suggest Craig Heindel who is putting together field trips. Others are Stew Clark in Bristol. Maybe we can get Earth Science Teachers into the Society by getting superintendents to pay. John Malter suggests a teaching issue.

Respectfully submitted,
Larry Becker, Secretary

EXECUTIVE COMMITTEE MINUTES 1/16/85

Attendance: Roger Thompson, John Malter, Shelley Snyder, Jeanne Detenbeck and Dave Westerman

The minutes of the previous meeting of the Executive Committee were distributed, reviewed and accepted. Dave Westerman presented a Treasurer's report which indicated a year end balance for 1984 of $684.95 and a current balance of $1,115.95. Dave also reported an error in his billing of Dartmouth (through Faxon) for dues to the amount of $2, and the committee agreed that it was okay to let it go as long as it is corrected before next year.

Four new members were accepted into the society: Norman Hatch, Bruce Cox, H. Douglas Klemme and Peter L. Beblowski.

Plans for the Winter Meeting were discussed, and Roger Thompson reported that Barry Doolan had told him that Rolfe Stanley had some papers dealing with bedrock geology lined up for the meeting. Roger agreed to take care of soliciting papers related to environmental issues. To date there has been no response from the Governor's office about providing a keynote speaker, and Roger agreed to follow up on the initial plan to try and get a speaker from those quarters. Plans for holding the meeting at UVM on 2/16/85 are all set, and the committee agreed that a brief Executive Committee meeting should take place during the Winter Meeting.

Roger announced that one of his primary goals during his tenure as President will be to increase the membership of the society. Toward that end he will emphasize this goal in his message in the next GMG. Other topics discussed relating to membership included an increase in the responsibilities of the Secretary. It was agreed that when a new member joins, the Secretary should send that member a notice of acceptance, an invoice for dues (if appropriate), and a copy of the Bylaws. The Secretary will also keep a record of who each new member's "sponsor" is with the purpose of establishing an award system. The Executive Committee agreed to offer the member who brings

in the most new members a free dinner at the Annual Meeting, and a $1.00 gift certificate for McDonald's(?) per new member for all sponsors. Other efforts to increase membership will include a review of a list of all past members, a special issue of the GMG for the High School Science Teacher's meeting this spring, and the inclusion of applications as an unnumbered center page in the next GMG.

Names were discussed as potential members of the Nominating Committee, and plans are to have the committee established in time to be able to announce its members at the Winter Meeting. No action was taken regarding the establishment of a Budget Committee, giving the Treasurer a few more weeks to evaluate the pros and cons of putting the records onto floppy disks. Dave will report with a recommendation at the next meeting.

The next meeting will be on February 16, 1985 during the Winter Meeting. The date for the Spring Meeting will be announced shortly.

Respectfully submitted,

David S. Westerman
Treasurer (for L. Becker)

MINERAL OF THE QUARTER

Hematite Fe_2O_3

Hardness 1 if earthy, 6.5 when crystalline
Specific Gravity 4.9-5.3
Color red or black, metallic lustre, silvery micaceous flakes

Hematite varies widely in appearance. It is found in thick tabular crystals, micaceous flakes, mammillary radiating growths, soft earthy masses of red paint ore, and iron roses composed of flat intergrown thin scales.

Hematite is the most important source of iron, occurring in tremendous beds of sedimentary origin. Hematite is the principal component of red laterite soils and is responsible for the red coloration of many sedimentary rocks. In our area, the Monkton Quartzite, as well as much of the Dunham Dolomite rocks, derive their color from the hematite which is an accessory mineral in their make-up. The source of this iron is the dark iron-rich rocks of the Adirondack Mountains to our west. These mountains provided the sediments which later became these Cambrian age rocks.

The Monkton Quartzite exposed in parts of the Hoover Street quarry in Burlington contains layers of silvery hematite interspersed throughout the deep reddish quartzite rock. These darker hematite layers make the bedding layers in the tidal sediments, from which the rocks formed, very visible.

