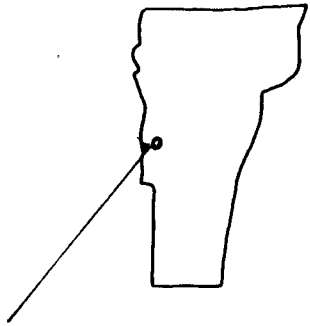
THE GREEN MOUNTAIN GEOLOGIST



QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

SPRING 1984 VOLUME 11 NUMBER 1

Join us as we begin our eleventh year at:

VGS' ELEVENTH ANNUAL

PRESENTATION OF STUDENT PAPERS

SATURDAY MAY 5, 1984 9:20 A.M.

HEMICYCLE WARNER BUILDING

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.

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PRESIDENT'S LETTER

Dear Members,

At the last Executive Committee meeting held February 18, 1984, the Committee approved in principle the proposal I outlined in this column of the Winter GMG. That proposal will establish from our membership rolls three Working Groups which will squarely address our long-term committments to:

1) Environmental Protection,
2) Public Education, and
3) Advancement of the Science.

Each of the Working Groups will be responsible to sponsor yearly activities appropriate to their subjects and formulate longer term goals to work towards. The need for these Working Groups is real; it will enable the collective interests and expertise of our active membership to be more fully utilized; and insure that our commitments made as a Society 10 years ago are realized in the form of more ambitious longer term projects than we have tackled in the past. Appointments of people to chair these Working Groups will be made by the Executive Committee at their spring meeting following the presentation of student papers. All of you will be asked to participate in some form; initially through questionnaires and comments. How much you are further involved depends on you! I urge you all to help in any way you can.

In other matters, I want to again publicly thank our editor, Jeanne Detenbeck, for her tireless efforts on behalf of the Society during the past year. She has nearly completed the manuscript by Charles Doll: Fossils from the Metamorphic rocks of the Silurian-Devonian Magog Belt in Northern Vermont for a special publication of Vermont Geology (see the Editor's report for more information about this publication) and has been actively soliciting papers on Vermont research presented at Winter meetings and past field trips. The planned field trip guide is an excellent project for the Society and will surely be well received. We all owe Jeanne a lot in keeping our GMG and Vermont Geology publications alive and well.

See you at the Spring Meeting in Middlebury!

Barry Doolan

SPRING MEETING PROGRAM

VGS SPRING MEETING **MAY 5, 1984**

HEMICYCLE
WARNER BUILDING MIDDLEBURY COLLEGE

REGISTRATION : COFFEE 8:45

CAMBRIAN-ORDOVICIAN STRATIGRAPHY

1. David Fitzgerald: The stratigraphy and structure northeast of Shoreham, Vermont 9:20
2. John Fraser: Stratigraphy of the Danby Formation, Clarendon Springs Dolostone, and Shelburne Marble, Shoreham, Vermont 9:40
3. Robert Gallagher: Identification and depositional environments of the Lower Ordovician Bascom Formation 10:00
4. Debra Merrill: Stromatactis structures in the Cow Head Breccia, Newfoundland 10:20

GEOCHEMISTRY

5. Mark Larsen: Geochemistry of a greenstone in the Underhill Formation 10:40
6. John Seibert: Rare earth and major elements of a greenstone body near Huntington, Vermont 11:00
7. Laurence Stabler: Metamorphic grade of the Stowe and Moretown Formations as determined by mineral assemblage and composition 11:20
8. Matthew Woodruff: Geochemistry and petrology of a granite pluton in Maple Corners, Vermont 11:40

LUNCH 12:00

SURFICIAL GEOLOGY

9. Karen Demsey: Erosional history and soil development on Quaternary surfaces in the northwestern Espanola Basin, New Mexico 1:00
10. Charles Stick: The glacial and post-glacial sediments of the region between Middlebury and East Middlebury, Vermont 1:20

JAMAICIAN STUDIES

11. Adam Baker: Recovery of a coral reef following hurricane destruction: Discovery Bay, Jamaica 1:40
12. Dorothy van Gerbig: Morphology and zonation of the fore-reef slope, deep fore-reef, and upper island slope (75ft to 500ft), west fore-reef, Discovery Bay, Jamaica 2:00
13. Robert Woellner: Composition and distribution of carbonate sediments from the west reef, Discovery Bay, Jamaica 2:20

PRESENTATION OF AWARDS 3:00

EXECUTIVE COMMITTEE MEETING 3:10

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ABSTRACTS

RECOVERY OF A CORAL REEF FOLLOWING HURRICANE DESTRUCTION: DISCOVERY BAY, JAMAICA

Baker, Adam, Department of Geology, Middlebury College, Middlebury, VT 05753

The reef terrace at Discovery Bay, Jamaica is 335 meters wide and extends from a depth of 3 meters to the fore-reef slope at 27 meters. In the four years following Hurricane "Allen" the terrace has recovered to a primary stage of succession, dominated by algae which trap and bind sediment, cement structural elements of the reef, and produce carbonate sediment. Sponges, worms, bryozoans and echinoderms actively bioerode, consolidate and contribute carbonate skeletal elements to the sediment.

Surf hinders the reestablishment of coral in the pre-storm Palmata Zone (3-7 meters deep), while absorption of sunlight in deeper water inhibits growth in the old Cervicornis Zone (15-27 meters). Coral recovery is greatest in the Mixed Zone (10-15 meters) where there was least storm destruction and where both sunlight and calm water prevail. Very little growth has occurred in the Lower Palmata Zone (7-10 meters).

Coral species which defined the pre-storm zones are recovering but have not regained competitive superiority; thus, other species dominate the immature reefs. Hurricanes responsible for total reef destruction can be identified in the geologic record using these temporary species . They will overlie a storm deposit and underlie corals representing a reef ecological succession. Repetition of this sequence indicates periodic hurricanes and the renewed cycle of reef maturation.

Rates of sediment accumulation may increase on the reef following hurricanes due to sediment trapped in voids of the coral debris, and the accelerated binding, cementing, and sediment-producing activity of algae. Less sediment is available to flow from the reef to the sand channels which run downslope; thus, more sediment is accumulating on the reef. Build-up of the reef above the sand channels from successive hurricanes will give rise to topographic features. This process may be responsible for the spur and groove structures that are typical of the Jamaican north coast.

EROSIONAL HISTORY AND SOIL DEVELOPMENT ON QUATERNARY SURFACES IN THE NORTHWESTERN ESPANOLA BASIN, NEW MEXICO

Demsey, Karen A., Department of Geology, Williams College, Williamstown, MA 01267

The study of soils can be an integral part of geomorphic research. The development and sequence of soil horizons provides evidence of geomorphic processes and events which have occurred on landscape surfaces, and indicates the conditions which prevailed during soil formation. In arid and semi-arid climates, soil accumulates calcium carbonate over time. The

morphology and content of calcium carbonate-rich horizons may be used to estimate soil and corresponding surface age.

A stepped sequence of surface remnants occurs along the Rio del Oso, in the northwest Espanola Basin, New Mexico. The surfaces represent a sequence of distinct erosional and depositional events which occurred during the late Cenozoic in response to tectonic, climatic, and base-level changes. I have estimated the ages of the surfaces by a combination of lab analyses of carbonate content and field observations of carbonate morphology in soils developed in the surface materials.

The estimated age for the highest surface in the area is 200,000 to 400,000 years. The surface was formed on thick alluvial fan deposits and was an active surface of pedimentation, graded to a base level approximately 200 m above the present Rio Grande flood plain, the local base level. Widespread erosion in conjunction with rapid lowering of base level led to deep channel entrenchment and abandonment of the surface beginning 200,000 to 250,000 years BP. A second, lower pediment began to form about 200,000 YBP in adjustment to a new base level about 100 m above the present flood plain. The surface was an active pediment until its abandonment between about 100,000 and 50,000 YBP with entrenchment of channels around this time. The third level of surfaces, 50 m above present channels, was probably formed between 20,000 and 50,000 YBP under conditions of widespread aggradation in conjunction with moister pluvial conditions during Pleistocene glacial times. Terrace remnants at progressively lower levels along the present Rio del Oso were formed from about 20,000 YBP to the present. They may have resulted from slow but progressive downcutting in response to gradually lowering base level, or from periodic alternation of erosion and aggradation due to climatic shifts. The lowest terrace, 3-6 m above the modern channel was formed by aggradation between 400 and 100 YBP. Subsequent downcutting lowered the Rio del Oso to its present level.

THE STRATIGRAPHY AND STRUCTURE NORTHEAST OF SHOREHAM, VERMONT

Fitzgerald, David J., Department of Geology,
Middlebury College, Middlebury, VT 05753

The stratigraphy and structure of the Upper Cambrian to Lower Ordovician formations belonging to the Beekmantown Group were investigated northeast of Pinnacle Hill. A detailed columnar section has been compiled from sections measured in the Shelburne Marble, Clarendon Springs Dolostone, and Danby Formation, representing a total of approximately 315 meters. Several lithofacies representing peritidal environments of deposition are identified. The Shelburne Marble and Clarendon Springs Dolostone are divided into three lithofacies, while the Danby Formation is divided into two.

The structure of this area is more complex than is shown on the Centennial Map of Vermont (Doll and others, 1961). Two thrusts are present in the field area. The Newell Mills Thrust (named here) lies in the central part of the study

area. It places the Upper Cambrian Clarendon Springs Dolostone westward on the Middle Ordovician Bascom Formation and trends south. To the east lies the Pinnacle Thrust (Doll and others, 1961). It places the Upper Cambrian Danby Formation westward on the Lower Ordovician Shelburne Marble in the northeastern part of the field area. Southward, the thrust cuts downsection, placing the Danby above the Clarendon Springs Dolostone. Farther south, the Pinnacle Thrust is folded where it cuts west across the Newell Mills Thrust. Near the crest of Pinnacle Hill, the folded thrust places the Upper Cambrian Danby above the Middle Ordovician Bridport Formation.

STRATIGRAPHY OF THE DANBY FORMATION, CLARENDON SPRINGS DOLOSTONE, AND SHELBURNE MARBLE, SHOREHAM, VERMONT

Fraser, John R., Department of Geology, Middlebury College, Middlebury, VT 05753

A 348-meter section of Cambro-Ordovician shelf carbonates and quartz sands in Shoreham is described. Studied exposures of the Danby Formation, Clarendon Springs Dolostone and Shelburne Marble lie to the south of the Pinnacle, just east of the Lemon Fair River. These formations lie on the western limb of the Middlebury Synclinorium and dip gently east. In the west part of the study area, the east-dipping Pinnacle Thrust places the Cambrian Danby and Clarendon Springs atop the Ordovician Bascom Formation. Only limited attention was devoted to the Bascom.

Through field study and petrographic analysis seven lithofacies are assigned to the stratigraphic section. Environments of deposition are identified for each lithofacies.

Lithofacies A ..... intertidal
Lithofacies B ..... upper subtidal/lower intertidal
Lithofacies C ..... lower shoreface
Lithofacies C_1 .... upper shoreface
Lithofacies D ..... intertidal
Lithofacies D_1 .... intertidal
Lithofacies E ..... intertidal/upper intertidal

Dolomitization appears to be by replacement of aragonite or calcite crystals. The stratigraphy suggests a stable continental shelf environment interrupted in the Cambrian by increased sea level or crustal subsidence.

IDENTIFICATION AND DEPOSITIONAL ENVIRONMENTS OF THE LOWER ORDOVICIAN BASCOM FORMATION

Gallagher, Robert J., Department of Geology, Middlebury College, Middlebury, VT 05753

The stratigraphy of the Upper Cambrian to Lower Ordovician shelf carbonates of the Beekmantown Group, exposed on the western limb of the Middlebury Synclinorium, were

investigated southwest of Middlebury, Vermont. The Bascom Formation of the Beekmantown Group provided the most complete exposures along Vermont Route 125 west and provides the scope of this study.

The Bascom Formation is a carbonate assemblage approximately 125 meters thick (Cady, 1945), of which 60 meters are described. Field analysis and thin section slabs provided petrographic evidence that the sediments which comprise the Bascom Formation were deposited in a low energy tidal flat environment with an influx of terrigenous sediment from a source area at the present location of the Adirondack Mountains. Four microfacies are defined and environments of deposition are defined for each.

Terrigenous clastics.....supratidal
Micrite.....intertidal
Intrasparite/micrite.....intertidal/subtidal interface
Biopelmicrite.....subtidal
Biopelsparite.....subtidal

From these diagnostic microfacies, environments of deposition for lithofacies are proposed.

GEOCHEMISTRY OF A GREEENSTONE IN THE UNDERHILL FORMATION

Larsen, Mark J., Department of Geology, Middlebury College, Middlebury, VT 05753

Major and trace element analyses were performed on the rocks of the Gillett Pond greenstone. The greenstone body, located just north of Huntington, Vermont, is mapped as an amphibolitic greenstone of the Underhill Formation on the Vermont state geologic map (Doll et al., 1961).

The rocks contain the greenshist assemblage of actinolite, chlorite, albite, epidote, and leucoxene, with calcite as a major constituent in two rocks, and biotite and hematite as accessory minerals in several other samples.

Major element chemistry reveals that the rocks are tholeiitic basalts. When plotted on the $MgO-FeO-Al_2O_3$ diagram (Pearce et al., 1977), the data falls in the fields of ocean island and continental basalts, suggestive of a transitional nature between ocean island and continental character. The rare earth element data support this, showing a slightly enriched light rare earth element (LREE) pattern relative to the heavy rare earth elements (HREE). When plotted against the chondrite standard, the REE display a fairly consistent trend, with a pattern 21 to 32 times enriched in the LREE, and 11 to 16 times enriched in the HREE.

The rocks of the Gillett Pond may represent lavas that were extruded in a transitional phase between continental and ocean floor volcanism during the initial stages of opening of the proto-Atlantic.

STROMATACTIS STRUCTURES IN THE COW HEAD BRECCIA, NEWFOUNDLAND

Merrill, Debra, Department of Geology, University of Vermont, Burlington, VT 05401

Limestone clasts within the Cow Head Breccia (Mid-Ord., western Newfoundland) that show an unusual association of sparry calcite and chert in calcilutite are found to contain stromatactis structures. These clasts are interpreted to have originated from a calcareous mud mound present on the carbonate shelf. These clasts show many similarities to the lithologies and morphologies described in Middle Ordovician calcareous mud mounds at Meiklejohn Peak and other localities.

The stromatactis structures are filled with radiaxial fibrous cement and internal sediments within an unbedded biomicrospar. The internal sediment consists of algal mud and trilobite and brachiopod fragments that have been relaced by a later blocky calcite cement. The Cow Head stromatactis clasts are unique because of the presence of chert within the stromatactis structures.

Thin section studies of the diagenetic textures reveal a complex post-depositional history. The radiaxial fibrous cement is interpreted as an early alteration of the original cement in a submarine environment. Exposure to the meteoric phreatic environment is suggested by the presence of the equant calcite as well as low levels of Mg, Fe, Sr in these clasts. Relict radiaxial fibrous textures are found within the chert horizons and some of the equant cement shows partial dissolution and chertification. This indicates that chertification took place subsequent to the precipitation of the later equant cement. This mound was later broken up and deposited within the slope deposits of the Cow Head Breccia.

RARE EARTH AND MAJOR ELEMENTS OF A GREENSTONE BODY NEAR HUNTINGTON, VERMONT

Seibert, John C., Department of Geology, Middlebury College, Middlebury, VT 05753

A greenstone body in the Underhill Formation, located 1.25 miles west of Huntington was studied for major and rare earth element abundances. The greenstones throughout the body have been metamorphosed to the biotite zone of the greenschist facies. Chlorite - biotite - blue green amphibole - albite is the primary mineral assemblage. Other commonly associated minerals include sphene and epidote. Post-kinematic apatite, albite, and Fe-Ti oxides are also present.

Since the rocks have been metamorphosed, the relatively immobile major element oxides (including P_2O_5, MnO, Al_2O_3, and TiO_2) and the rare earth elements (REE) are used to determine the original chemistry and tectonic environment of the greenstones. REE elements show LREE enriched trends (80 - 190 X chondrite) and relatively depleted trends in the HREE's (11 - 20). Rocks with similar concentrations have been classified as alkali basalts, or as Fe-rich tholeiites. Concentrations and variations of major and rare earth elements suggest that the basalts could have originated by a small degree of partial melting of an undepleted mantle. This was probably followed

by the fractionation of clinopyroxene and plagioclase.

A TiO_2 - MnO - P_2O_5 ternary diagram (Mullen 1983) indicates that the basalts formed in an ocean island or continental environment. Comparison of REE trends with known oceanic basalts and continental basalts indicate similar origins. Stratigraphic relationships, geologic location, and chemical similarities with the Tibbit Hill volcanic unit in northern Vermont suggest that they are continental rifting basalts, and not ocean island basalts.

METAMORPHIC GRADE OF THE STOWE AND MORETOWN FORMATIONS AS DETERMINED BY MINERAL ASSEMBLAGE AND COMPOSITION

Stabler, Laurence C., Department of Geology,
Middlebury College, Middlebury, VT 05753

Mineral assemblages and mineral compositions of the Stowe Formation and the Moretown member of the Missisquoi Formation have been investigated in central Vermont to determine if changes in mineral composition record gradients of metamorphism.

Analysis of mineral compositions from 14 thin sections along a 60-mile belt of the Stowe Formation and the Moretown member of the Missisquoi Formation show that phengite, biotite, and chlorite do not experience any systematic change in composition from north to south. Plagioclase compositions exhibit small variations in composition (An_{0-5}) except in the southern end of the Stowe Formation and in the Moretown Formation northeast of Bethel, where the An content of the plagioclase increase abruptly (An_{20-35}).

Based on mineral assemblages and mineral compositions, the Stowe Formation is assigned to the chlorite zone except in the southern end of the formation, where it is assigned to a biotite-garnet zone due to presence of garnet and Ca-rich plagioclase. The Moretown Formation is assigned to the biotite zone except in the area northeast of Bethel, where the formation is assigned to the garnet zone. With the exception of these two areas metamorphic grade within the formations remains relatively constant; changes in the compositions of the minerals appear to be primarily a result of changes in bulk rock composition.

Overall metamorphic grade increases to the east from the Stowe to the Moretown Formation. Steeper metamorphic gradients also occur locally to the south of the study area in the Stowe Formation and in the Moretown Formation northeast of Bethel, indicating local changes in tectonic conditions in these areas and a general change in tectonic conditions to the east.

THE GLACIAL AND POST-GLACIAL SEDIMENTS OF THE REGION BETWEEN MIDDLEBURY AND EAST MIDDLEBURY, VERMONT

Stick, Charles J., Department of Geology,
Middlebury College, Middlebury, VT 05753

The structure and composition of the glacial and post-glacial sediments that dominate the surficial geology of the Champlain Lowlands are exposed in three sand and gravel pits that lie on the western flank of the Green Mountains, between Middlebury and East Middlebury, Vermont.

The School House Road pit, located .5 kilometers north of East Middlebury, is deltaic in origin and formed as the Middlebury River transported meltwater sediments from the Green Mountains to Lake Vermont. Foreset beds of fine to medium sand, silt, and lacustrine clay are exposed in the lower 25 feet of the pit, between 485 and 510 feet. The beds dip northwest 25 degrees. Horizontal beds of fine sand, silt, and lacustrine clay are found up to 540 feet in the northeast corner of the pit. The horizontal upper surface of the delta, between 550 and 560 feet, is comprised of laminated well-sorted medium sand. These beds may mark a Coveville shoreline of Lake Vermont.

The Foster Brothers and Carrara pits are due east of Middlebury. The sedimentary features here suggest that material was deposited in ice-contact deltas along a stagnant ice margin. Within the Foster Brothers pit, foreset beds of poorly-sorted coarse sand, gravel, and large boulders are found up to an elevation of 540 feet. Grain size analysis of the Foster Brothers pit shows a general decrease in particle size in a westerly direction. A thin bed of well-sorted sand found between 537 and 556 feet in the Foster Brothers pit may represent a former Coveville shoreline. Well-rounded cobbles interfinger to the west with thinly-bedded sand, silt, and lacustrine clay. The cobbles probably represent the coarser fraction of turbidity currents that flowed down the flanks of the ice-contact deltas.

Large sub-rounded boulders found in the eastern portion of both deposits were somehow deposited in the deltaic sediments (ice-rafting?). The only evidence of faulting in the study area is in the upper portion of the Carrara pit between 470 and 500 feet. Such faults are probably the result of the melting out of buried ice blocks.

The morphosequence model (Koteff and Pessl, 1981) provides a basis for inferring the origin of the sediments examined in these two pits.

MORPHOLOGY AND ZONATION OF THE FORE-REEF SLOPE, DEEP FORE-REEF, AND UPPER ISLAND SLOPE (75ft to 500ft), WEST FORE-REEF, DISCOVERY BAY, JAMAICA

van Gerbig, Dorothy F., Department of Geology,
Middlebury College, Middlebury, VT 05753

A fringing reef extends for close to 150 miles along the north shore of Jamaica. On the west fore-reef of Discovery Bay the reef crest lies approximately 400ft offshore. A broad, gently sloping terrace extends seaward from the crest

for approximately 1000ft where a break in slope marks the top of the fore-reef slope.

A depression or "moat" lies parallel to the reef crest at the top of the fore-reef slope. It catches loose sediment transported down from the reef terrace, and directs the sediment into channels on the slope. The channels lie between a series of reef lobes and pinnacles. The lobes consist of a rich diversity of marine fauna. On the upper portion of the slope, the platy form of Montastrea annularis is the dominant coral, but platy species of Agaricia become dominant farther downslope. The slope appears to be accreting seaward. It extends down to a second break in slope at 150ft, which marks the top of the deep fore-reef.

The deep fore-reef, from 150ft to 400ft, is a near-vertical to overhanging wall. Active seaward accretion is apparent to a depth of approximately 360ft. The wall is divided into three zones. From 150ft to 230ft scleractinians are the dominant framework-builders. From 230ft to 360ft sclerosponges dominate. From 360ft to the wall's base, there is a marked decrease in the abundance of all framework building organisms, and active seaward accretion no longer seems to occur. Most organic growth in this zone takes place on promontories which are continuations of the slope-reef lobes. The downslope drainage of sediment continues from the slope channels down reentrants that are located between the promontories.

A third break in slope at approximately 400ft marks the top of the island slope. It converges abruptly with the deep fore-reef where piles of debris derived from above are deposited at the base of the reentrants. The upper portion of the region is typified by a very steep slope of approximately 45 degrees. The slope angle grades down to an angle somewhere between 30-35 degrees at a depth of 500ft. The slope is covered with a generally fine, unlithified sediment that forms a thin veneer over the lithified reef rock.

COMPOSITION AND DISTRIBUTION OF CARBONATE SEDIMENTS FROM THE WEST REEF, DISCOVERY BAY, JAMAICA

Woellner, Robert A., Middlebury College,
Middlebury, VT 05753

The texture, composition, and mineralogy of recent sediments from the west reef at Discovery Bay, Jamaica are studied. These properties are related to environmental factors. Sediment distribution throughout the reef is influenced both by hydraulic forces and the distribution of sediment producers.

Distribution of sediment sizes has shown an increase in the amount of fine-size particles with depth. Particle size diversity is greatest in the backreef Thalassia and deep fore-reef environments. Recent sediments consist of fragments of coral, Halimeda, mollusca, foraminifera, algae, and echinoderms, in order of decreasing abundance.

Sediment composition and texture vary with depth, and thus may be useful in the interpretation of the environment of deposition of older carbonate reef structures.

GEOCHEMISTRY AND PETROLOGY OF A GRANITE PLUTON IN MAPLE CORNERS, VERMONT

Woodruff, Matthew M., Department of Geology, Middlebury College, Middlebury, VT 05753

The Maple Corners intrusion is a biotite granodiorite that lies about 12 miles north of Montpelier in east-central Vermont. It is about one mile long and is concordant in the Northfield Formation. The pluton is from the Late Devonian plutonic series (post-tectonic), and it lacks any gneissoid structures common in the New Hampshire syntectonic plutons.

Early cooling produced primary biotite and muscovite with well-formed plagioclase and quartz. Late hydrothermal alterations produced epidote, calcite and (mostly in the plagioclase) secondary muscovite. Normal zonation of plagioclase shows late-stage sodium enrichment. A temperature of 640 C was obtained from a core sample, using a biotite geothermometer. This is the minimum melt temperature in the system Ab-Qu-Or-H_2O at 5 kbar.

Compared to other New England granites, geochemical analyses show enrichment in SiO_2, Al_2O_3, and Na_2O, with depletions in all other major elements. Major element concentrations categorize the granite as a possible I-type. Trace elements amounts are low; rare earths, when normalized to chondrite, are enriched in the light elements (50-80), with low concentrations of heavy elements (8-3).

The granite formed due to late-stage effects of the Acadian Orogeny during Devonian times. It is possible that partial melting of the lower crust produced the granite, yet the origin is equivocal.

The Shaw Mountain conglomerate was studied because of a recent interpretation that some of the cobbles are from calc-alkaline "dikes" in the adjacent Moretown Formation. However, the high TiO_2 content in the cobbles is inconsistent with an origin from the Maple Corners intrusion, and possibly any other local plutons.

VGS BUSINESS & NEWS

COMMITTEE ON NOMINATIONS

The committee, composed of John Malter, Chairman, and Chuck Ratte', has submitted the following slate of officers for the fall election:

President	Roger Thompson
Vice President	Ballard Ebbett
Secretary	Laurence Becker
Treasurer	Dorothy Richter
Board of Directors	Shelley Snyder

The VGS Bylaws make provision for accepting additional nominations from members, to be submitted by mail to the secretary up to one month after the spring meeting.

GROUNDWATER WATCHDOG COMMITTEE REPORT

Members of the VGS' ad hoc "Groundwater Watchdog Committee" have worked together over the past year to revise H.30, a House bill devoted to establishing correlative rights as the doctrine governing the liability for groundwater use in Vermont. We have met individually and collectively with legislators, members of the Agency of Environmental Conservation, the Health Department, the Attorney General's office, as well as private lawyers and other members of VGS, in order to draft a new H.30 that would be closer to what we as geologists feel comfortable with. Below is the draft we have come up with, last revised on 3/1/84. It includes comments received from you following the winter VGS meeting. We want to thank you for your help and input.

The plans for H.30 now rest in the hands of Mr. Henry Carse of Hinesburg. He is the chair of the House Natural Resources Committee. He has kindly held two hearings on H.30 this past session. We had no expectations of getting H.30 to the floor this year. However, this background work plus additional work this summer will hopefully allow H.30 to be introduced early in 1985.

Major roadblocks to passage of H.30, at this point, appear to come from the agricultural community. Farmers fear, apparently, that a bill such as H.30 would unduly restrict what they could do with their fields, especially in regard to spreading manure. Once H.30 comes out of Mr. Carse's Natural Resources Committee, it will most certainly be called into the Agriculture Committee for review. From there, its fate will be uncertain.

Any comments that you have on H.30 or this summary would be gratefully received.

Brewster Baldwin
David Tarbox
Chris White

(draft no. - H.30) EDITION 3/1/84

TO THE HOUSE OF REPRESENTATIVES:

The Committee on Natural Resources to which was referred House Bill H.30, entitled "AN ACT TO ADD 10 V.S.A. S 1284 RELATING TO GROUNDWATER" respectfully report that they have considered the same and recommend that the bill be amended by striking all after the enacting clause and inserting in lieu thereof the following: "Sec. 1. 10 V.S.A. S 1284 is added to read:

S 1284. GROUNDWATER; CORRELATIVE RIGHTS; RIGHT OF ACTION

Findings and declaration of intent

Whereas, case law in Vermont in regard to groundwater has generally followed the concept that groundwater behaves in a mysterious and unknowable manner; and

Whereas, the knowledge and science of hydrology has sufficiently advanced over the past century so that groundwater behavior can be explained scientifically and can be predicted with a degree of accuracy not possible in the past; and

Whereas, present-day knowledge of hydrology indicates that surface and subsurface water are inherently interrelated in terms of both quality and quantity and that indeed surface water usually supplies ground water; and

Whereas, groundwater hydrology is a well-developed science that allows for groundwater quality and quantity to be mapped and forecasted so that the effects of groundwater withdrawal and/or groundwater contamination have predictable and demonstrable effects on neighboring water supplies; and

Whereas, groundwater is a mobile resource and is similar to surface water or the atmosphere in that it is a necessarily shared resource amongst all affected users:

Now, therefore, the legislature declares that in order to better allocate the liability for all uses of groundwater in the State of Vermont, this legislation is enacted.

(a) Definitions

(1) "Groundwater" means water below the land surface in a zone of saturation;

(2) "Zone of saturation" means that portion of soil, sand, gravel or rock in which the openings, voids and pores are filled with water.

(3) "Surface Water" means any water on the land surface.

(4) "Correlative rights" means the rights of groundwater users to use groundwater for reasonable and beneficial purposes provided that the use does not deny other groundwater users equal rights. All users must share the common resource according to the reasonableness and benefits of their respective uses as considered in part by the factors listed in section (c).

(5) "Groundwater use" means the withdrawal or diversion of groundwater, and any alteration of its character or quality.

(6) "Person" means any individual, partnership, company, corporation, association, unincorporated association, joint venture, trust, municipality, the State of Vermont, or any agency, department of subdivision of the state, Federal agency, or any other legal or commercial entity.

(b) The doctrine of correlative rights shall govern the allocation of liability for all uses of groundwater in the State of Vermont. Correlative rights requires a balancing of the equities among the affected and potential groundwater users.

(c) Factors to be considered in balancing the equities among the groundwater users may include, but need not be limited to, the following:

(1) the purpose of the respective uses;

(2) the economic, social and environmental value of the respective uses;

(3) the nature and extent of the harm caused, if any;

(4) the practicality of avoiding the harm, if any;

(5) the practicality of adjusting the quantity or quality of water used or affected and the method of use by each party;

(6) the maintainance or improvement of groundwater and surface water quality;

(7) the protection of existing values of land, investments, and enterprises; and

(8) the burden and fairness of requiring a groundwater user who causes harm to bear the loss.

(d) Any person who, by groundwater use, causes harm may be found liable according to the doctrine of correlative rights and factors such as those listed in subsection (c). Injunctive relief shall be available where appropriate."

And that when so amended the bill ought to pass.

A1/cm - 2/15/83 - 9:15 a.m. - s;H.-30 amend:6

EDITOR'S REPORT

The month of May should see the publication of Charles Doll's "Fossils from the Metamorphic Rocks of the Silurian-Devonian Magog Belt in Northern Vermont". We can take orders for this 3rd volume of Vermont Geology at the Spring Meeting. Cost for this issue (which will contain 20 photographic plates of the fossils and an extensive bibliography) has been estimated at $8.00 for VGS members and $9.00 for non-members (postage and handling included).

Letters have been sent to those past field trip leaders who have indicated a willingness to provide an entry for the first of two VGS Guidebooks. There should be 6 or 7 entries (due to the editor on June 30) and, hopefully, in print by the fall meeting.

Letters are also in the mail soliciting manuscripts for another volume of professional papers from our speakers at the 1984 winter meeting. Presentation of a paper at the winter meeting is not a prerequisite for having a paper published in Vermont Geology, however. If you are interested in submitting a manuscript for publication in a future volume of Vermont Geology, please write for details to:

Jeanne Detenbeck, VGS Editor
RFD 1 Box 209
Shelburne, VT 05482

VGS EXECUTIVE COMMITTEE MINUTES

The meeting was called to order during lunch hour of the Winter Meeting at Norwich University on February 18, 1984 by President Barry Doolan. Present at the meeting were Barry Doolan, Dorothy Richter, Diane Vanecek, Brewster Baldwin, Roger Thompson, Chris White, Jim Ashley, Jeanne Detenbeck, John Malter, Stewart Clark and Gene Simmons.

Minutes from the last meeting were accepted as printed in the GMG.

OLD BUSINESS:

Chris White reiterated the purpose of the membership information form (as printed in the GMG) as being to develop a directory and to further the sense of community in VGS. Chris will do the computer work for the next few years.

Chris White would like to have the Society review Vt. bill

H.30 (which will probably not come up for vote this year) and adopt a statement about our support of it. The next GMG should publish a summary of the concerns about the bill and what it takes to get it through the legislature. Brew Baldwin said that we can promote just as much information as we want without losing our tax exempt status. Only outright lobbying by the Society could affect that, but individual members can lobby without creating a problem. A report will be written for the Spring GMG and reviewed by Barry. Approval from the membership will be obtained using a response form in the GMG.

NEW BUSINESS:

The Spring Meeting date was set for May 5 at UVM. That date is preferred by MU but it is the beginning of finals at UVM. (April 28 is the date for GRE's.) The call for papers should go out soon and should emphasize the graduate student participation. We want to encourage participation by more than MU and UVM. It was noted that we could go to double sessions if necessary. If students decide to come up from Williams College, Brew could arrange to have the meeting at MU on short notice.

Roger Thompson will arrange to have the books audited and the report ready by the Spring Meeting.

Brew would like to have a shorter lunch break at the Spring Meeting and have the Executive Committee meeting afterwards. The only objection would be from those with long trips home afterwards.

The appointment of the Nominating Committee was discussed. John Malter was appointed to get a pool of prospective members for selection. Barry will make an announcement at the afternoon session to encourage volunteers.

The Summer Field Trip will be an overnight trip to Thetford Mines. Barry suggested that the ultramafics from the border up to Thetford could be included. Brew gave a history of the Thetford Mines guide book which he wrote originally. It was rewritten several times at the suggestion of Clague(?), R. Laurent, and Barry. The date for the trip will be August 11-12 (Aug. 4-5 is the Burlington Gem and Mineral Club show.) We will meet about noon on the 11th at a Canadian location and proceed to Thetford. Both campgrounds and motels will be available for overnight lodging.

Jeanne Detenbeck reported for the Editorial Committee. They met in November to discuss publishing Dr. Doll's metamorphic fossils manuscript and field trip guides. It was decided that we would publish the former if Dr. Doll would accept our including a preface with a disclaimer. The preface was read aloud and it was suggested that we put more emphasis on the fact that this publication deviates from our review policy for papers published by VGS in Vermont Geology. The field guide will come out in two volumes, probably. It should be possible to set a summer deadline for receipt of manuscripts for the first volume and the second volume will be ready in time for the fall 1985 NEIGC.

Barry explained his idea for establishing long term commit-

tees which would have committments that would be more continuous than the terms of the officers. He will organize as well as present them. They will use VGS as a basis for communication. The leader of each committee would have a charge each year from the Executive Committee for some activity to be accomplished during that year. Barry can use the information gathered by Chris White as the basis for assignments. Roger Thompson suggested that we might have more small field trips for special interests.

Treasurer's Report - Those applying for membership will now be put on the mailing list immediately and the Executive Committee will approve membership at the next meeting. There are 90 paid members for 1984. Balance on 2/17/1984 was $2130.84. $25 was received on 2/18/1984. Fred will let us know about charges for the coffee and donuts.

The meeting was adjourned for the afternoon session.

Respectfully submitted
J.C. Detenbeck, pro te

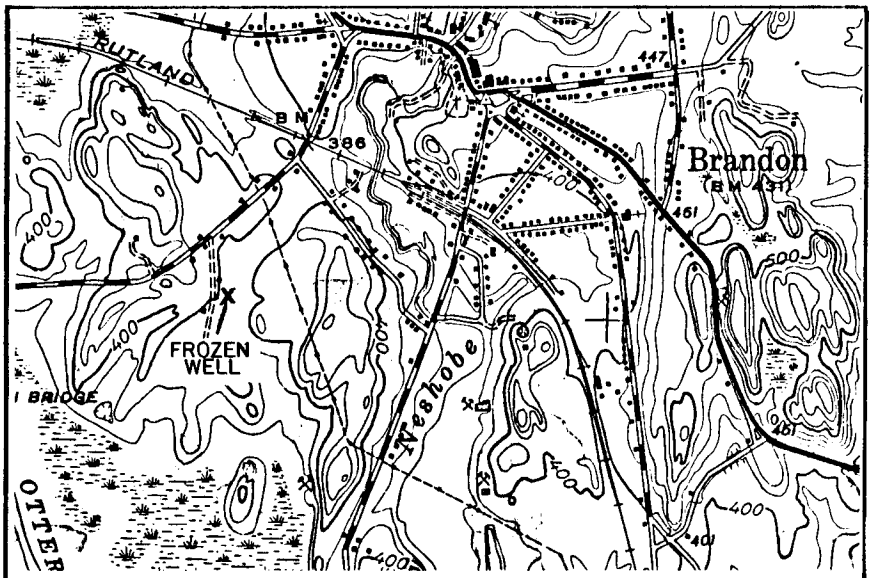
BELOW THE SURFACE

THE "FROZEN WELL" OF BRANDON, VERMONT"

Kevin Dann
RR1 Box 577-1
Huntington, Vermont 05462

A Beers' Atlas can yield some curious mysteries. About a year ago I was looking at the 1869 Beers' Atlas map of Brandon, Vermont, searching for clues to some strange features I'd noticed on an aerial photograph. I couldn't find any trace of them, but an equally strange title on the map caught my eye. There on the map, about a mile southwest of the village of Brandon, and a quarter mile from Otter Creek, was a spot marked "Frozen Well". Of all the local oddities that surely existed in Brandon in 1869, somehow the Beers people had seen fit to recognize a "frozen well" as an oddity worthy of a place on their map, whose usual subjects were houses, farms, mills, and other industries of the day. Few natural phenomena ever received notice on the Beers' maps.

Though noted on this widely circulated 1869 map, by that year the excitement over the frozen well had faded considerably since its discovery ten years earlier. During those years it fascinated some of the most accomplished scientific minds of the day, including Louis Agassiz, Charles Lyell, and Edward Hitchcock, and it prompted a thorough investigation by the most highly respected scientific society in New England, the Boston Society of Natural History. The members of the "expedition" sent to investigate the curious phenomena were among the Society's most eminent: Dr. Charles T. Jackson (Vice-President of the BSNH at the time), William A. Rogers (a noted geologist), and Thomas T. Bouve' (BSNH President 1870-1880). Despite their collective efforts, the cause of the mysterious Brandon frozen well was never ascertained, and indeed it has remained a mystery until the present day.



Location map for Frozen Well. Brandon 1:24,000 quadrangle.