A location in the Dunham where micaceous, silvery hematite is quite easily found is at the former Parrot Jasper Mine in Colchester. To reach this location now that Route 2 has been rebuilt in that area, take Rt. 2 toward the Islands from I-89. Leave Rt. 2 at Clay Point Road. Go left to the firehouse and park in the far right of the firehouse parking lot so as not to

interfere with their use of the parking lot. Take the little path through the woods from the back of this parking lot until you meet a path leading upwards. Follow this path about .2 mile to where it grows steeper and turns left. On the right of the path, the cut blasted into the Jasper bed becomes visible. Climb up the bank to your right and you should be able to see the area where the Jasperlite (as it should be called) is still being worked. Hematite forms dark bands through the blood red dense Jasperlite as well as lining cavities with silvery micaceous crystals. One wonders if this iron rich rock was chemically deposited by iron-concentrating bacteria in Cambrian times. The Jasper breccia at a higher level in this mine also raises some questions. What caused the fracturing of this very hard material and its subsequent envelopment in the pink dolomite in which it now is found?

Submitted by Ethel Schuele

STATE GEOLOGIST'S REPORT

NEW LEGISLATION - Legislation has been submitted to the 1985 General Assembly to create for the first time an actual organization within state government known as the Vermont Geological Survey, a division of the Agency of Environmental Conservation. The 1844 legislation authorized the position of the State Geologist with the responsibility to conduct a survey of the state's geology. Over the years the process became the organization in name only. This legislation intends to make the organization official. The new legislation also provides that the state geologist shall be director of the division. The bill also revises, and modernizes former statutes relating to the duties and responsibilities of the state geologist and the functions of the Geological Survey division. The legislation will also place the state geologist into the classified service of the state personnel system.

A copy of the new legislation (draft #1) is available from the legislative council (request #85-370) or the state geologist.

OIL AND GAS - The David and Jean Burnor well #1 drilled by Columbia Gas Transmission Company in Fairfield, Vermont was abandoned and plugged on October 22, 1984 at a depth of 6970 feet. No hydrocarbons were encountered. Fresh water zones occurred at depths of 50' (at the interface between glacial sediments and bedrock), 350', 880' and 3380'. Information regarding geological formations encountered, structural geology, geophysical logs, seismic interpretations, etc. are (by law) to remain confidential for two years unless released earlier by Columbia. The drilling site will be rehabilitated in the spring.

GRANTS - A grant has been received from the Federal Department of Energy to continue participation in the High-Level Radioactive Waste Repository Crystalline Rock Program. The State Geologist's office has been the lead organization for

three years in providing a state overview (monitoring) capability. The program also provides review and critique of documents produced by the Department of Energy that are required by the Nuclear Waste Policy Act of 1982. These documents establish the guidelines and processes that will be used for site selection. Below is the most recent project schedule. The draft regional characterization reports are currently undergoing a comprehensive review.

NEAR TERM CRYSTALLINE REPOSITORY PROJECT SCHEDULE
December 1984

Issue Draft Region-to-Area Screening Methodology Document (DSMD)	09/06/84
Receive State Comments on DSMD	10/26/84
Issue Final Siting Guidelines	12/06/84
Issue Revised Draft Regional Characterization Reports	12/11/84
Final Siting Guidelines Effective	01/07/85
Receive Additional State Comments on DSMD based on review of Final Siting Guidelines	01/07/85
Receive State Comments on the Regional Characterization Reports	03/15/85
Issue Final Region-to-Area Screening Methodology Document	04/03/85
Hold Region-to-Area Screening Methodology-Weighting Workshop	05/85
Issue Final Regional Characterization Reports	07/85
Issue Draft Area Recommendation Report	11/85
Issue Draft Area Characterization Plan	03/86
Issue Final Area Recommendation Report	05/86
Issue Final Area Characterization Plan	09/86
Begin Area Phase Field Work	09/86

Work is nearing completion on a grant from the U.S. Geological Survey to gather all the information on Vermont's metallic mineral resources for entry in the U.S.G.S. computerized Mineral Resources Data System. Over 130 occurrences, prospects and mines have been located and sent to U.S.G.S. at the time of this writing. The work is being conducted by Alan McBean a former graduate of the University of Vermont geology program. Alan is also preparing a new metallic minerals locality map which will be available as a transparent overlay map (scale 1:250,000) to be used with the 1960 Centennial Geologic Map of Vermont. Also many of the samples from the localities visited (approximately 90) are on display at the University of Vermont Geology Department Museum.