It all began in November of 1858, when Abraham Trombley* of Brandon decided to dig a new well on his land. Aided by a neighbor, Trombley sank a well to a depth of 14 feet whereupon he hit a deposit of frozen gravel! The deposit, 12 to 15 feet in thickness, consisted of "coarse gravel, rounded pebbles, and lumps of clear ice, from the size of an egg to that of a twelve-pound cannon ball". Continuing past this deposit of frozen gravel, they reached water at 32 feet. The next day, however, when Mr. Trombley went to draw water from the well for his family's use, a two-inch layer of ice had formed. Each night the same thing happened, so that Trombley had to send his boy down the well to cut through the crust of ice and retrieve the water.

Upon his next visit to town, Trombley took with him some frozen masses of earth and lumps of ice to show to the villagers. The frozen well, which was at best a considerable bother to the Brandon farmer, was an exciting curiosity to his fellow townsmen, and it soon became something of a local attraction. By the following summer, when ice could still be found coating the stones of the well for four or five feet above the surface of the water, news of the Brandon frozen well had hit the Burlington Free Press. Even in Boston, newspapers carried accounts of the frozen well, and these accounts aroused the attention of members of Boston's considerable scientific community. In May of 1859,

*His name was mispelled in all the published accounts as Twombley. Conversation with older residents of the community seem to indicate that Trombley is correct. Town records contain a deed with the "Trombley" spelling, but, unfortunately, it was signed with an "X", by an apparently illiterate man.

the Boston Society of Natural History received a letter from Uriah A. Boyden, Esquire, of Boston, requesting the Society to examine the "so-called ice stratum in Brandon, which has recently been referred to in the newspapers". Mr. Boyden was curious enough about the "ice stratum" to include his check for $300 to cover the Society's expenses in their investigation. A committee was formed immediately, consisting of T.T. Bouve', W.B. Rogers, and Dr. C.T. Jackson. A week later, John H. Blake, a Boston lawyer who owned the Brandon Iron Company, was added to the committee.

On June 10, Rogers and Bouve' being busy with other matters, Jackson and Blake made their first trip to Brandon. Jackson was an experienced geologist as well as an able physician (he is often credited as being the first doctor in America to use anesthesia during surgery). While still a medical student he had made a geological tour of Nova Scotia (1828-9) and published his reports of the trip in the American Journal of Science. He had studied geology at the Sorbonne in Paris, was Maine's first State Geologist from 1836-1839, and had also made geological surveys of Rhode Island and New Hampshire. With this as his background, Jackson spent his first day in Brandon not at the well, but in an examination of the geology of the immediate area; he and Blake measured the slopes of the hills, the thickness of the surficial strata, and traced the gravel bed in which the well was dug to its outcrop in the town gravel pit nearby. After making this survey, Blake and Jackson turned their attention to the well itself. They took temperature readings of the water in the well, of the air in the well shaft and at the surface, and also measured the temperature of the water at several neighboring springs and wells. They decided to sink another shaft halfway between the frozen well and the top of the "Hogback", a gravel ridge, but Mr. Trombley protested, as he had a crop of potatoes growing there at the time!

The "expedition" returned to Boston with little to report. Their chemical analysis of the water showed it to be normal. The other wells and springs in the vicinity were not extraordinarily cold, so they knew, at least, that the phenomenon was limited in area. But how limited? Returning to Brandon at the end of August, Jackson and Blake arranged to dig another well, away from Mr. Trombley's potatoes this time. It was carried to a depth of 29 feet, but no frozen material was found, and before long, a second attempt was made. This time, at the same depth, frozen gravel was found. To dig all these holes, W.H. Blake recruited miners from his iron company. Their strength and skill proved necessary in the researches, since the second shaft needed double-timbering and planking to prevent a cave-in.

Despite all the resources brought to bear on the frozen well, the Boston naturalists ventured only tentative explanations for the phenomenon. In 1862, after three summers had failed to dissipate the cold at the bottom of the two wells, Jackson and Blake issued a report of their findings. They reviewed the various hypotheses offered to account for the phenomena: 1) the penetration of cold currents of air through the gravel; 2) the descent of cold air into the well in mid-winter; 3) radiation of heat from the bottom of the well; 4) the existence of some nat-

ural freezing mixture in the frozen strata; and 5) electricity. They discounted all of these hypotheses, however, believing that "the freezing is due to the nature of the conducting medium in which the well exists... The wave of heat in summer months is not adequate to overcome the cold of the longer winter months, while the uncommonly severe winters of 1856 and 1857 may have lowered the temperature of the rocky masses of boulders...". This vague interpretation, the best the Boston naturalists could muster, they proposed would be tested by time, believing that a few summers, helped along by the numerous pits they had sunk into the gravel bed, would hasten the thawing. A decade of summers failed to do so, however, and in 1871 the committee closed the matter, saying that they could think of "no new or additional experiments or researches" and wished "to be discharged from further consideration of the subject".

There were others who had their own imaginative interpretations. A Mr. Booth, editor of the Springfield Republican, could not help using the frozen well to make a swipe at a notable non-Republican politician of the day, Stephen A. Douglas. After describing the well to his readers, Booth added that:

> Stephen A. Douglas was born near the spot where the well now is. This..can hardly mystify the thing, for he left his native town years ago, and there has never been any known sympathy between him and ice water since he was born.

At the time of the discovery of the frozen well, Vermont was fortunate to have as its State Geologist one of the most capable geologists of the era, Edward Hitchcock. Hitchock, who had served for a decade as Amherst College's President, had in 1857 begun to compile information for a "final report" on the geology of Vermont, and when news of the frozen well reached him, he naturally set out for Brandon. Hitchcock's investigations (with his assistants, his son Charles, and a self-taught scientist of sorts from Proctorsville, Albert D. Hager) followed along much the same lines as those of the Boston Society of Natural History. However, the pragmatic Hager, who called the frozen well "a mammoth refrigerator" carried out some new experiments to determine the insulating properties of the clay that lay below the ice-laden gravel deposit. He found it to be an extremely efficient insulator, and concluded that it protected the buried ice from the warming effects of the earth's internal heat. Hager's opinion as to how the ice got there in the first place was as misguided as his clay conjecture had been accurate. He attributed the ice to certain nebulous (and decidedly non-existent) streams of cold subterranean water.

Edward Hitchcock, however, came closer than anyone else in deciphering the frozen mystery. He knew that buried beneath the gravel there was a "frozen nucleus" that caused the well to ice over, since if this were not so all wells in porous soil would be converted into frozen ones. In 1859, the year that he and Hager had visited the well, Hitchcock seemed to concur with the idea that the frozen nucleus had been produced by causes active at that time. Though he speculated that the frozen deposit was possibly a remnant of a glacial period, he remained skeptical.

By 1861, the year Hitchcock's final report, The Geology of Vermont, was published, he seemed to place more credence in the idea of the ice as a glacial relict. Though admitting that "the period since that time...we reckon by piling tens of thousands of years upon one another", Hitchcock stated that "if we can show how a frozen deposit, formed at the time of any past period, might be indefinitely preserved, it is no matter how long ago it was first congealed". Hager's experiments had proved to Hitchock's satisfactions the insulating quality of the native clay, so his mind was free to reckon back into the geological past. This is the ability which set geologists apart in 1860, and which still does today, the ability to confront time, to acknowledge the possibility of an overwhelmingly distant geological past.

The plausibility of the frozen mass as a glacial relict was witnessed in Hitchcock's eyes by the nature of its host deposit, a "moraine terrace" as he called it. Such terraces Hitchcock supposed to have been produced by stranded icebergs during the Pleistocene. It is at this point that Hitchcock's insight breaks down. Like every one of us, Hitchcock was a prisoner of his moment in history, and that moment for Hitchcock (as well as for a host of other prominent geologists, not to mention most of the general populace) was framed by a belief in the Biblical flood. Like so many other scientific men of his day, Edward Hitchcock was originally schooled and ordained for the ministry, so that in crossing over into the realm of science, the Deluge of scripture naturally became the marine invasion of geology. To the Amherst minister/geologist's mind, that marine invasion brought icebergs into New England, and nameless thousands of years ago it left one buried in a cloak of insulating clay in the town of Brandon.

Louis Agassiz, Charles Darwin, and a century of scientific observation have changed our once-Biblical view of the Pleistocene, and they have eliminated icebergs as a possible cause of the Brandon frozen well. But Hitchcock was not far off. There must indeed have been a "frozen nucleus" to cause Mr. Trombley's well to freeze over for so many years, a nucleus left not by floating icebergs, but by a continental ice-sheet, one whose proportions would have stretched the limits of even Hitchcock's profound imagination. While most of the ice blocks which wasted from the enormous glacier have long since melted, some forming kettle ponds like Spectacle Pond near Island Pond or Silver Lake in Barnard, others became entrapped in clay sediments that acted like the outer walls of Hager's "refrigerator". Hitchcock, Jackson and the rest of their scientific and lay contemporaries had been staring the Ice Age in the face without knowing it.

Does some latter-day Mr. Trombley still send his boy down the well in June to break the ice? Unfortunately not, for the Brandon frozen well came to a decidedly unpoetic end in the 1930's when heavy equipment working nearby disturbed the protective clay layers and the underlying glacial relict. It possibly survives today, smaller perhaps, yet still there. The fact is that there may be other similar Ice Age remnants scattered throughout the state, waiting to be discovered. If you know of any really cold springs nearby, you might check their temperature, and bring along a shovel. That spring just might be made of 12,000 year old glacial meltwater.

REFERENCES CITED

Beers, F.W., 1869, Atlas of Rutland County; Beers, Ellis and Soule, New York.

Burlington Free Press, June 21, 1859, pg. 2 and August 9, 1859, pg. 2.

Hitchcock, Edward, Hitchcock, Edward, Jr., Hager, Albert D. and Hitchcock, Charles H., 1861, Report on the geology of Vermont; Claremont, N.H., v. 1, p. 192-208.

Jackson, C.T., 1872, Report on the Brandon frozen well; Boston Society of Natural History Proceedings, v. 14, p. 306-308.

Jackson, C.T. and Blake, J.H., 1859, Report on the Brandon frozen well; Boston Society of Natural History Proceedings, v. 7, p. 81-84.

Jackson, C.T., Blake, J.H. and Rogers, W.B., 1862, Report on the Brandon frozen well; Boston Society of Natural History Proceedings, v. 9, p. 72-81.

MINERAL OF THE QUARTER

SCHORL

Black iron and manganese-rich member of the Tourmaline group

Hardness 7	Specific Gravity - 3.25
Hexagonal System	No cleavage or streak
Luster - glassy	

Tourmalines are sodium, aluminum boro-silicates whose general formula is:

$$Na(Mg,Fe,Mn,Li,Al)_3Al_6(Si_6O_{18})(BO_3)_3(OH,F)_4$$

They are ring silicates whose 6-membered silicate rings and 3-membered borate rings are held together by positive ions such as Al, Na, Li, Fe, Mn, Mg.

Tourmaline forms under conditions of high temperature and pressure in metamorphic schists and coarse granites. Crystals are best developed in pegmatite deposits. They are generally prismatic with a triangular cross-section. Often the sides of the triangle are curved and there are striations parallel to the length of the prisms. It can also be found in fine needles or black masses.

Some tourmalines - mainly those found in pegmatites - are found in gem quality and in colors vying the rainbow in brilliance. The colored crystals often vary in shade from the outer surface of the crystal to the core or down the length of the crystal. A Brazillian gem variety is called watermelon tourmaline because the rind of the crystal is bright green, inner rind white and the interior is deep pink. Tourmalines occur in gem quality in blue, green, red and yellow shades. Most tourmaline, however, is not gem quality.

An interesting property of the tourmaline crystal is responsible for its use in electrical apparatus. Tourmaline crystals are both pyro- and piezo-electric. This means that when a crystal is either heated or cooled (pyro-), or rubbed or squeezed (piezo-), one end of the crystal becomes positive and the other negatively charged. This will cause it to attract dust, ash or small pieces of paper. The Dutch imported tourmaline from Sri Lanka in the late 18th century to remove ash from their meerschaum pipes. Today it is used in pressure and depth gauges.

Schorl is found in Vermont in four counties - Windham, Rutland, Orange and Windsor.

Windham

Park on the Vermont side at site of the former bridge between Bellows Falls and New Hampshire at the Connecticut River. Climb down very steep bank with care. Minerals are found both north and south of the old bridge location. Sillimanite and prehnite, as well as garnet, fluorite and orthoclase are also found along this bank. Be sure to note the Indian petroglyphs.

Rutland

Look for tourmaline in the outcrops along the road cut on Route 155 about 6-8 miles south of East Wallingford. Large crystal aggregates have been reported from this location. Albite, actinolite, epidote, pyrite, sphene and diopside also have been found here.

Orange

This location is in the dumps of the old Ely copper mine between West Fairlee and South Vershire. Take Route 113A to West Fairlee, go west 1 1/2 miles toward South Vershire. Old smelter, ruins of former village of Copperfield are visible on both sides of the road. Park and walk north on the dirt road 3/4 mile to dumps. Also found here are pyrite, pyrrhotite, sphalerite, actinolite, calcite, garnet, hornblende and malachite.

Windsor

This location is in the road cut along Route 103, one mile east of the intersection of 103 and Route 100 north of Ludlow, Vermont. Ray Grant reported a variety of rock types in the long road cut - marbles, gneisses, mica schists, pegmatites and quartzites and calc-silicates. He indicates good crystals of black tourmaline, pyrite, diopside, calcite and talc can be found here.

References

Pough, Frederick, 1976, Field Guide to Rocks and Minerals, 4th edition: Houghton, Mufflin Company Boston, 266p.

Guide to Field Identification of the Minerals of the World, 1973: Golden Press, p. 170-172.

Gemstones of the World, 1979: Grange Press, p. 110-112. Previously printed in German at Idar-Oberstein.

Grant, Ray, 1968, Mineral collecting in Vermont: Special Publication No. 2, Vermont Geological Survey.

Submitted by
Ethel Schuele

FOSSILS

SPONGES

The sponges (phyllum Porifera) are primitive animals with little more than hollow bodies and pore-filled body walls. They are considered to be the most primitive form of multicellular animal. The sponges have no organs or nervous tissue. They are composed of two types of cells. The flagellate cells function as water circulators. The amoeboid cells serve many functions including secretion of skeletal spicules which is of interest to the paleontologist. The skeleton is internal and may be composed of siliceous or calcareous spicules or organic fibers.

Because sponges have soft bodies, they are generally poorly preserved. Preservation is usually as disassociated spicules and as mud-filled casts.

The most frequently found sponge in Vermont is *Zittelella*, occurring in the Chazean limestones of the Champlain Valley. The sponge is sometimes preserved by filling in of the cavity with mud, and because the spicules are fused in this genus, the skeleton is often preserved. In the field it is recognized by the color difference between the fossil and surrounding rock. *Zittelella* is funnel-shaped in cross section. There are also unidentified sponges found in Vermont which range in shape from cylindrical to globular.

Submitted by
Shelley Snyder

REPRINT

Several months ago, Jeffrey Pelton gave me a copy of the following article which he would like to share with VGS members. It appeared in the March 1981 issue of SCIENCE 81 and is **reprinted by permission of SCIENCE 84 Magazine, copyright the American Association for the Advancement of Science.**

Against the Drift
John Tierney

From the very start the International Stop Continental Drift Society knew it would have to struggle against the weight of scientific opinion, not to mention the weight of the continents themselves. It was a small, meagerly funded group - "a non-prophet association," as it called itself - pitted against an academic establishment that accepted the notion of drifting continental plates as geological dogma. But something had to be done.

The first blow was struck in the Netherlands, which was drifting aimlessly until several members of the society sank a giant screw into the ground at the State University of Leiden. The screw, about four inches in diameter, was encased in concrete and dedicated at a ceremony celebrating the bolting of the Eurasian plate to the Earth's mantle. (There were those, however, who claim the screw only reached a depth of three feet.) The project's design prompted a heated debate, with a Greek member of the society arguing that the screw should have been threaded

counter-clockwise to withstand the Coriolus effect produced by the Earth's rotation. "And no washer!" he scoffed. "If the screw works loose before the other plates are fixed, Eurasia may find itself tail-ending North America from the backlash."

These squabbles have been moderated from afar by John C. Holden, a consulting geologist and free-lance illustrator who lives on a farm in the Cascade Mountains of Washington state. Shortly after a friend of his founded the society in 1976, Holden became its president and proclaimed the group's objectives: "The immediate cessation of sea-floor spreading, cooling of orogenic magmas, quiescence of large volcanoes, damping of seisms greater than 4.0 on the Richter scale, and ending of subduction and other crustal discriminations." New members were assessed dues of five dollars and warned that "like most natural disasters, the newsletter will appear at unscheduled times."

The group now has about 200 members, some of them geologists genuinely opposed to the idea that continents drift. The dissidents, who tend to be older geologists trained before plate tectonics theory was accepted in the late 1960's, contribute regularly to the Continental Drift Hit List, a section of the newsletter devoted to evidence that casts doubt on plate tectonics. It is usually the only part of the newsletter meant to be taken seriously.

The rest of the newsletter is filled with cartoons, letters, editorials, and absurd proposals to abolish continental drift, either in theory or in practice. "It appears that the Earth simply has too much energy," wrote three members from Oregon. "We propose to 'tire' it out a bit by promoting the increasing extraction of fossil fuels and mineral resources." A Washington member, inspired by the discovery of a "rift valley" on a carrot he was eating, wrote a 1,600-word essay on the vegetable's crust, core, and mantle and promised further research in the field of carrot tectonics. A concerned geologist from Central Michigan University warned that unless drift was stopped "in the future the U.S. could end up bordering Communist countries. With Russia and China as neighbors, it would be difficult to stop Communists from infiltrating our country, joining our country clubs, and marrying our sisters."

What sort of person reads the ISCDS Newsletter? Arthur A. Meyerhoff, perhaps the most prominent critic of plate tectonics theory, is a member; so is Robert Dietz, the geologist who coined the term "sea-floor spreading". And so is Leo Plas Jr., the founder of Alternate Sources of Entropy, a group "currently working on direct conversion of sunlight into money."

"I'd guess that maybe 20 percent of our members are professionally trained geologists who actually don't believe in continental drift," says Holden. "The rest accept it but don't like the way it has become instant dogma. I happen to believe in it myself, but I also see some basic problems with it. There's not an honest geologist alive who can tell you what motors continental drift, but it's still regarded by everyone as a fact, not a theory. You can hardly publish a paper today without including a paragraph about continental drift. The scientific method depends on skepticism and a tension of ideas, but we seem to have lost that. Somehow it's just not fun anymore."

CHAMPLAIN VALLEY GEM & MINERAL SHOW

DATES and TIMES

Saturday, **AUGUST** 4th, 10 AM to 6 PM
Sunday, **AUGUST** 5th, 10 AM to 5 PM

PLACE

South Burlington Community Library
Dorset Street and Kennedy Drive, South Burlington, VT
1 mile from Dorset St. exit (exit 14E) of I-89

DONATION

$1.50 for adults
$.75 for children under 16 and senior citizens

FEATURES

SLIDE ILLUSTRATED LECTURES

1. SATURDAY 10:30 AM : Dr. Charles Ratte', Vermont State Geologist, "History of Gold Prospecting and Mining in Vermont".
2. SATURDAY 2:00 PM : George Robinson, Curator of Economic Minerals, Canadian Natural History Museum, Ottawa, "Minerals of Quebec Province".
3. SUNDAY 2:00 PM : George Robinson, "Underground and All Around, Mineral Explorations Around North America" - a mineral collecting travelogue.

FILMS (run continuously)

1. "Alaska; Beyond Expectations" - 28 min color
2. "Oil" - 14 min. color
3. "A Touch of Gold" - 28 min. color (history of jewelry)
4. "The Living Planet" - 31 min. color (aerial journey around world) a CINE Golden Eagle Award winner. This film is currently being featured at the Air and Space Museum of the Smithsonian.

EXHIBITS

1. The special feature will be a 24 ft long display of 293 stamps from 70 countries, featuring minerals and gems. This exhibit by Jean and Don McKenna of Cranston, RI was a special feature in February at the Tucson, AZ, Mineral Show (the largest in the US), and will be going by special request later this year to the Munich, Germany, show (the largest in Europe). They feature a specimen which corresponds to each stamp in the exhibit.
2. George Robinson and his wife are bringing an exhibit of Quebec minerals which will feature some beautiful St. Hilaire material.
3. The Schoolers will be bringing an exhibit of Tri-State (Missouri, Oklahoma and Kansas) minerals.
4. Stormwood will be bringing an exhibit.
5. Viola Sullivan, whose art from photo-micrographs was featured last year, will exhibit her color prints from mica photo-micrographs.

DEMONSTRATIONS

1. Nancy Weiser of Gary's Gems will demonstrate the construction of one of her favorite and very popular gem trees at the show. She will do a half-hour demonstration twice a day.
2. Roger Sylvestre has again offered to demonstrate how to identify gemstones with the loupe and the optical microscope.

3. Earl Melendy will again identify minerals for people at the show. His wife, Marie, has offered to help identify fossils. Both are charter members of the Brattleboro Mineralogical Society. They have a note-worthy museum at their home in South Londonderry, VT.
4. Members of our club will demonstrate their skills in gemstone faceting, soapstone carving, scrimshaw, cabochon making, etc.

15 DEALERS

SWAPPERS AREA ON PREMISES

MEETINGS

MAY 5 **VGS SPRING MEETING** - Program on page 3 of this GMG.

JUNE 18-20 Fifth International Conference on Finite Elements in Water Resources, the University of Vermont, Burlington, VT. Contact Dr. J.P. Laible, Finite Element Conference, Dept. of Civil Engineering and Mechanical Engineering, University of Vermont, Burlington, VT 05405.

JULY 9-11 GEOTECHNICAL ENGINEERING PRACTICE - a special lecture series at Massachusetts Institute of Technology, Cambridge, MA. Sponsored by the Boston Society of Civil Engineers Section / ASCE in cooperation with the Department of Civil Engineering, MIT. Contact: Thomas K. Liu, Haley and Aldrich, Inc., 238 Main St., Cambridge, MA 02142.

AUG 4-5 Fifth Annual Champlain Valley Gem and Mineral Show. Fun and education for all ages and interests. Sponsored by Burlington Gem and Mineral Club. See previous page in this GMG for details of activities and times.

AUG 11-12 **VGS SUMMER FIELD TRIP.** Plan on joining us on this weekend trip to Thetford Mines in Canada (with, possibly, a look at other ultramafics in Canada during the trip up from the border to the mines). We will meet about noon on the 11th at a Canadian location. Both campgrounds and motels will be available for overnight lodging. Brewster Baldwin will be assisted by Barry Doolan and possibly Roger Laurent on this, our first attempt at an overnight summer field trip. Look for details in the Summer GMG early in August.

OCT **VGS FALL FIELD TRIP AND ANNUAL MEETING** - the weekend after NEIGC. Barry Doolan will lead a field trip in the Jeffersonville, VT area. Details in the Fall GMG.

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.

REMINDER: Have you returned your Membership Information Form (found in the Winter 1984 GMG) to Chris White?

FIRST CLASS

THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

SUMMER 1984 VOLUME 11 NUMBER 2

* SUMMER EXTRAVAGANZA ! *

WEEKEND FIELD TRIP TO

THETFORD MINES AREA, P.Q.

SATURDAY & SUNDAY

AUGUST 11 - 12, 1984

See important details on page 3

CONTENTS PAGE

PRESIDENT'S LETTER

Dear Members,

I would like to take up some of my space in this issue with a look at field work in Vermont. Since the Fall 1982 GMG report by Chuck Ratté, I am not aware of an update of geologic activity presently being conducted in Vermont. I know much is going on (besides the drilling project for natural gas in Fairfield Center), and a new update would be of interest to all our readers. In hopes of producing an update for the Fall 1984 GMG, I have reprinted Chuck's questionnaire on page 8 of this issue. If you are involved in any project, big or small, please take a minute and fill it out and send it to Chuck and/or to the Green Mountain Geologist before **September 18** for inclusion. If it is generally known that we will publish descriptions of work presently in progress on an annual basis, it will increase communication. Perhaps some interesting summary articles could be published in future issues of the GMG.

In another matter relating to the field, I urge you to attend the summer field trip sponsored by VGS. It will be a two-day extravaganza to the Thetford Mines - Asbestos ophiolite complexes. Brew Baldwin has done a superb job in revising his old guidebook for future publication by the Society. The new version includes updated maps and several new stops. Whether you have done the trip in the past or not, I guarantee you will not be disappointed!! Remember the dates: **AUGUST 11-12, 1984** (see page 3 for details.).

Finally, I want to draw your attention to the mundane topic of bylaw amendments. Our Society has grown to the point that we have the financial and human resources to tackle ambitious topics not appropriate for our present standing and special committees. An amendment to our bylaws will be presented by the Executive Committee to the Society at the annual meeting to address this problem (see page 4). All amendments require a 2/3 vote of members present at the annual meeting (scheduled this year for October 6th at the Smuggler's Notch Inn in Jeffersonville). I welcome any comments or suggestions from you concerning these proposed bylaw amendments.

Barry Doolan
President

VGS BUSINESS & NEWS

TREASURER'S REPORT

This report is about and not by the Treasurer. Dorothy Richter submitted her resignation as treasurer in May because she was looking elsewhere in New England for a job. In compliance with the bylaws, the Executive Committee voted to have David Westerman fill the vacancy until the fall election.

Dorothy has served most ably as treasurer since fall 1982 and we owe her a hearty vote of THANKS. Come back to VGS meetings when you can, Dorothy; we'll miss you when you don't.

(VGS Business and News continues on page 4.)

THETFORD MINES
FIELD TRIP ANNOUNCEMENT

Meeting Place:
Thetford Mines, Quebec, at McDonald's (on Route 112 at junction with Route 267 crossing.

Meeting Time:
8:30 A.M., Saturday, August 11; carpool; leave extra vehicles in nearby parking lot.

Trip schedule:
Saturday
9:00 A.M. Depart in caravan.
5:00 P.M. Return for cars.
Sunday
A.M. Depart in caravan from McDonald's for at least the morning.
4:00 P.M. (approximately) Leave last stop near Richmond,P.Q.

Nature of the Trip:
Brew Baldwin and Barry Doolan are leading a full two-day field trip to the Thetford Mines complex, which is a nearby and excellent example of an ophiolite sequence. This "flake" of ancient Ordovician ocean crust is important because it fits the model of plate tectonics and because it helps explain Vermont geology. The area abounds in huge waste piles from the asbestos mines.

Most of the time will be spent in and near the Thetford Mines complex, but the route homeward is through a second ophiolite assemblage near Asbestos, where the geology is similar to that in Vermont. Most of the stops are at roadcuts or are within several hundred feet of the road. One is a two-part 3 or 4-hour hike. The first part involves a traverse through woods, with a few short steep slopes, and back to the cars. The second part is a climb of about 250 m (half on a sloping pasture and the rest on a wooded hill). There are gentler alternatives at this locality.

Drive to Thetford Mines, Friday, August 10; spend night. The trip is on Saturday and Sunday, August 11 and 12; return to Vermont Sunday late afternoon and early evening.

One route to Thetford Mines from central or western Vermont is to cross the border at Derby Line, drive north on Route 55, thence east on Route 112 (bypass Sherbrooke to south if possible). Thetford Mines is about 140 miles north of the Vermont border.

Field Trip Guide:
Provisional copies of the Thetford Mines Area Field Trip Guide will be available for participants at a nominal cost to defray expenses (probably less than $2.00 for a document of about 20 pages).

Accomodations: (phone for reservations)
Balmoral Hotel, Robertsonville, 3 miles NE of McDonald's, on Route 112. Phone **418+335-9138**; bilingual.
Camp sites: one is Camp Tinel, 7 miles NE of McDonald's, on Route 112. Phone **418+338-1717**; they only speak French.

What to bring:
Rain gear, camera, hand lens; hiking boots not needed.
I.D. (birth certificate or driver's license...)
Canadian money; camping gear if you do not use motel.

Ride-sharing:
Phone whoever is nearer:
Barry Doolan, Fletcher, VT after 5PM: **(802)849-6344**
Brew Baldwin, Middlebury, VT office: **388-3711 X5443**
home: **388-4150** evenings
to say you need a ride or have space for someone who needs a ride.

VGS BUSINESS & NEWS (continued)

NOTICE OF AMENDMENT TO THE SOCIETY BYLAWS AT 1984 ANNUAL MEETING

The Executive Committee at the Spring Annual Meeting in Middlebury agreed by consensus to make a resolution to amend Article XII of the bylaws at the next Annual Meeting (October 6th). Article XII pertains to all committees of the society except the Executive Committee and the Committee on Nominations. The need for an amendment became evident in trying to establish Working Groups which deal with long range projects pertinent to the stated purposes of our Constitution. The proposed amendments will deal with the following:

1. Method of establishing, renewing and dissolving long-term (e.g. 3 year) Working Groups undertaking specific projects of importance to the Society. These Working Groups include (but not limited to): Geological Education, Advancement of the Science, and Public Issues.

2. Election, duties, and length of term of Chairpersons of these committees.

3. Method of appointing committee members.

4. Special Committees and Standing Committees of the Society.

This notice of amendments to the bylaws satisfies the requirement to inform all members of proposed amendments "..at least four weeks before the Annual Meeting.." as stated in Article XIII of our bylaws. I welcome your input and help in formulating the final language of the amendments.

Barry Doolan
President

COMMITTEE ON NOMINATIONS

Because of the resignation of the Treasurer, as noted previously, the slate of officers submitted by the Committee (John Malter, Chairman, and Chuck Rattè) now reads as follows:

President	Roger Thompson
Vice President	Ballard Ebbett
Secretary	Laurence Becker
Treasurer	Cameron McCormack
	David Westerman
Board of Directors	Shelley Snyder

GROUNDWATER WATCHDOG COMMITTEE REPORT

Proposed Resolution for Adoption
by the Society at its Annual Meeting

"Whereas, the existing case law in Vermont regarding groundwater generally follows the concept that groundwater behaves in a mysterious and unknowable manner; and

Whereas, the doctrine of absolute ownership for groundwater has been the governing concept for case law litigation in Vermont; and

Whereas, subsurface hydrology, and its relationship to surface hydrology, has a scientific basis; and

Whereas, there are measurable and predictable consequences regarding both the quality and quantity of available water when groundwater use takes place; now therefore be it

Resolved by the Vermont Geological Society:

That the Society expresses its support for and conceptual approval of H.30, a bill devoted to establishing the doctrine of correlative rights for allocating the liability for groundwater use in the State of Vermont."

Submitted by Chris White
for the committee

Complete text of the revisions to H.30 which this VGS committee has helped draft were published in the Spring 1984 GMG.

EDITOR'S REPORT

At this writing, Volume 3 of Vermont Geology is at the printer and will be ready soon. An order blank is provided on page 9 of this issue. A brief description of this fine publication follows:

FOSSILS FROM THE METAMORPHIC ROCKS OF THE SILURIAN-DEVONIAN MAGOG BELT IN NORTHERN VERMONT

Charles G. Doll

The fossils reported in this paper display a wide range of preservation. Some have been, and probably will continue to be, considered suspect by paleontologists accustomed to working with better preserved materials. Other specimens are readily identifiable even to the trained eye. Included in this paper are 20 photographic plates illustrating the fossils finds of Charles Doll, collected and catalogued by him over the past 40 years from the Silurian-Devonian metalimestones and metaclastic rocks of northern Vermont. This paper provides previously unpublished information on paleontological controls of the Silurian-Devonian rocks in northern Vermont.

Special thanks to Ethel Schuele for the faithful line drawing from one of Dr. Doll's fossil photos. It makes the front cover outstanding.

Vermont Geology, Volume 4, (The Vermont Geological Society's Guidebook 1) is in progress this summer. Those who attend the summer field trip will use the provisional Thetford Mines field trip guide, in preparation for the Guidebook, which should be ready by Fall meeting. J.C. Detenbeck

NEW MEMBER

Welcome to Sharon Strassner of Middlebury, VT, who was accepted as an associate member by the Executive Committee at the Spring Meeting.

SPRING MEETING REPORT

Again, an impressive program of student research papers was presented at Middlebury College. Our two $25 prizes went to two Middlebury College undergraduates, **Adam Baker** (Recovery of a coral reef following hurricane destruction: Discovery Bay, Jamaica) and **Charles Stick** (The glacial and post-glacial sediments of the region between Middlebury and East Middlebury, Vermont). Judges for this session were Roger Thompson, Don Burns and Jeanne Detenbeck.

VGS EXECUTIVE COMMITTEE MINUTES

The meeting was called to order at 3:00 PM in the Warner Building, Middlebury College on May 5, 1984. Present were Barry Doolan, Brewster Baldwin, Chris White, Roger Thompson, Shelley Snyder and Jeanne Detenbeck.

Minutes from the previous meeting (printed in the spring GMG) were approved as presented with deletion of a (?).

There was no treasurer's report due to the resignation of the treasurer.

OLD BUSINESS

1) Report of the Budget Committee. Roger Thompson in his audit of the Society's books for 1983 found them "clear, accurate and proper in every way". Dorothy Richter is to be complimented for doing a nice job with the records. It was moved, seconded and passed that the report be accepted as presented. These records will go to the new treasurer.

2) Report of Committee on Nominations. By agreement of the Executive Committee, this committee consists of only two members, Chuck Ratté and John Malter. A change in the report in the spring GMG replaces Dorothy Richter with Cameron McCormack and David Westerman. It was suggested that the bylaws be amended specifically to receive nominations from the floor at the annual meeting. It was noted that we are deliberately alternating nominees for President from the academic and "real" worlds.

3) Report of Publication/Editorial Committees. Jeanne Detenbeck reported that the cost of Vol. 3 of Vermont Geology, Dr. Doll's manuscript, has been set at $8 for members and $9 for non-members. This publication should be ready for sale in May. Requests have gone out for submission of Field guidebook entries by June 30 and manuscripts of professional papers from the winter meeting by July 1. She recognized the need to name specific members of the Publications Comm., one of whom is Shelley Snyder, who has been most helpful in assembling the GMG's during the past year. Dr. Doll's request for author's copies of his paper was resolved with the help of Barry Doolan. Dr. Doll will receive

(continued on page 11)

Please help us to collect information about research currently being conducted in Vermont by filling in the questionnaire on the reverse side of this page and returning it to either:

Jeanne C. Detenbeck
VGS Editor
RFD #1 Box 209
Shelburne, VT 05482

or

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

Additional copies of this questionnaire may also be obtained from either address.

GEOLOGIC PROJECTS IN VERMONT

If you or anyone you know are (or intend to be) engaged in any geologic work (research, investigations, consulting, etc.) in the State of Vermont or directly related to the State, the Vermont Geological Society and the State Geologist would like to collect the following information. Please fill out one questionnaire for each project which you are conducting.

NAME & AFFILIATION _____

ADDRESS & PHONE _____

COWORKERS & AFFILIATIONS _____

ADDRESS & PHONE _____

TITLE & BRIEF DESCRIPTION OF PROJECT
(Please use additional page if necessary.)

STARTING DATE _____ COMPLETION DATE _____

LOCATION OF PROJECT _____

WHERE WILL THE RESULTS OF THIS WORK BE AVAILABLE?

WILL YOU KEEP FIELD NOTES ON FILE? _____

DO YOU INTEND TO PUBLISH THE WORK? ____ WHERE? _____

WOULD YOU MAKE A COPY AVAILABLE FOR THE FILES OF THE VERMONT STATE GEOLOGIST AT VGS' EXPENSE? _____

HOW WOULD YOU CATEGORIZE THIS WORK? (CIRCLE THE APPROPRIATE ONE)

Geophysics	Hydrology, Geohydrology, Hydrogeology
Engineering Geology	Mineralogy, Geochemistry
Economic Geology	Environmental Geology
Igneous Geology	Glacial, Surficial, Geomorphology
Metamorphic Geology	Paleontology, Historical Geology
Structural Geology	Sedimentary Geology, Stratigraphy

Other (specify) _____

Additional copies of this questionnaire can be obtained from either address on the back of this page.

Thank you.

FOSSILS FROM THE METAMORPHIC ROCKS
IN THE SILURIAN-DEVONIAN MAGOG BELT
IN NORTHERN VERMONT

Charles G. Doll

VERMONT GEOLOGY
VOLUME 3

16 pages, 20 plates

Please send me _____ copies of
VERMONT GEOLOGY Volume 3.

Enclosed is my check for _____
[$8.00 ppd for members,
$9.00 ppd for non-members]

NAME _____

ADDRESS _____

_____

Please make checks payable to:
Vermont Geological Society.

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

Order blank on other side

for

Volume 3 of VERMONT GEOLOGY.

PLEASE NOTE:

This is the only order blank that individual members of the Society will receive.

2 free copies and will be offered other copies at the base cost of $6. Barry reported that his Vermont history has been completed through the Cambrian-Ordovician rock sequence and is ready to be reviewed in part.

4) Summer Field Trip. Barry has some maps and stops in Quebec ready to add to the original Thetford Mine area field guide. Barry and Brewster need to meet to coordinate the stops and set up logistics for the trip. Brew is going to work on the text for the field guide and Roger Laurent wants to update some parts of the old guide. Barry would like to maintain the same authors as the original field guide and append his new stops. Brew will send his part of the guide to Barry by June 1 and Barry will send it on to Jeanne D. She will prepare the guide entry in the form in which it will appear in the larger guidebook and then prepare handouts of this Thetford Mines area field guide for the Aug. field trip. The GMG announcing the trip should be in the mail by July 26.

5) Fall Field Trip and Annual Meeting. It was agreed that October 6, the weekend before NEIGC would be better because Oct. 20 is so late. Oct. 20 will only be chosen if reservations at Smuggler's Notch Inn cannot be made for Oct. 6. The field trip will cover the Pinnacle to Hazens Notch formations in the northern Mt. Mansfield Quadrangle.

6) Membership Working List. Chris White reported that he has received about 25 membership information forms. Barry wants the Executive Comm. to have the phone numbers. Chris will work with the new treasurer between now and January (when dues are due) to make up a membership card or some other return form by which to collect the information about members.