The U.S. Geological Survey has also matched the small amount of money now used to initiate a new bedrock and surficial geological program. This funding has been made available through the new U.S.G.S. sponsored COGEOMAP program (Cooperative Geological Mapping) for 1985. The intent is to expand the program in future years. This funding has made it possible to support the following mapping programs through September 1985:

Northfield Quadrangle - Bedrock - David Westerman
Northfield Quadrangle - Surficial - Fred Larsen
Southern Vermont Precambrain Project - James Skehan

PUBLICATIONS - The Bedrock Geology of Brattleboro Quadrangle, Vermont-New Hampshire (Bulletin 32) by J. Christopher Hepburn, Newell J. Trask, John L. Rosenfield and James B. Thompson, Jr. is now available for sale at the Department of Libraries, Geological Documents Section, 111 State Street, Montpelier, Vt 05602. The full text plus colored map and cross-sections is $12.00. A separate set of the map and cross-sections (flat) is available for $5.00. Payment must accompany your order.

Charles A. Ratté
State Geologist
Agency of Environmental Conservation
Montpelier, Vermont 05602

GEOLOGIC PROJECTS IN VT.

This is a continuation of the list of geologic projects in Vermont started in the Fall 1984 GMG. We will be adding to and updating this list in future GMGs. The following entries are abstracted from the complete list of USGS projects that are being conducted wholly or partly in Vermont. Shown for each entry are: title; project chief; FY starting date/FY completion date or (estimated) completion date and descriptions as they apply to Vermont studies. Because the list is so long, it will be continued in the next GMG issue. The State Geologist has the complete listing including the project numbers.

MINERAL RESOURCES ACTIVITIES

Sherbrooke-Lewiston 2 Degree Quadrangle, Maine-New Hampshire-Vermont (CUSMAP); F.C. Canney; 1979/1983.

Geochemical Exploration in the Glens Falls 2-Degree Quadrangle (CUSMAP); K.C. Watts; 1982/1985(est.).

Geostatistical Analysis of Resource Potential of Maine, New Hampshire and Vermont; W.J. Bawiec; 1982/1983.

Geologic Studies of the Sherbrooke-Lewiston 2-Degree Quadrangle, Vermont, Maine and New Hampshire (CUSMAP); R.H. Moench; 1979/1985(est.).

Geology of Chromite; B.R. Lipin; 1981/1985(est.). Preparation of reports on the chromite potential of mafic and ultramafic rocks of Vermont will begin. The mineral potential of zoned ultramafic intrusives will also be studied, and compilation of a metallogenic map of ophiolites in the eastern United States will be underway.

Massive Sulfides of New England; J.F. Slack; 1979/1985(est.). Geochemical studies of the Elizabeth mine area, Vermont, will be completed during FY 1984. Isotopic studies of oxygen, hydrogen and boron in tourmaline from massive sulfide deposits and tourmalinites in Vermont, New Hampshire and Massachusetts will continue.

Vermont RARE II and Wilderness Areas; J.F. Slack; 1981/1983.

Geochemical Characteristics of Granitic Plutons Associated with Porphyry-Type Cu-Mo; R.A. Ayuso; 1981/1985(est.). Mapping of hydrothermal zones in Maine, New Hampshire and Vermont, will continue in FY 1984. Sampling of plutons in the Northeast Kingdom area of Vermont will be underway. The isotopic determinations for dating (Rb-Sr) and signatures (Pb) of the plutons will continue and summarizing of the bulk chemical data will begin.

Mineral Resource Appraisal of Glens Falls 2-Degree Quadrangle; J.F. Slack; 1982/1985(est.).

Geochemistry of Stratabound Sulfide Deposits; W.C. Shanks; 1983/1987(est.). Stable isotope studies from the Elizabeth mine in Vermont, Juan de Fuca rise, offshore Oregon and Washington, and the Guaymas basin, Gulf of California, will be underway in FY 1984.

Appalachian Metallogenic Map; William Cannon; 1982/1984(est.).