7) Groundwater Watchdog Committee Report. Chris and Brewster reported on their efforts before the Vt. House Natural Resources Committee in amending bill H.30. Brew felt the statement in the GMG had been "drafted, rebuilt, stroked and curried" and that inroads had been made on the attitudes of some members of the Nat. Res. committee. Support of the document by the Executive Comm. or some other action would make it easier for the Ad Hoc committee to present their amended version of H.30 to the legislature. Barry suggested that we add to the agenda of the annual meeting in Oct. a discussion of the liability of groundwater use in Vermont and consider adoption of a report in the spring GMG. Does the Society have any liability in taking a stand? Barry doesn't see any. Brew suggested that the Society could support the principle of the bill and not the details. Roger will look into the legal aspects. The following statement was adopted:

> "The Executive Committee strongly supports the aims of H.30 as presented in the spring 1984 GMG. This is in keeping with the purposes of the Society to 'promote the proper use and protection of its [Vermont's] natural resources'. The Executive Committee urges all members to read and become familiar with this paper and be prepared to take a position at the annual meeting regarding allocation of liability for groundwater use in Vermont."
>
> Chris and Brew will provide a resolution statement in time for the Fall meeting.

NEW BUSINESS

1) Committees. Barry introduced his three working committees and chairpersons as follows:

Advancement of the Science: Rolfe Stanley, chairman.
This includes all academics.
Public Issues: Chris White and Bill Glassley, co-chairmen.
Education: Barry Doolan and Ballard Ebbett, co-chairmen.

Barry sees a constitutional problem in establishing these groups, because they will be standing committees created at the wim of the Exec. Comm. with no real long-range committment to continuity such as he envisions. He suggested that we amend the bylaws to include establishment of these committees. Jeanne suggested that we rewrite the bylaws to make all committees mentioned therein more specific. Roger suggested a motion to make the working committees permanent. Consensus was to make a resolution to change Article 12 of the bylaws in time for action at the 1984 annual meeting.

2) Editorial Costs and Services. Barry suggested that the editor should have a budget for daily use, and be reimbursed in some way such as page charges for the use of her personal computer equipment. At a future Exec. Comm. meeting some amount as a cash advance, to be set aside for her use, should be approved.

3) Treasurer. A letter of resignation of the treasurer, Dorothy Richter, was presented to the Exec. Comm. In compliance with the bylaws, the Comm. voted by ballot to fill the vacancy. David Westerman was elected to serve until the election at the annual meeting.

4) The application of Sharon Strassner as an associate member was accepted.

5) Mail. Jeanne asked that someone in Montpelier be appointed to check our PO Box regularly. Barry will ask Diane Vanecek to do this for us.

Meeting adjourned.

Respectfully submitted,
Jeanne C. Detenbeck
Secretary, pro tem

FOSSILS

DIATOMS

Diatoms are single-celled plants found in fresh and marine waters. The shell (frustule) is composed of silica, giving the plant a jewel-like appearance. The frustule is made of two halves that fit together like a box. After the diatoms die, the frustules sink to the bottom of the body of water and are incorporated in the sediments.

We find fresh water diatoms in Lake Champlain sediments. They are used to distinguish between the Lake Champlain sediments (with diatoms), and the earlier Champlain Sea, which was marine, and fresh Lake Vermont. Many cores up to 24 feet long, taken in Lake Champlain by the University of Vermont Geology Department, have yielded diatoms. The cores with Lake Champlain and Cham-

plain Sea sediments have a zone with no fresh water diatoms. This zone is called Sherman's Barren Zone. Underlying Sherman's Barren Zone is the foraminifera-bearing Champlain Sea sediment. There are no marine diatoms in the marine sequence.

Parker and Edgington (1977) presented the seeds of an interesting idea. They looked at diatom frustule concentrations in Lake Michigan sediments. What they found was a reduction in the number of frustules in the sediments. By using ^{210}Pb and ^{137}Cs dating techniques, the sediments were dated. The number of diatom frustules per dry gram of sediment, as well as the condition of each frustule, was looked at. The authors found that the concentration of frustules decreased two orders of magnitude in cores spanning 80 to 100 years. An increase in the diatom production was ruled out as a reason for change in concentration. Diatoms at a core depth equivalent to 50 years showed evidence of dissolution when compared with fresh diatoms. The common log plot of frustule concentration versus sediment depth suggested an average half life of 12 to 15 years for the diatom frustules.

This paper may provide some insight into why Sherman's Barren Zone exists and why we have no diatoms in our marine sediments.

Reference Cited

Parker, J.I. and Edgington, D.N., 1977, Concentration of diatom frustules in Lake Michigan sediment cores: Limnology and Oceanography, v. 22, p. 887-893.

Submitted by
Shelley Snyder

STATE GEOLOGIST'S REPORT

Scientific note on the July 13, 1983 Rock Fall (Debris Avalanche) at Smuggler's Notch, Mt. Mansfield, Stowe, Vermont.

INTRODUCTION

At or about 7 A.M. on July 13, 1983 a block of bedrock broke free from the East Southeast facing cliff at elevation 3200 feet in Smuggler's Notch, Mt. Mansfield, Vermont. As this large block (estimated weight of 10,000 tons) of ledge tumbled down the 70° slope it broke into several blocks ranging from 5 to 3000 tons. This rock fall scoured the soil and sediment as well as trees and other vegetation in its path and soon acquired the characteristics and proportions of a debris avalanche. The main mass of the debris avalanche lost momentum as it was slowed by the thicket of trees at the base of the slope. Two or three boulders estimated to weigh in the vicinity of 5 to 10 tons knifed their way through the trees, bounced across the paved Smuggler's Notch roadway (Route 108) leaving several large holes in the pavement, and came to rest in the parking area on the east side of the roadway. One small bolder nicked the back edge of the roof on the information booth. No other damage to man or man-made structure occurred during this event.

(Continued on next page.)

PROBABLE CAUSE

Geology

The geology of the area and its proneness to rock fall activity have been described by Christman (1956 and 1959). The involved bedrock is a quartz-chlorite-mica schist of the Camels Hump Group (Underhill Formation). Three joint sets - N 30° E dip 75 NW, NS dip vertical, and N 80° E dip vertical combined with schistosity striking EW dipping 10° S to strike NE dipping 10° - 15° SE and a prominent fracture cleavage (parallel to a shear direction) striking NS dipping 80° E through horizontal establish a naturally segmented bedrock highly susceptible to frost and root wedging.

Exposure

The ESE exposure of the cliff face makes this site subject to the freezing-thawing process for a greater duration than normal. The frost wedging process is likely to occur during sunny, winter periods as well as during the early spring and late fall seasons.

Slope and Elevation

The near vertical slopes with numerous overhanging, unsupported joint blocks at elevations above 3000 feet merge with slopes of near 70° that have little or no soil cover. Recessed zones created by spalling rock, channel melt water and storm water into open joints and foliation surfaces. These zones are most susceptible to the rock fall phenomenon.

References Cited

Christman, R.A., 1956, Geology of the Mt. Mansfield State Forest: Vermont Geological Survey and Department of Forests and Parks.

—— 1959, Geology of the Mt. Mansfield Quadrangle, Vermont: Vermont Geological Survey, Bulletin No. 12.

Exploratory Oil and Gas Well being drilled at Fairfield, Vermont

Drilling started on Thursday, July 19, 1984 on a 10,500 foot deep exploratory oil and gas well on Chester A. Arthur Road in Fairfield, Vermont. The well is being drilled by Delta Drilling Company of Tyler, Texas for the Columbia Gas Transmission Corporation. Drilling is expected to be completed in early November.

The well is expected to provide a stratigraphic test of the Eastern Overthrust involving an upper thrust plate of Precambrian - Eocambrian Underhill Formation east of the Hinesburg thrust. The Paleozoic section, perhaps repeated by additional thrust slices is expected to be encountered at depth. Seismic surveys conducted during the summers of 1982-83 detected structures several thousand feet below the surface that appeared to provide favorable trapping conditions for hydrocarbons.

Charles Ratté
State Geologist

RECENT PUBLICATION

The Geological Society of Maine has published Bulletin No. 3, Field Trips of the Geological Society of Maine, 1977-1983. It is a 129 page collection of guidebooks for 12 Maine field trips which the Society began in 1977 as part of their annual summer meeting. The guidebooks include both bedrock and surficial trips, complete with discussions, road logs, maps and references. Several of these trips have been in areas where no previously published trips have been held. The price is $10.00 for non-members. Make checks payable to:

Geological Society of Maine, Inc.

Send request to:

Geological Society of Maine
c/o Robert Gerber, Treasurer
RFD #1, Box 483
So. Harpswell, Maine 04079

MEETINGS

AUG 4-5 — Fifth Annual Champlain Valley Gem and Mineral Show, at South Burlington Community Library, Dorset Street and Kennedy Drive. Saturday 10-6, Sunday 10-5. Donation. Full details appeared in Spring GMG.

AUG 11-12 — **VGS SUMMER FIELD TRIP** to Thetford Mines area, P.Q. See page 3 for details.

SEPT 20-23 — 56th Annual New York State Geological Society meeting at Hamilton College. [Donald Potter, Chairman, Department of Geology, Hamilton College, Clinton, NY 13323; (315)858-7212]

SEPT 28-29 — 15th Annual Binghamton Geomorphology Symposium at Binghamton, NY. Tectonic Geomorphology. [Marie Morisawa, Department of Geological Sciences, SUNY, Binghamton, NY 13901; (607)798-2615]

OCT 6 — **VGS Fall Field Trip and Annual Meeting.** Barry Doolan will lead the trip, covering the Pinnacle to Hazen's Notch formations in the northern Mt. Mansfield Quadrangle. Banquet at Smuggler's Notch Inn. Details in the Fall GMG.

OCT 12-14 — 76th Annual New England Intercollegiate Geological Conference. Danvers, MA. 27 field trips from SW Maine to Boston. [Lindley Hanson, Department of Geological Sciences, Salem State College, Salem, MA 01970]

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.

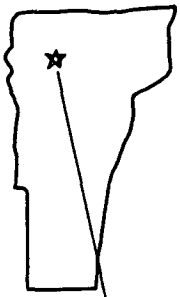
Please see center page for order blank for Volume 3 VERMONT GEOLOGY and Questionnaire about geologic research in Vermont.

SHELBURNE, VT
JUL 26
PM
1984

FIRST CLASS

Charles A. Ratté
4 Chestnut Hill
Montpelier, VT 05602

THE GREEN MOUNTAIN GEOLOGIST



QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

FALL 1984 VOLUME 11 NUMBER 3

While the leaves are in full color
and before the snow flies, join our

FALL FIELD TRIP

STRUCTURE & STRATIGRAPHY of the CAMELS HUMP GROUP
NORTH OF THE LAMOILLE RIVER
LEADER: BARRY DOOLAN, UVM

SATURDAY, OCTOBER 6, 10 A.M.

MEET AT VILLAGE MARKET - RTE 15 - CAMBRIDGE, VT

* * *

BANQUET & ANNUAL MEETING AT SMUGGLERS NOTCH INN

(details on page 3)

CONTENTS PAGE

PRESIDENT'S LETTER

As the end of my term as President rapidly approaches, I look back over the past year with mixed emotions. Like many of the officers who have previously served the Society, the experience has been both personally rewarding and satisfying. I leave with a strong committment to the Society and an even stronger respect for the many functions the Society serves for its members, the science itself, and society. Although I couldn't possibly list all of you who have provided the support and energy that kept us going this past uear, both personally, and on behalf of the Society --- Thank You!!

This year's Annual Meeting will be held at the Smuggler's Notch Inn in Jeffersonville on October 6th. The meeting is important to the Society since we will be voting on several bylaw changes which the Executive Committee feel are important to the future of VGS. Please look over these bylaw changes carefully and send in your absentee ballot if you can not personally attend.

The Fall field trip which precedes the Annual Meeting will be an excursion across the Enosburg/Fletcher anticlinorium and the Green Mountain anticlinorium in the Fletcher - Cambridge - Waterville area (see the announcement on page 3). The trip will emphasize the structural and stratigraphic relationships of the Camels Hump Group in this part of Vermont. Exposures are abundant and no strenuous traverses are planned. Come and enjoy the foliage!

Barry Doolan

VGS BUSINESS & NEWS

COMMITTEE ON NOMINATIONS

Due to a change, the slate of officers for election at the annual meeting on October 6, 1984 is as follows:

President	Roger Thompson
Vice President	Ballard Ebbett
Secretary	Laurence Becker
Treasurer	David Westerman
Board of Directors	Shelley Snyder

ABSENTEE BALLOT

For those members unable to attend the annual meeting on October 6, an absentee ballot is provided so that you may participate in the decisions which will be made. Turn to page 13, complete the ballot, and mail it in now, while you think of it!

[VGS Business & News continued on page 4.]

FALL PROGRAM

FALL FIELD TRIP AND ANNUAL MEETING

PURPOSE: Examine the structure and stratigraphy of the Camels Hump Group north of the Lamoille River. Major structures include the Enosburg Falls - Fletcher anticlinorium to the west and the Green Mountain anticlinorium to the east. (Does the intervening Cambridge syncline exist?) The trip will examine the stratigraphy of the Pinnacle and Tibbit Hill formations; the relationship of these formations to the Underhill and Hazens Notch formations; and correlation of early structures across the Green Mountain anticlinorium.

LEADER: Barry Doolan, University of Vermont

DATE: SATURDAY, OCTOBER 6, 1984

TIME: 10:00 A.M.

PLACE: Assemble at the Village Market on Route 15 in Cambridge, Vt. We will carpool from here and return to this location at the end of trip.

SCHEDULE:

10:00 AM	Leave Cambridge, VT.
LUNCH	Bring your own brown bag lunch or purchase food at the Village Market before 10:00 AM.
4:00 PM	Return to Cambridge
4:30 PM	Happy Hour at the Smugglers Notch Inn in Jeffersonville
5:30 PM	Dinner at the Smugglers Notch Inn
7:00 PM	Annual Meeting at Smugglers Notch Inn. (Proposed agenda, page 5.)

RESERVATIONS: No reservations are needed. Choose between the chicken dinner (about $9.00) or the prime rib dinner (about $12.00). Possibility of other selections.

REFERENCES

The following references will acquaint you with the geology of this region:

Albee, Arden L., 1972, Stratigraphic and structural relationships across the Green Mountain anticlinorium in north-central Vermont: in Guidebook for Field Trips in Vermont, 64th Annual Meeting of the New England Intercollegiate Geological Conference, Burlington, Vermont, p. 179-194.

Christman, Robert A., 1959, Geology of the Mount Mansfield Quadrangle, Vermont: Vermont Geological Survey Bulletin No. 12, 75 p.

The following U.S.G.S. 7 1/2 minute topographic maps can be used to locate field trip stops:

Gilson Mt.
Jeffersonville

PROPOSED BYLAW CHANGES

The complete text of proposed bylaw changes which will be submitted to the membership at the annual meeting on October 6, 1984 is printed below. Two-thirds vote of members who are voting is required for such amendment to our bylaws.

PLEASE NOTE:

This is a new ARTICLE XII.
Present ARTICLE XII becomes ARTICLE XIII.
Present ARTICLE XIII becomes ARTICLE XIV.

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: [Same as present Article XII C]
      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 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.

AGENDA FOR FALL ANNUAL MEETING

Opening remarks - Barry Doolan
Secretary's Report
Treasurer's Report
Old Business
   Committee Reports
      Publications Committee
      Committee on Nominations
      Groundwater Watchdog Committee
New Business
   Amendment of Bylaws
   Vote on Groundwater Resolution
   Election of Chairpersons to Committees
   Election of Officers
   Other Business
Closing remarks - Roger Thompson

GROUNDWATER WATCHDOG COMMITTEE - A REMINDER

A reminder to members attending the annual meeting. The Groundwater Watchdog Committee has spent much time meeting before the Vt. House Natural Resources Committee in an attempt to amend bill H.30 so that it will promote the proper use and protection of Vermont's natural resources. While the VGS executive committee has endorsed the aims of these amendments, the members of the VGS watchdog committee feel that it would be easier for them to present their version of H.30 to the legislature if they had the backing of the VGS membership. Therefore, a resolution has been drawn up for the approval of the membership at the annual meeting that would support their efforts. There will be time for discussion at the annual meeting before a vote is taken.

[continued on page 6]

Proposed Resolution for Adoption by the Society at its Annual Meeting

"Whereas, the existing case law in Vermont regarding groundwater generally follows the concept that groundwater behaves in a mysterious and unknowable manner; and

Whereas, the doctrine of absolute ownership for groundwater has been the governing concept for case law litigation in Vermont; and

Whereas, subsurface hydrology, and its relationship to surface hydrology, has a scientific basis; and

Whereas, there are measureable and predictable consequences regarding both the quality and quantity of available water when groundwater use takes place; now therefore be it

Resolved by the Vermont Geological Society:

That the Society expresses its support for and conceptual approval of H.30, a bill devoted to establishing the doctrine of correlative rights for allocating the liability for groundwater use in the State of Vermont."

MEMBERSHIP LIST - ADDITIONS AND CHANGES

In an attempt to keep our membership list updated, the following addresses (additions and changes) are listed here:

Charles FOX	25 Denison Apt 202 Hartford, CT 06105
Craig HEINDEL	RD 1 Box 319 No. Ferrisburg, VT 05473
Robert JORDAN	Delaware Geological Survey University of Delaware Newark, Delaware 19716
Alan McBEAN	1113A Ethan Allen Ave. Winooski, VT 05404
Cameron McCORMACK	P.O. Box 402 Montpelier, VT 05602
Dale MENTO	P.O. Box 1049 Boston, MA 02115
Mark PHILLIPS	177 Taylor Street Manistee, Michigan 49660
Dorothy RICHTER	180 N. Policy St. Salem, NH 03079
Chris STONE	Box 910 Calais Stage Montpelier, VT 05602
Susan STRASSNER	Meadow Way Middlebury, VT 05753
David TARBOX	52 Seymour St. Middlebury, VT 05753

Please help us keep our address list up-to-date by sending address changes to the treasurer when you move. We don't like to "lose" our members, even temporarily!!

NEW MEMBERS The following new members were accepted at the last executive committee meeting:

Robert R. Jordan	Newark, Delaware
Alan J. McBean	Winooski, Vermont
Mark P. Phillips	Manistee, Michigan
Chris Stone	Montpelier, Vermont

EXECUTIVE COMMITTEE MEETING MINUTES

The meeting was called to order by the president on Friday, September 21, 1984 at 2:15 PM at Perkins Hall, UVM. Present were Barry Doolan, Brew Baldwin, Chris White, Dave Westerman, Diane Vanecek and Jeanne Detenbeck.

The minutes from the previous meeting (5/5/84) were approved as written.

The treasurer reported a balance of $506.48. There are no outstanding bills or checks. Checks for 13 copies of Vermont Geology v.3 will be deposited and there are 8 standing orders for our publications.

OLD BUSINESS

1. Editor's Report. Vol. 3 of Vermont Geology is ready. Work on Vol. 4, the first of our guidebooks is underway and will contain about 5 trips. Brew Baldwin and the editor worked out the format on the basis of their experience preparing the provisional field trip guide for the Thetford Mines trip.

2. The wording of the proposed version of the bylaw amendments was worked out by those present. Article XII now becomes guidelines for 4 permanent committees and the old XII becomes XIII concerning standing and special committees. A change in Article XI A is proposed to add the permanent committee chairpersons to the executive committee. It may be necessary to amend Article IV B in 1985 if these permanent committee chairpersons are to eventually replace the at-large members of the Board of Directors. A resolution should be made to appoint someone to check the bylaws for consistency in regard to these changes.

3. The proposed agenda for the fall field trip was discussed and times adjusted.

4. Brew and Dave were asked for their input to the Geologic Projects in Vermont report for the GMG.

NEW BUSINESS

1. At the request of the State Geologist, the executive committee agreed to create a committee to review recommendations for proposed changes in nomenclature of Vermont stratigraphic units. This committee would be established as the official group which can change Vermont stratigraphic names which are in accordance with the uniform stratigraphic code. Chuck Ratté, Brew Baldwin, Dave Westerman and Barry Doolan were appointed.

2. Cammy McCormack's name was removed from the ballot for the office of treasurer in accordance with her request.

3. The question of a working budget for the editor was resolved. The treasurer will provide cash advances for large expenditures which cannot be billed. The editor can handle short term cash expenditures as long as the treasurer continues to be prompt with reimbursements.

4. The treasurer requested we make no expenditures greater than $500 until we have receipts from sale of our publications. Dave reported that the records require multiple entries which is confusing and time consuming. The budget committee will be reappointed and charged with establishing a new system.

5. Brew Baldwin reported that we had a very successful summer field trip, albeit small with only 7 participants. However this allowed the leaders to make significant changes in the field trip guide.

6. Applications for membership were approved for Chris Stone, Mark Phillips, Alan McBean and Robert Jordan.

Respectfully submitted,
Jeanne Detenbeck, Secretary pro tem

EDITOR'S REPORT

Vermont Geology, vol.3 is available for sale. VGS members should use the order blank found in the Summer 1984 GMG. Announcements will be mailed this week to about 80 non-members interested in our publications.

A provisional copy of the Thetford Mines area, P.Q. field trip guide was prepared for the summer field trip. On the basis of this experience, Brew Baldwin and I were able to agree on the format for Guidebook 1 which should contain about 5 field trip guides. It should be ready by the end of the year.

MINERAL OF THE QUARTER

Fuchsite, a bright green chromium-bearing form of muscovite mica, which was discussed here several issues ago has been spotted in a new location in Vermont. A recent large rock fall at Smuggler's Notch above Stowe has brought with it rocks which contain fuchsite in a white carbonate matrix and associated with some quartz. A large specimen from the fall was exhibited at the recent Gem & Mineral Show at South Burlington High. Veins of the bright blue-green mica were visible running through the carbonate matrix rock, in all an attractive specimen.

Rockhounds visiting that area during this leaf-viewing season may want to climb along this rockfall to find some of this mineral. Ed Salvas who made this new find indicates that lithium as well as chromium has been detected spectroscopically in the fuchsite from this location. While lithium minerals usually are found in pegmatite deposits, the presence of lithium in the specimen is not too anomalous as several low-grade pegmatites have been reported in this area. Ed also reported another location for fuchsite in the Stowe area. With permission it is possible to collect fuchsite in the ledge behind the dumpster of McCarthy's restaurant in Stowe.

Submitted by
Ethel M. Schuele

GEOLOGIC PROJECTS IN VT.

This is only a partial listing of the projects currently in progress in Vermont. An update to this list will be published in the Winter 1985 GMG.

UNDERGRADUATE AND GRADUATE THESES IN PROGRESS

Middlebury College - Bachelors Theses

1. Browne, Tamra. Heavy metal concentrations in Quaternary sediments near Essex Junction, Vermont.
2. Cole, Francis. Structures within units below the Champlain thrust near Snake Mountain.
3. Duncan, Chris. Detailed gravity and magnetic survey in the central Champlain Valley.
4. Durning, Jonathon. Seismic profile in glacial sediments northeast of Middlebury, Vermont.
5. Goldfinger, Michael. Geochemistry of greenstones in central Vermont.
6. Hill, John. Geochemistry of greenstones in central Vermont.
7. Johnson, Susan. The Green Mountain front in East Middlebury.
8. Lohmann, Ruth. The Green Mountain front in East Middlebury.
9. Ulin, Marjorie. Soil loss in the central Champlain Valley.

Norwich University - Bachelors Thesis

10. Thompson, Marsha. Geochemistry of volcanic rocks in the Barre West Quadrangle, Vermont.

University of Vermont - Bachelors Theses

11. Prahl, Crispin. Basement-cover relationships in the Lincoln area, Vermont.
12. Koop, Greg. Stratigraphy and structure of the Underhill Formation in the Jeffersonville area.
13. Rose, Hugh. Stratigraphy and structural relations near the Underhill - Hazens Notch contact, Jeffersonville, Vermont.
14. Hillman, Doug. Depositional environment of the Rockledge Conglomerate, northern Champlain Valley, Vermont.

University of Vermont - M.S. Theses

15. Butler, Robert. Depositional environment of the Danby Formation, Champlain Valley, Vermont.
16. DelloRusso, Vincent. Precambrian - Late Precambrian relations in the Lincoln area, Vermont.
17. Lapp, Eric. Relationship between carbonaceous schists and the Mt. Abraham Formation, Lincoln Gap area, Vermont.
18. O'Loughlin, Sharon. Relationships between the Hazen Notch and carbonaceous schists of the Lincoln Gap area, Vermont.

19. MacClean, David. Carbonate turbidites in the Middle Ordovician, Grand Isle area, Vermont.
20. Strehle, Barbara. Deformation mechanisms and evolution of fault fabrics in northern Vermont.
21. Leonard, Katherine. Deformation of Ordovician rocks west of the Champlain thrust in northern Vermont.
22. Graves, Judith. Fault fabric studies in the Jay area, Vermont.

FACULTY RESEARCH

1. Coish, Raymond, Middlebury College. Geochemistry and geologic setting of Vermont greenstones.
2. Baldwin, Brewster, Middlebury College. Stratigraphy and depositional environmental studies of allochthonous and autochthonous rocks of western Vermont.
3. Glassley, Bill, Middlebury College. Metamorphic history of central Vermont.
4. Larsen, Fred, Norwich University, Surficial geology of central Vermont.
5. Westerman, David, Norwich University. Geology and evolution of the Taconian Line in central Vermont.
6. Mehrtens, Charlotte, University of Vermont. Stratigraphy and depositional environments of Cambrian-Ordovician sediments, Champlain Valley, Vermont.
7. Hunt, Allen, University of Vermont. Detailed stratigraphy of the Champlain Sea sediments from lake core and on land samples.
8. Stanley, Rolfe, University of Vermont. Structure and Stratigraphy of the Green Mountain National Forest, Vermont.
9. Drake, Jack, University of Vermont. Geochemistry of sediment-water interaction, Lake Champlain.
10. Doolan, Barry, University of Vermont. Structure and stratigraphy of the Camels Hump Group, northern Vermont.
11. Karabinos, Williams College. Structure and metamorphic history of Mt. Holly complex and cover rocks, southern Vermont.
12. McHone, Gregory, Indiana University/Purdue University, Indianapolis, Indiana. Xenoliths of the Shrewsbury breccia dike, near Cuttingsville, Vermont.
13. Fisher, George and Keith Kannada, Johns Hopkins University. Metamorphic studies of the Gile Mountain and Waits River formations.

VERMONT GEOLOGICAL SURVEY PROJECTS

1. Bedrock geologic mapping in the Northfield 7 1/2 minute Quadrangle (Principal Investigator, David Westerman).
2. Surficial Geologic Mapping in the Northfield Quadrangle (Principal Investigator, Fred Larsen).

U.S. DEPARTMENT OF AGRICULTURE

1. Geologic evaluation of the Green Mountain National Forest (Principal Investigator, Rolfe Stanley).

U.S. GEOLOGICAL SURVEY PROJECTS
(mostly regional in scope)

1. Geophysical, geochemical and mineral resource evaluation of the Glens Falls 2 degree sheet (includes southern Vermont) - CUSMAP.
2. Geophysical mapping of early Mesozoic basins of the Eastern United States. (Project Chief: Jeffrey Phillips)
3. Lithospheric Studies of the Eastern U.S. based on isostatic earth models. (Project Chief: Mark Gettings)
4. Thickness and character of glacial deposits, Northeastern and North-central United States. (Project Chief: Carl Koteff)

OTHER U.S.G.S. PROJECTS IN VERMONT

1. State Geologists - U.S.G.S. Topographic Mapping Cooperative
2. State Geologists - U.S.G.S. Slope Stability Study Cooperative
3. Regional Aquifer Systems Analysis (RASA) (Water Resources Division is conducting studies on selected river basins in Vermont).
4. Stratigraphy and structure of the Silurian and Devonian rocks of the Connecticut Valley synclinorium in Vermont. (Project Chief: Norman Hatch)

STATE GEOLOGIST'S REPORT

High-Level Nuclear Waste:

The State Geologist's Office continues to have the responsibility for reviewing materials prepared by the U.S. Department of Energy concerning possible sites for a disposal repository in crystalline rocks. The office also has been an active participant in D.O.E. sponsored workshops designed to develop site screening methods which are scheduled to occur in the next year. This process will narrow the field of 200+ rock bodies in 17 states selected in the "Regional" Phase of the study to about 20 rock bodies that will advance to the "Area" Phase of study. The area phase will involve actual field work.
R. Montgomery Fischer has been under contract to the State and assists the State Geologist in the conduction of this program.

Oil and Gas:

The Columbia Gas Transmission Company's Burnor #1 Exploratory Well in Fairfield, Vermont, has recently progressed to a depth of 4000 feet. The State Geologist in cooperation with a Petroleum engineer on loan from New York State Department of Conservation serves as the State's Natural Gas and Oil Resources Board representative and inspector on this project.

[continued on page 12]

Samples of drill cuttings for every 10 feet of depth are being saved for future logging and testing by the State Geologist or his representative. A request for additional borehole data for "breakout" stress analysis studies has been presented to the company officials.

Mineral Resources:

A grant from the U.S. Geological Survey has made it possible to start a special project to gather all possible information on Vermont's economic mineral deposits including mineral occurrences, prospects, inactive and active mines, quarries, etc. This information will be placed in the U.S. Geological Survey's computerized Mineral Resource Data System. Alan McBean has been hired to conduct this project.

Information Services:

Diane Vanecek is the Information Officer for the State Geologist's Office. The Office is currently organizing its information files on a county-town system and is planning to record information on microfiche and/or store it on computer.

Cooperative Programs with the U.S. Geological Survey:

Topographic Mapping: The State Geologist's Office participates in a cooperatively funded topographic mapping program with the U.S. Geological Survey. To meet its goal of completing the topographic mapping of the conterminous U.S.A. by 1990, the U.S. Geological Survey is producing new topographic maps in a "provisional" format with 7 1/2 x 15 minute coverage. The Vermont Mapping Advisory Committee several years ago agreed with the U.S.G.S. committment (at that time) to convert to metric scale and contours. The St. Johnsbury provisional map has been published and is available for purchase. User comments and critique of this product are welcome.

Slope Stability Studies: A Slope Stability (Landslide) study has completed the second summer of field work. The goal of this 3-year cooperatively funded project is to produce a reconnaissance level survey and cataloguing of slope stability problems in the state, particularly in the higher elevations of the Green Mountains. Efforts are currently underway to extend this program by incorporating more detailed, instrumented and quantitative studies of specific problem areas. Smuggler's Notch and Dorset Mountain are presently being considered for detailed studies.

Mapping Programs:

The State Geologist's Office is providing a small amount of financial support for bedrock and surficial mapping in the Northfield 7 1/2 Minute Quadrangle. Preliminary reports and maps produced by David Westerman (bedrock) and Fred Larsen (surficial) are on open-file at the State Geologist's Office. Matching funds have been applied for under the U.S. Geological Survey COGEOMAP program to enhance these studies, and expand the program to other quadrangles.

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

ABSENTEE BALLOT

(Vote for one for each office.)

PRESIDENT — Roger Thompson ☐

VICE PRESIDENT — Ballard Ebbett ☐

SECRETARY — Larry Becker ☐

TREASURER — David Westerman ☐

BOARD OF DIRECTORS (2-year term) — Shelley Snyder ☐

COMMITTEE CHAIRPERSONS

GEOLOGICAL EDUCATION COMMITTEE
Ballard Ebbett & Barry Doolan ☐

ADVANCEMENT OF THE SCIENCE COMMITTEE
Rolfe Stanley ☐

PUBLIC ISSUES COMMITTEE
Christopher White & William Glassley ☐

PUBLICATIONS/EDITORIAL COMMITTEE
Jeanne Detenbeck ☐

BYLAW AMENDMENTS

I approve the amendments to the VGS bylaws as presented on pages 4-5 of the Fall GMG.

YES ☐ NO ☐

GROUNDWATER USE RESOLUTION

I approve the resolution supporting the Groundwater Watchdog Committee as presented on page 5 of the Fall GMG.

YES ☐ NO ☐

Instructions for returning this ballot are printed on the reverse side.

ABSENTEE BALLOT

If you will not be attending the VGS annual meeting on October 6, 1984 at 7:00 P.M. at Smugglers Notch Inn, 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 5.**

MEETINGS

SEPT 28-29	15th Annual Binghamton Geomorphology Symposium at Binghamton, NY. Tectonic Geomorphology. [Marie Morisawa, Department of Geological Sciences, SUNY, Binghamton, NY 13901; (607)798-2615]
OCT 6	**VGS FALL FIELD TRIP AND ANNUAL MEETING** See details on page 3.
OCT 12-14	76th Annual New England Intercollegiate Geological Conference. Danvers, MA. 27 field trips from SW Maine to Boston. [Lindley Hanson, Department of Geological Sciences, Salem State College, Salem, MA 01970]
FEB 23 1985	Tentative date for **VGS WINTER MEETING.** Details in Winter 1985 GMG.

Barry and Brew examine an outcrop at the summer field trip.

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.

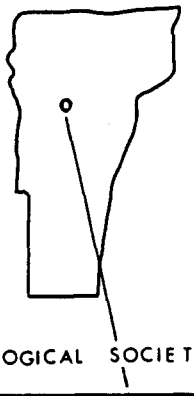
Don't forget to order your copy of Vermont Geology Volume 3! Order blank in Summer 1984 GMG.

SHELBURNE, VT
SEP 25
PM
1984

FIRST CLASS

Diane Vanecek
19 Sumner Street
Northfield, VT 05663

THE GREEN MOUNTAIN GEOLOGIST



QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

WINTER 1984 VOLUME 10 NUMBER 4

It doesn't seem possible that this will be the

SEVENTH ANNUAL WINTER MEETING

SATURDAY, FEBRUARY 18, 1984

8:30 A.M. COFFEE & DONUTS

9:00 A.M. MEETING CONVENES

NORWICH UNIVERSITY SCIENCE CENTER

NORTHFIELD, VERMONT

[See page 3 for directions.]

CONTENTS PAGE

PRESIDENT'S LETTER

This month marks the tenth anniversary of the adoption of our Constitution and Bylaws in 1974. The beginning of our second decade is a time to "renew our vows" outlined in our charter and initiate efforts to make the Society even stronger in the decade to come.

We are already in a strong position. Our membership is well-balanced between college and university professors and students, secondary school educators, private and government related professionals and lay people. We have an active membership that has grown to over 100 individuals plus 10 corporate members since we were founded. Although most are Vermont residents, our list includes members from 11 states and three countries. The society has addressed a broad range of issues over the past decade including the advancement of the science itself, environmental quality and maintaining the professional standards of geologists functioning in industry and government. In addition a variety of teacher oriented field trips and workshops have been sponsored. Our two publication arms, the quarterly published GMG, and Vermont Geology have served us well in communicating to each other and in bringing our findings to the public in published form. In short, all of the factors necessary for continuing in the future as a viable robust society are present. This is a reflection of the dedication of past leadership and an active enthusiastic membership.

So where do we go from here? The diversity, size and expertise of the Society membership now enables us to tackle some long range concerns which are in keeping with the purpose of our Constitution. Long range plans have been difficult to implement in the past because of the yearly rotation of our officers. We must, however, keep our purposes firmly in mind.

During this start of our next decade, I would like to reemphasize our commitment as a society to the following major issues:

1) Public Education
2) Environmental Quality
3) Advancemant of the Science

These issues are fundamental to the purposes of our Constitution. All members have expertise and/or strong interest in at least one of these issues. It is the membership itself, not the short-term officers who must ultimately be responsible for our Society to continue and strengthen its impact in these areas.

With this in mind, I will try to establish during my year as President a process whereby long-term working groups will be established in each of these three areas. The responsibilities of each group will be to sponsor on a yearly basis a forum, discussion group, symposium and/or publication which is in keeping with our long range commitment to these issues.

Using this column in the Spring, Summer and Fall issues of GMG, I will outline some suggestions for topics that each of these working groups can address and my progress in implementing these groups. In the meantime, I welcome your comments and urge all of you to think seriously about volunteering your time and expertise in helping the Society to continue its prosperous history.

See you in Norwich!

Barry Doolan

ABOUT THE WINTER MEETING

THE SEVENTH ANNUAL WINTER MEETING

OF THE VERMONT GEOLOGICAL SOCIETY

As you can see in the Program published on the next page, the Winter Meeting at Norwich promises to be a good one. In place of the usual format of morning session - lunch break - afternoon session of past meetings, organizers of this meeting are making a special effort to facilitate discussion and communication for members in a social atmosphere. The morning session is shortened and will be followed by an informal "poster session". The presenters of the talks are asked to bring along maps and data used in their talks so that informal discussion can take place. In addition, members who are not making formal presentations may want to bring along materials they have been working on to discuss with other members. Some tidbits we know of at this time are "Glacial history of the Mad River valley" by Fred Larsen, "A reinterpretation of the reinterpretation of the Belvidere Mountain Complex" by Barry Doolan and "Metamorphosed fossils from the Silurian-Devonian rocks of Vermont" by Charles Doll. It is hoped, in addition, that we might be able to set up a special table for earth science teachers and another on our Society's and the Vermont Survey's publications.

Brown bag lunches are recommended; however, for those who forget, orders for grinders and soft drinks can be made at the start of the meeting.

Registration, coffee and donuts, starts at 8:30 A.M. in Room 48 of the Norwich University Science Center.

The morning and afternoon sessions will be in Room 45, and the poster session - lunch break will be upstairs in Room 148. Please try to attend, there will be something for everyone!

DIRECTIONS TO CABOT SCIENCE ANNEX

NORWICH UNIVERSITY, NORTHFIELD, VERMONT

Cabot Science Annex is the southernmost brick building at Norwich University. The building is on the west side of Route 12, 0.7 miles south of the Northfield post office. Park adjacent to the building or in the student parking lot to the south. Look for VGS signs and enter the south entrance.

WINTER MEETING PROGRAM

Saturday, February 18, 1984
Cabot Science Annex
Norwich University
Northfield, Vermont

REGISTRATION (no fee), Coffee and donuts ROOM 48 . . . . 8:30

MORNING SESSION ROOM 45

Opening remarks: Barry L. Doolan, Convener 9:00

1. C. Mehrtens: Cyclic siliciclastic and carbonate sedimentation in the Cambrian through Lower Ordovician of northwestern Vermont 9:10
2. P. Washington: Structure near Shoreham, Vermont and the relation between the Pinnacle and Orwell thrusts 9:30
3. B. Doolan: The Ottauquechee-Sweetsburg connection: Implications for Cambrian(?) allochthonous emplacement of the Hazens Notch Formation, north central Vermont 9:50
4. D. Westerman: The nature of the Taconian line in the Northfield 7.5-minute quadrangle, Vt. . . 10:10
5. G. Simmons: Exploration of the first thousand feet of crust in New England 10:30

POSTER SESSION AND DISCUSSION ROOM 148 . . . . . 11:00

C. Doll: Metamorphosed fossils from the Silurian-Devonian rocks of Vermont.
B. Doolan: A reinterpretation of the reinterpretation of the Belvidere Mountain Complex
F. Larsen: Glacial history of the Mad River valley, central Vermont (see abstract).