Sherbrooke-Lewiston Geophysical Studies (CUSMAP); F.C. Frischknecht; 1979/1984(est.). Compilation of an aeromagnetic map of the Sherbrooke and Lewiston 2-degree quadrangles will be completed in FY 1984. Plans also include...studies of conductive metamorphic rocks in Maine, New Hampshire and Vermont.

Deep Electrical Soundings; F.C. Frischknecht; 1981/1985(est.). Deep magnetotelluric and controlled survey soundings along a New England seismic traverse will be initiated in FY 1984.

Remote Sensing of Glens Falls 2-Degree Quadrangle (CUSMAP); N.M. Milton; 1981/1984(est.).

Central and Eastern U.S. Tectonics; M.F. Kane; 1982/1983.

Geophysical Analysis of Glens Falls Quadrangle (CUSMAP); D.L. Daniels; 1982/1986(est.).

Sherbrooke-Lewiston 2-Degree Quadrangle, W.A. Bothner; 1979/1984(est.).

Glens Falls 2-Degree Quadrangle, NY-NH-VT, Geophysical Studies; C.L. Long; 1984/1986(est.).

Tectonic and Crustal Studies; W.B. Hamilton; 1984/1988(est.). A report on the evolution of continental crust by arc magmatism, using data gathered in New England under project number 9370-03065, will also be prepared.

Geophysical Mapping of Early Mesozoic Basins; Jeffrey Phillips; 1984/1987(est.).

ENERGY RESOURCES AND MARINE GEOLOGY

Uranium Resources in Plutonic Rock, Northeastern United States; E.L. Boudette; 1981/1985(est.). Field and laboratory studies of the geochemistry and emplacement tectonics of New England igneous rocks will continue in FY 1984.

MEETINGS

FEB 16 **VGS WINTER MEETING**
See details on Page 3.

MAR 13-16 NORTHEASTERN SECTION, GEOLOGICAL SOCIETY OF AMERICA
Annual Meeting at Lancaster, PA. For further information contact: Seymour S. Greenberg, Department of Geology and Astronomy, West Chester University, West Chester, PA 19383

APR 20 NATIONAL ASSOCIATION of GEOLOGY TEACHERS
Annual meeting at Norwich University. For more information contact: Dr. Fred Larsen, Earth Sciences, Norwich University, Northfield, VT 05663

APR 27 VERMONT SCIENCE TEACHERS ASSOCIATION
Tentative date for annual meeting at the Fairbanks Museum, St. Johnsbury, VT. For more information contact: Jeffrey Pelton, Springfield High School, Springfield, VT 05156

MAY 4 **VGS SPRING MEETING**
Annual presentation of student research papers at Middlebury College. Details and abstracts in the Spring GMG.

SEPT 16-19 NORTHEASTERN NORTH AMERICAN GROUNDWATER CONFERENCE
At Portland, ME. See details below.

OCT 1985 **VGS FALL FIELD TRIP AND ANNUAL MEETING**
Fred Larsen will give us a guided tour through(?) Lake Hitchcock. Banquet will be held in the White River Junction area. Exact date and further information will appear in the Spring and Fall GMGs.

OCT 1987 NEIGC at Norwich University.

A preliminary announcement of a Northeastern North American Groundwater Conference devoted to groundwater issues of interest to residents of Northeastern United States and Eastern Canada has been received. Emphasis of the conference will be on exploring relationships between groundwater problems, policies, management, regulations and solutions. It should be of interest to geologists, hydrologists, attorneys, government officials at federal, state/provincial, regional and local levels and concerned citizens. Unfortunately, the deadline for return of a questionnaire to determine the level of interest was January 1, but if you are interested in such a conference contact:

Teco Brown
NENAGC
Department of Environmental Protection
State House - Station 17
Augusta, Maine 04333

GREEN MOUNTAIN GEOLOGIST
VERMONT GEOLOGICAL SOCIETY
BOX 304
MONTPELIER, VERMONT 05602

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In case you forgot: **DUES ARE DUE**

ADDRESS CHANGE ? Send it to the Treasurer at the address above, please.

SHELBURNE VT FEB 1 PM 1985 05482

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