LUNCH, DISCUSSION AD LIB, EXECUTIVE COMMITTEE MEETS . . 12:00

AFTERNOON SESSION ROOM 45

Opening remarks: William Glassley, Convener 1:00

6. B. Doolan: Seismic activity and state of stress in Vermont: A brief review and relationships to regional geology 1:10
7. D. Tarbox and C. White: Evaluation of predicting groundwater behavior under on-site wastewater treatment systems 1:30
8. J. Malter: Oil spill debris disposal 1:50
9. B. Fowler, J. Drake and D. Hemenway: Phosphorus fluxes from St. Albans Bay, Lake Champlain sediments 2:10

THE OTTAUQUECHEE - SWEETSBURG CONNECTION: IMPLICATIONS FOR CAMBRIAN(?) ALLOCHTHONOUS EMPLACEMENT OF THE HAZENS NOTCH FORMATION, NORTH CENTRAL VERMONT

Doolan, Barry L., Department of Geology, University of Vermont, Burlington, VT 05405

Osberg (1965) demonstrated the continuity between the Cambrian(?) age Sweetsburg Formation and the Ottauquechee - Mansonville rocks on the respective west and east sides of the Sutton Mountain - Green Mountain anticlinorium. The Hazens Notch Formation (HNF) which lies immediately west of the Ottauquechee in north central Vermont has been considered by various authors to be younger, older or stratigraphically equivalent to the Ottauquechee Formation. The HNF differs from the Ottauquechee and all other older units of the Oak Hill Group by containing slivers, pods and/or blocks of talcose and massive serpentinite, greenstone, blueschists and amphibolites. The structural top of the HNF contains hard rock slivers of serpentinized asbestos-producing harzburgite with a tectonic sole of greenstone and amphibolite. The structurally lower contact with the Underhill Formation is not well defined, but according to Thompson (1975), lower Sweetsburg lithologies separate the HNF and the underlying Underhill Formation. (The stratigraphic relationships suggest that the HNF lies entirely within the Ottauquechee Formation.) The Ottauquechee together with the HNF and all underlying formations have been folded in an east over west rotation zone antithetic to the direction of commonly accepted subduction polarity. This folding predates the final emplacement of ophiolite sheets in Thetford Mines, Asbestos and Orford - Chagnon regions of Quebec and also prior to the juxtaposition of Stowe - Moretown rocks in Vermont. The evidence suggests allochthonous emplacement of HNF with overlying structurally attached rocks of oceanic lithosphere onto the Ottauquechee in Cambrian(?) time. The formation of the rotation zone in the eastern parts of the Oak Hill Group necessitates fundamental changes in the nature of plate subduction following the arrival of the Hazen's Notch Allochthon; however, a polarity flip is not favored nor required to explain the observed relationships.

References:

Osberg, P., 1965, Geological Society of America Bulletin, v. 76, p. 687-700

Thompson, P., 1975, unpublished M.S. thesis, University of Vermont, 68p.

SEISMIC ACTIVITY AND STATE OF STRESS IN VERMONT: A BRIEF REVIEW AND RELATIONSHIPS TO REGIONAL GEOLOGY

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Vermont is situated between two distinct seismic provinces each with persistent historical to present day seismic activity. To the northwest, the northwest trending Ottawa - northern Adirondack seismic region is susceptible to WSW compressive forces which reactivate NNW to NW trending fault surfaces. To the southeast, the Concord - Boston seismic

region is equally active but responds to WNW directed compression along N to NE oriented fault planes. The distinctiveness of each province and the almost total lack of seismic activity in Vermont does not support the existence of the Ottawa - Boston seismic zone of early workers. The two seismic provinces are representative of larger stress provinces of regional significance. The Atlantic Coast stress province to the southeast of Vermont and characterized by WNW compression is probably related to horizontal density variations due to cooling of oceanic lithosphere moving away from Atlantic based spreading centers. Parallism of the Atlantic Coast Stress Province with offshore magnetic anomalies and the on-land western limit of McHone's (1978) Eastern North America Dolerite Province supports a genetic link between present stress directions and lithospheric cooling. The northwestern seismic region is part of a larger Mid-Continent Stress Province believed to result from asthenospheric drag resistance to the present absolute motion of the North American Plate.

Recent stress indicators and measurements in Vermont are few in number. Available data is supportive of placing the boundary between the two stress provinces northeastward through Vermont from the southeastern corner of the Adirondack Massif to near the Vermont - Quebec - New Hampshire border. The actual boundary may be diffuse.

The lack of recent tectonic activity in Vermont appears to be related to late Mesozoic igneous activity and annealling effects of metamorphism during the Acadian Orogeny.

(Review largely from:

Yang and Aggarwal, 1981, Journal of Geophysical Research, v. 86, p. 4981-4998

Zoback and Zoback, 1980, Journal of Geophysical Research, v. 85, p. 6113-6156).

PHOSPHORUS FLUXES FROM ST. ALBANS BAY, LAKE CHAMPLAIN, SEDIMENTS

Fowler, Bruce, Drake, J. and Hemenway, D. (Abstract page 30)

GLACIAL HISTORY OF THE MAD RIVER VALLEY, CENTRAL VERMONT

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A reconnaisance study of surficial deposits was made by ten students and one professor as a glacial geology class project at Norwich University during the fall of 1983. A significant exposure of Late Pleistocene sediments is located on the north side of Shepard Brook Road 2.6 km WNW of the confluence of Shepard Brook and the Mad River. From the bottom up the sediments are: (1) oxidized yellowish-brown sand and pebble gravel, (2) compact yellowish-brown till, (3) laminated silt and clay layers that have been sheared, and, above a covered section, (4) compact till at the surface. Detailed studies have not been carried out but it appears that the two tills could represent two glaciations. Several till exposures near the Mad River either incorporate or overlie sheared lacustrine sediment that probably was deposited during the last glacial advance when the north-draining Mad River valley was blocked on the north by advancing ice.

Systematic northward retreat of the ice margin during deglaciation is shown by the development of three successive proglacial lakes. First, Glacial Lake Granville formed when the ice margin retreated north of a 1,405-ft threshold at Granville Notch. A second lake, Glacial Lake Winooski, had a threshold at 915 ft ASL at the north end of Williamstown Gulf and had already formed in the Montpelier-Barre area prior to the draining of Lake Granville. Northward retreat of the ice margin in the Mad River valley resulted in the lowering of Lake Granville to the Lake Winooski level. The evidence for Lakes Granville and Winooski consists of deltas deposited at their respective shorelines. Evidence for a third and lower glacial lake derives from a major set of stream terraces that, when plotted on a projected profile, appears to represent a fluvial system graded to a base level at an elevation of about 700 ft ASL in the lower Mad River valley. This third lake could have formed when the ice margin was in the vicinity of Richmond and drainage from the Winooski River basin was diverted through the valleys of the Huntington River and Hollow Brook into Glacial Lake Vermont.

OIL SPILL DEBRIS DISPOSAL

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Since 1979 there have been an average of 175 oil and other hazardous materials spills reported to the Vermont Department of Water Resources and Environmental Engineering annually. The debris from oil spills includes oil saturated soil and rocks, vegetation, and absorbent materials used during the cleanup phase. The liquid oil is skimmed up for re-refining or recycling. The liquid portion is not disposed of as a debris.

Public awareness and research have focused primarily on the environmental impact of the initial spill plus the efforts taken to control and cleanup the discharge. The disposal of spill debris has not received the same degree of attention.

Historically, the disposal of spill debris has included: co-disposal with municipal solid waste at landfills; burial and encapsulation at selected sites; incorporation with road base construction materials; long term storage above ground; incineration and land spreading of the debris.

The disposal of spill debris has primarily been to sanitary landfills. However, since many of these landfills received State certification after 1979 chiefly for handling municipal refuse, the use of this disposal option has been limited to small quanitiies of oil spill debris. Most debris from large oil spills is either stockpiled at specially prepared sites or shipped out of state for disposal at certified industrial landfills.

Land spreading or land farming has been used throughout the country at petroleum refineries for the disposal of various hydrocarbon sludges for over 30 years. In Vermont, this technique was first demonstrated in 1977. Land farming was used to successfully treat approximately 1500 gallons of coal tar sludge that was collected in the vicinity of the Pine Street Canal in Burlington.

The concept of land farming is to utilize naturally occurring microbes present in soil to metabolize the oil associated with the waste. This is accomplished by spreading the debris about three inches thick at a specially prepared site. The debris is rototilled for maximum aeration on a periodic basis during the treatment season which would usually be from May to October. Surface water runoff and groundwater contamination must be prevented during the operation of a land farming site. Berms and drainage diversions are incorporated on site to prevent surface water runoff. Groundwater contamination can be prevented by establishing a compatible application rate of debris based on site characteristics including soil type and thickness; groundwater conditions; ambient temperature; nutrients and pH of the soil. Regularly scheduled monitoring in both the unsaturated and saturated zones is necessary to assure that degradation is occurring in the upper 6" - 12" treatment zone and that downward migration of hydrocarbons is not occurring.

Several landfarming sites have been proposed in Vermont. There is one landfarming site currently located on a portion of the Bristol municipal landfill that is available only for dealing with oil spill debris from a large incident on Lake Champlain. The need for environmentally sound management of spill debris through landfarming, landfilling, or other technologies continues to be a major concern of the Department of Water Resources.

CYCLIC SILICICLASTIC AND CARBONATE SEDIMENTATION IN THE CAMBRIAN THROUGH LOWER ORDOVICIAN OF NORTHWESTERN VERMONT

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The Lower Cambrian stratigraphic sequence in northwestern Vermont consists of several cycles (after Vail and others, 1977) of alternating carbonate and siliciclastic shelf sedimentation. At the base of the Lower Cambrian sequence is the Cheshire Formation, a transgressive sequence of tidally dominated shelf sediments. The Cheshire is overlain by the Dunham Dolomite, which records continuous transgressive sedimentation from peritidal through shelf edge environments. In portions of Vermont the Dunham is conformably and gradationally overlain by the basinal shales of the Parker Slate. In other areas, the uppermost Dunham is overlain by the Monkton Quartzite, a mixed carbonate-siliciclastic transgressive tidal flat sequence (Rahmanian, 1981). Conformably overlying the Monkton is the Winooski Dolomite. Preliminary work on the Winooski suggests that it is a transgressive sequence of peritidal through shelf edge environments. The Winooski is gradationally and conformably overlain by the Danby Formation. The Danby is thought to be a mixed carbonate and clastic unit deposited in tidal to subtidal environments with evidence of storm overprinting. The cyclic sequence is capped by the Lower Ordovician Clarendon Springs Formation, thought to represent shallow shelf sedimentation. Each of the formations described above is a cycle, defined as a transgressive sequence

produced by eustatic sea level change (Vail and others, 1977). The repetitive alternation of clastic and carbonate formations is the result of changes in sediment supply. The relative contributions of changes in eustatic sea level and sediment supply must be understood when interpreting local stratigraphic sequences.

EXPLORATION OF THE FIRST THOUSAND FEET OF CRUST IN NEW ENGLAND

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The velocity of compressional waves has been measured in fifty boreholes in New England. All holes exceed 500 feet in depth, about half exceed 1000 feet, and the deepest hole is 1800 feet. Although most holes were drilled originally for water, many were not sufficiently productive to be used as water wells.

In rocks outside shear zones, the velocity increases about 15 percent at a depth of 150-300 feet. The velocity below this depth is approximately the intrinsic velocity of crack-free rock. We infer that open cracks and microcracks are abundant (in a volumetric sense) in the New England crust to a depth of 150-300 feet and are not open at greater depths.

We have also measured velocity in several wells drilled in shear zones. The velocity decreases significantly (15-50 percent) where the borehole intersects the shear zone. We infer that the fractures associated with the shear zone are open to depths of at least 1000 feet. We speculate that they are kept open by continued tectonic movement.

EVALUATION OF PREDICTING GROUNDWATER BEHAVIOR UNDER ON-SITE WASTEWATER TREATMENT SYSTEMS

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Part of the study of the renovative capacity of different designs of large scale on-site sewage disposal systems involves the assessment of groundwater behavior under the disposal fields. It was found that the degree of mounding under innovative systems, viz. mounds and wedges, was negligible compared to what was forecasted in the original hydrogeologic reports. This lack of mound growth is thought to be because of possible underestimation of permeability, possible preferred groundwater flow paths at the fill-native soil interface or possible short-circuiting which effectively underloaded the fill beneath the leach beds.

For traditional systems, located in natural soil deposits, the mounding and ambient groundwater behavior was more easily determined. This was because the greater ambient saturated thickness under the traditional leach fields provides for a well-established and more easily sampled saturated zone. One traditional system whose hydrology was studied in detail showed

a chloride plume and groundwater mound development from the leach fields. Results of the field investigations indicate that the originally forecasted mound growth overestimated the height to which the mound actually grew. Using similar parameter saturated thickness permeability inputs on a quadrilateral finite element computer program shows that the computer output more clearly matches the observed data. It is thought that one key difference between the earlier forecast and the finite element-generated forecast is the consideration of saturated thickness in determining aquifer response to hydraulic loading.

Inherent complexities in the geology of natural soil deposits suggests that the necessarily limited budgets for soil sampling programs constrain the degree to which one can adequately predict the exact aquifer response to stress. However, it is thought that generalized data inputs in models which recognize key hydraulic factors such as saturated thickness and variations in soil permeabilities more accurately estimate groundwater behavior.

STRUCTURE NEAR SHOREHAM, VERMONT AND THE RELATION BETWEEN THE PINNACLE AND ORWELL THRUSTS

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The structure in the vicinity of Shoreham, Vermont, is dominated by thrust faulting and associated transverse faults. The Pinnacle thrust is the easternmost of the thrusts and probably represents a southern continuation of the Champlain thrust. The Orwell thrust, as mapped by previous workers, is a composite surface representing the absolute western boundary of the allochthon. The intervening zone contains many thrust faults, but very few distinct thrust sheets. The Shoreham thrust, as previously mapped, is a combination of unrelated thrust surfaces.

This complex zone is apparently a duplex, with the Pinnacle thrust as the roof and the Orwell thrust as the sole thrust. A portion of the Pinnacle thrust sheet is preserved in Shoreham village where the sole thrust transects the roof thrust along the Shoreham thrust. The duplex is bounded on the south by a transverse fault zone (the Shorewell fault zone) very near the Shoreham - Orwell town line. South of the Shorewell fault zone, only the Orwell thrust is developed.

The Pinnacle and Orwell (south of the Shorewell fault zone) thrust sheets are structurally continuous to the east, and as the Pinnacle thrust approaches the fault zone from the north and the Orwell thrust approaches from the south, they cut across section so that they are stratigraphically correlative at the zone. Thus, the Pinnacle and Orwell thrusts were probably a single continuous surface before the addition of the duplex beneath the Pinnacle thrust. The duplex lifted the Pinnacle thrust sheet, detaching it from the Orwell thrust sheet to the south.

THE NATURE OF THE TACONIAN LINE IN THE NORTHFIELD 7.5-MINUTE QUADRANGLE, VERMONT

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Bedrock mapping along the Taconian Line in the Northfield 7.5-minute quadrangle, Vermont, was carried out during June of 1983. Occurring between rusty pre-Silurian Cram Hill quartzites and phyllites on the western side of the line and the easily recognized rocks of the Northfield Slate to the east is a zone of rocks bound on both sides by faults. This zone was mapped for a distance of 10 km along strike (NNE) and was found to vary gradually in width from 150 m to 350 m and back to 150 m.

The southern half of the zone is dominated by rocks of the Shaw Mountain Formation (Sil). These rocks include coarse-quartz pebble conglomerates and crinoidal limestones as well as other calcite- and quartz-rich metasediments, but a wide variety of mylonitized products of these lithologies are also present. These mylonites are often restricted to strongly milled, narrow zones bounding slices of relatively undisturbed rock. In the northern half of the study area, chlorite-rich volcanics and feldspathic crystal tuffs commonly containing blue quartz dominate the fault-bound zone although slices of quartz-pebble conglomerate and Cram Hill quartzite occur within the zone. Earlier workers placed these volcanic rocks stratigraphically at the top of the Cram Hill Formation, but their lack of a pervasive regional metamorphic fabric suggests that they are part of the Siluro-Devonian section.

The terrane within the fault-bound zone consists of a patchwork of fault-bound slices producing a fish-scale map pattern. Fracture cleavages and mylonite fabrics trend NNE and dip steeply to the west while elongated pebbles in the conglomerate and well-developed mineral lineations in the mylonitized rocks consistently plunge steeply to the north. Slickensides and preliminary study of rotated crystals in oriented thin sections both show that rocks on the western sides of faults have moved down relative to those on the eastern sides. As they are currently oriented, these faults show a normal sense of motion.

As a working model, this zone of faults is thought to represent a series of imbricate thrusts formed during the early stages of the Acadian Orogeny. Near-shore, shallow-water Silurian shelf sediments and volcanics along the western margin of an ocean basin were thrust westward over a pre-Silurian basement. Deeper-water deposits of the Northfield Slate were then thrust onto the Silurian shelf section. Continued shortening caused the fault planes to steepen through vertical to their current orientation.

VGS BUSINESS & NEWS

TREASURER'S REPORT

The financial condition of the Vermont Geological Society for January 1, 1983 to December 31, 1983 is as follows:

Beginning Balance January 1, 1983		$1119.29
Income		$1487.06
Dues	1068.07	
Now account interest	85.14	
Vermont Geology sales	58.80	
Annual Dinner	275.05	
Total income	1487.06	
Expenses		$1049.04
Postage	229.02	
Printing/Xeroxing	344.86	
Office supplies	28.25	
Refunds on Student Dues	15.00	
Pavilion Auditorium - Rent for Winter Meeting	80.75	
Student Prizes	50.00	
Post Office Box Rent	20.00	
Telephone	6.56	
Annual Dinner	274.60	
Total expenses	1049.04	
Year end balance December 31, 1983		$1557.31

Respectfully submitted,

Dorothy A Richter

Treasurer

New members in 1983 included 8 individuals and 1 organization. Our mailing list contains 108 individuals and 10 organizations. So far in 1984 (as of January 16), 73 members have paid dues - better than this time last year!

NEW MEMBERS

Welcome to these new members, accepted since Spring 1983.

Robert Allcott	Middlebury, VT
Robert Black	Pittsfield, VT
John Garver	Seattle, WA
Steven Goldberg	Montpelier, VT
Paul Karabinos	Williamstown, MA
Webster Stickney	Lakewood, CO
Paul Washington	Middlebury, VT

!NEEDED! MEMBERSHIP INFORMATION

At the fall Executive Board Meeting, it was decided to put membership information on a computer disk. The purpose of this is to provide VGS members with information about themselves and their fellow members.

We hope to develop a directory that lists members, with their addresses and phone numbers, according to their profession or interests. A separate division of the membership list could also be done on the basis of zip code. With such information, members may realize that there are other VGS members near by. At the least, car pooling could be done on the way to VGS gatherings. Optimally, new friendships and scientific exchange might develop.

Our first step, though, is to gather the information. Please submit your information as soon as possible. If a healthy society is in part based on a strong sense of community, then this will help our Society.

An INFORMATION FORM is printed on the last page of this issue of the GMG. Please complete and return it to me.

Thank you,

Chris White

EDITOR'S REPORT

I am optimistic that VGS will be able to publish two volumes of Vermont Geology this year. Charles Doll's manuscript "Fossils from the Silurian-Devonian Magog Belt of Metamorphic Rocks in Northern Vermont" is nearly ready to go to the printers and information about the publication date and the cost should be available at the winter meeting at Norwich. The response to a call for field trip guides from leaders of VGS-sponsored trips has been so encouraging that the first of what will probably be two volumes could emerge sometime this fall. Receipt of professional papers for a third volume in that Vermont Geology series is slow, and only one manuscript is completely ready for publication at this time.

The Editorial Committee met on two successive days (November 14 and 15) to accomodate the member's schedules. The members agreed that we should publish the Doll manuscript in its entirety as long as the author would agree to a preface by the committee stating that not all the views expressed in the manuscript were approved by the committee. There is much in the way of unpublished fossils locations and unquestionable fossil finds in the manuscript, that it should appear in print.

The committee set a goal of fall 1985 (in time for the NEIGC meeting in New Haven, CT, dedicated to John Rodgers) for completion of 2 or 3 volumes of field trip guidebooks. (The fall 1985 GSA centennial meeting in Boston, which would have provided a broad based outlet for our guides, has unfortunately had to be relocated.) The volumes will contain 8 1/2 x 11" 3-hole punched pages, stapled between 2 green cover stock sheets. Each volume will contain a state map showing locations of all trips in that volume. The format of individual trip

entries will follow that of recent NEIGC and Geological Society of Maine guidebooks. Common elements in these include: an introduction stating purpose and significance of the trip, road log including stop descriptions and permission information, descriptions of stratigraphy, structure, sedimentology or fossils as appropriate to the trip, map with stop locations and geologic data, references cited or short bibliography, and optional cross sections, detailed maps, diagrams or photos. A policy was established for choosing trips to be used for our guidebooks: 1) publish only field trips sponsored by VGS, 2) field trips outside Vermont must tie into Vermont geology, and 3) trips must not present material that would offend workers in such areas when the trip is outside the state boundary.

Interest has been shown in publishing Brewster Baldwin's Thetford Mines area field trip guide, but never having been one of our field trips, it does not meet the criteria listed above. Brew has learned that Roger Laurent has new information about this area and has expressed interest in rewriting the existing unpublished guide. It was enthusiastically suggested that we sponsor a 2-day weekend summer field trip in this area in conjunction with the revised field trip guide.

submitted by Jeanne C. Detenbeck

FALL MEETING REPORT

It was a very busy day for the good crowd (~25 persons) who joined our fall field trip on October 15 at Okemo. We spent a full day visiting a number of outcrops that exhibited most graphically much in the way of classical structure and stratigraphy. Chuck Ratte' used a Geiger Counter to show us convincingly the presence of and difference in concentration of Uranium ore within the Okemo Quartzite Formation. An interesting discussion of blue quartz was conducted at one outcrop (see Mineral of the Quarter in this issue for more details). In the afternoon, Paul Karabinos showed us an unconformable Tyson/preCambrian contact, a Tyson/Hoosac contact on Mission Church Farm Road (where the question was posed, "Is it a sedimentary contact or eoCambrian faulting?") and another Tyson/preCambrian contact off Old Elbow Road within an uphill section. In distinguishing preCambrian from EoCambrian and younger rocks, it was suggested that preCambrian marble was high grade and therefore large grained, whereas eoCambrian and younger was fine-grained limestone. The field trip ended with the memorable quote, "Don't interpret indecisiveness for lack of Dogma!" We were, indeed, late for the Happy Hour by that time!

After the banquet, these officers were elected:

President	Barry Doolan
Vice President	Roger Thompson
Secretary	Larry Becker
Treasurer	Dorothy Richter
2-year director	Diane Vanecek

VGS EXECUTIVE COMMITTEE MINUTES

The meeting took place October 15, 1983 in the Ludlow Seward's Restaurant. Dorothy Richter began with the treasurer's report. The V.G.S. balance as of October 14, 1983 was $1,615.56 with an outstanding bill of $114.83 to Jeanne Detenbeck. Chris White asked about the annual auditing of the books. The budget committee is responsible for the arrangement of this activity so we could ask Roger Thompson to make sure the auditing gets done. Barry Doolan suggests that we do the auditing prior to the receipt of the next years dues to keep things simpler.

Discussion of the winter meeting begins. The Current Issues Forum has suggested that we have one-half of the meeting devoted to papers on waste disposal. Chris White and Bill Glassley will organize. Dorothy Richter suggests we invite a keynote speaker. Tentative date set for third weekend in February at Norwich University. Name tags and sign up sheets will be useful at next meeting.

Chris White offers to computerize our membership list. The Society would just need to buy a disk. We could also keep a list of our members as to the type of their employment and their major areas of interest.

In the past there have been problems passing new applications around for approval amongst members of Executive Committee. This takes time and therefore the applicant must wait to get on the mailing list. The Executive Committee agreed that the name of a new applicant should immediately go on the mailing list and that approval of applicants should take place at each Executive Committee meeting. This will streamline the process in that a group of applicants can be approved at once.

Respectfully submitted,

Laurence R. Becker

Laurence R. Becker
Secretary

DISCUSSION & REPLY

Discussion: Simplified Lithotectonic Synthesis of Pre-Silurian Rocks in Western New England, by Rolfe Stanley and Nicholas Ratcliffe.

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Stanley and Ratcliffe's recent publication by the Vermont Geological Survey is a provocative and stimulating contribution to understanding the complexities of Vermont Geology. Their approach of retrodeforming the orogeny is highly instructive. This method combined with the excellent illustrative materials brings the processes of mountain building within the realm of understanding of both specialists and non-specialists in the field. For these reasons the paper will surely be a lasting contribution and as the authors fully intended one which will serve as a basis for further discussions.

Stanley and Ratcliffe's basic premise lies in the assumption that the pre-Silurian deformational features of rocks west of and including the ultramafic belt of western New England are the result of a collision of two plates. The North American plate, constructed during a period of rifting extension and subsidence, consists of Grenville age crust with a passive continental shelf-slope-rise triad built upon it. This margin faces toward and progressively thins into an oceanic crust formed by constructive processes at spreading ridge centers in an early Paleozoic ocean (Iapetus). The second plate consists of an association of rocks assembled in pre-Middle Ordovician times consisting of a volcanic arc-complex (Bronson Hill) with associated fore-arc basins and accretionary prism lying above an east dipping subduction zone (Plate 2, cross section 8, Stanley and Ratcliffe, 1983). The Taconic orogeny is thus the result of a collision of the North American continental margin with the accretionary prism, fore-arc and volcanic complex. The model is an attractive one, especially so for southern New England, and is one that has stood the greatest test of time in this last model-happy decade of plate tectonics (e.g. Chapple, 1973; Osberg, 1978; Robinson and Hall, 1980; Rowley and Kidd, 1981; and Robinson, 1982).

My discussion focuses on several aspects of Vermont geology which are at odds with this model or at least at odds with the deformational sequence proposed by Stanley and Ratcliffe. Problems of bringing this model into Canada are also addressed. Finally, in keeping with the spirit of Stanley and Ratcliffe's paper, I will present several alternatives which focus on differences of interpretation discussed below.

My main disagreement with Stanley and Ratcliffe is with their interpretation of the deformational history of the ultramafic and associated rocks in the Hazens Notch Formation and their adjacent Rowe Thrust Zone (RTZ). Both of these lithotectonic units are considered to be remnants of an older accretionary wedge sequence that has been repeatedly deformed during the Taconic orogeny (p. 3) but distinct differences in deformational history and lithic composition of these two units are known. As pointed out by Gale (1980), and Doolan and others (1982), the structural top of the Hazens Notch Formation is

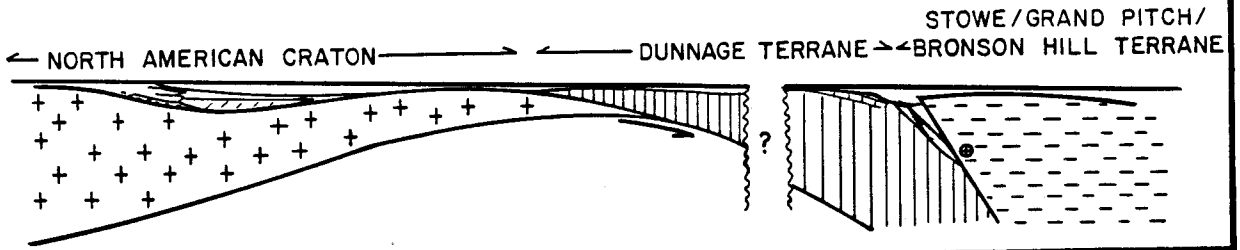
seen in the Belvidere Mountain area south of Lowell, Vermont. Here, serpentinized ultramafic rocks are shown to be emplaced along faults which result in distinctive and regionally important tectonic layering. Gale (1980) has elegantly shown that a tectonic stratigraphy of serpentinite-coarse grained garnet amphibole-fine grained amphibole-greenstone-muscovite schist developed prior to their implacement along similarly oriented faults against the Hazens Notch Formation. The "inverted" metamorphic stratigtaphy displayed in the mafic rocks (the Belvidere Mountain amphibolite) juxtaposed beneath the sole of serpentine sheets suggests an origin of intense frictional heating and recrystallization prior to the emplacement against the Hazens Notch Formation (Gale, 1980). The ultramafic-mafic association is referred to as the Belvidere Mountain Complex (BMC) by Gale (1980). Correlatives of the mafic members of the BMC at nearby Tillotson Peak contain blueschist assemblages (Laird and Albee, 1981). Recent radiometric age determinations (Laird and others, 1984; Lamphere and others, 1983) of the Belvidere of 490 my, constitute these rocks as the earliest metamorphic recrystallization of "Taconic" Age in Vermont. This age is quite similar, however, to ages obtained for metamorphic aureoles beneath ophiolite complexes in the New England-Quebec Appalachians including the Boil Mountain Complex (Boudette, 1983), Thetford Mines (491 $\pm$ 3 my Ar/Ar age, Clague and others, 1981) and Mt. Albert (504 my K-Ar age from hornblende, Lowdon and others, 1963).

Gale (1980) has also shown that the same deformation which emplaced the BMC against the Hazens Notch (D1, F1) continued to deform the structurally underlying Hazens Notch Formation by tight F1 folds and D1 faults. Subsequently, the entire BMC-Hazens Notch tectonic stratigraphy was folded with an eastward verging sense by F2 folds.

Stanley and Ratcliffe underestimate the importance of these folds although they do recognize that such folds "may have occurred" (p. 5). Mapping by Cady and others (1961) in the Hazens Notch Formation on the east limb of the Green Mountain anticlinorium and detailed mapping by Thompson (1975) in the Hazens Notch Formation on the west limb have shown that these F2 folds clearly affect the map pattern even at a scale of 1:250,000. Field mapping by Eiben (1976) and Aubrey (1977) in the Underhill slice on the west limb of the anticlinorium also show the importance of the east verging F2 folds in controlling the map pattern. Further west in the Fletcher-Enosburg Falls anticlinorium, work by this writer and field camp students from UVM has mapped large scale upright F2 folds. Further west still in the Milton Quadrangle, all fold structures are west facing (see for example Carter, 1979; Dorsey and others, 1983). The second generation F2 folds appear to be an important component in northern Vermont geology and their intensity and east verging sense of overturning also appears to increase to the east. They involve rocks of the Hazens Notch, Underhill and Pinnacle formations and formed subsequent to the emplacement of the BMC which marks the structural top of the sequence.

Correlative folds have not yet been documented to the east of the BMC. Truncation of structures of the Hazens Notch Formation are emphasized by Stanley and Ratcliffe and are interpreted to be derived by "continued motion of the Whitcomb Summit thrust" and, presumably, their Belvidere Mountain thrust which

MODEL INVOLVING THREE PLATES



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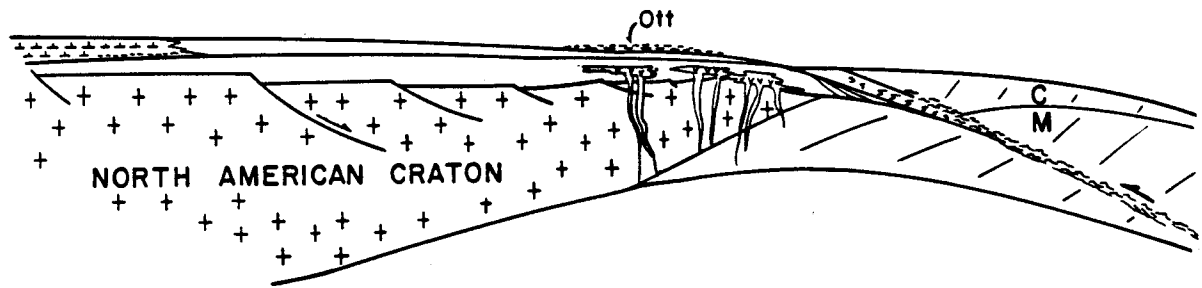

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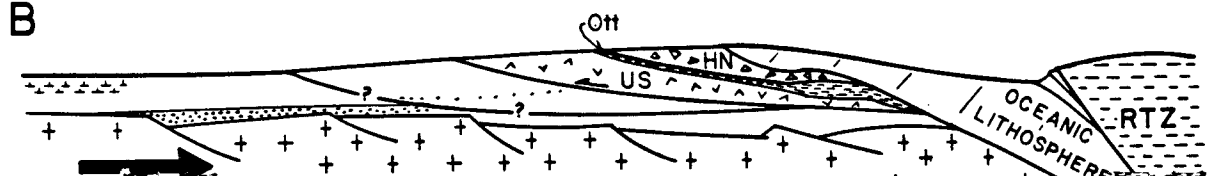

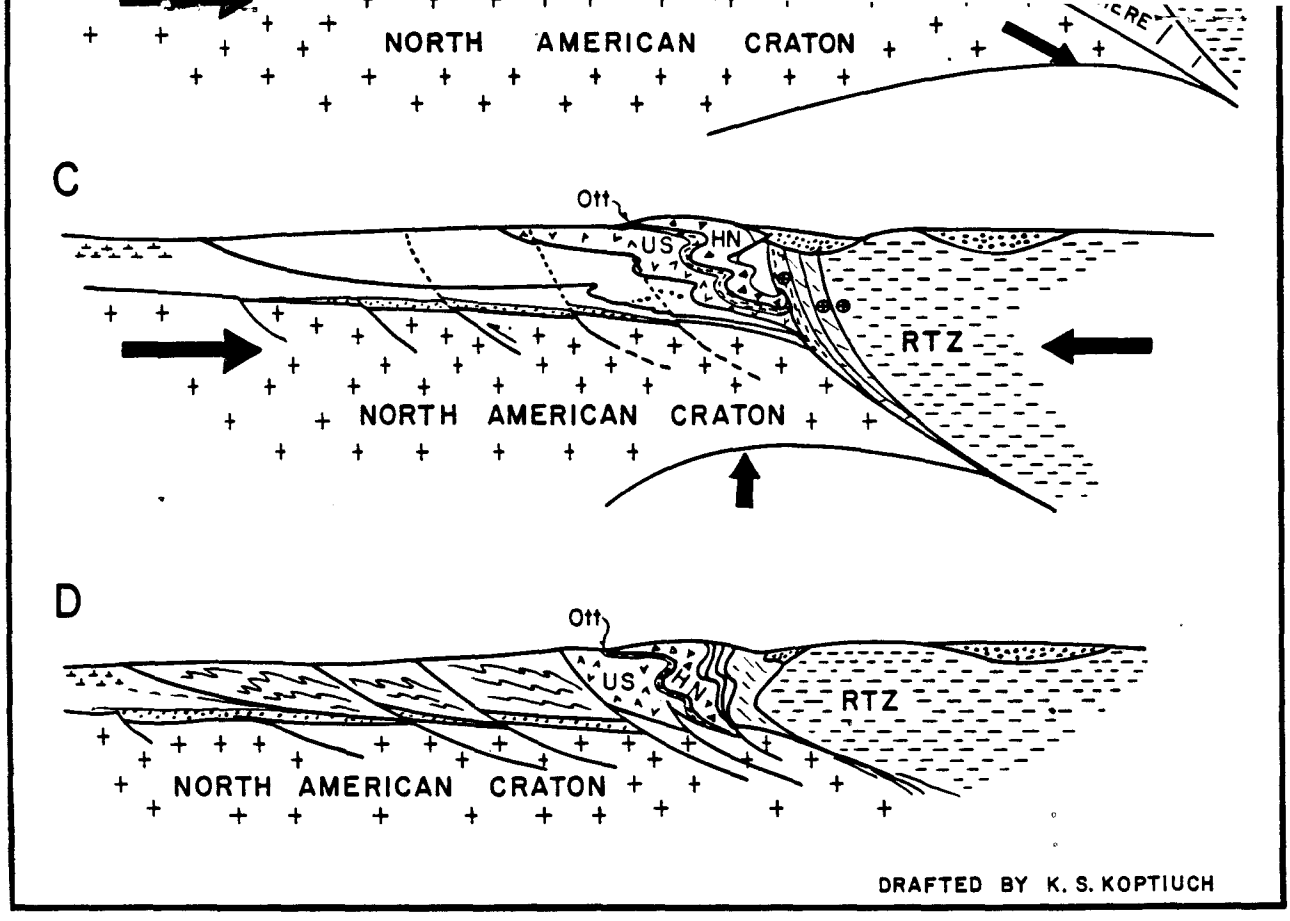
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FIGURE 1

separates the RTZ from underlying units (p.6). The motion of the RTZ-Hazens Notch contact, however, clearly cannot be a continuation of the same thrusts which juxtaposed blueschists, greenschists, amphobolites and serpentines against the Hazens Notch Formation, since the folds which fold these thrusts are truncated by the RTZ. The complex deformational and recrystallization history and the tectonic assemblage of the rocks of the BMC are best interpreted to result from formation in an oceanic trench prior to its emplacement into the Hazens Notch Formation. The emplacement of the Hazens Notch Formation between oceanic rocks and clastic rocks of the Ottauquechee and Underhill formations, the lithic character of the Hazens Notch Formation, and their association with blueschists, amphibolites and serpentinites fits well with descriptions from worldwide examples of ophiolite melange (Gansser, 1974). The lack of blueschist and serpentinites with the distinctive dynamic aureole of amphibolite and greenstones in the RTZ suggests that these rocks had a different history. I prefer to think that the RTZ was not juxtaposed against the North American Craton until after the fault emplacement of the BMC against the Hazens Notch Formation and its subsequent west over east folding (Doolan and others, 1982).

The faults that juxtapose the RTZ and Hazens Notch Formation referred to as the Belvidere Mountain thrust by Stanley and Ratcliffe may indeed have had a long "continual motion" but I know of no evidence which suggests that this motion follows similar fault surfaces responsible for the formation of the BMC and emplacement of the Hazens Notch slice onto the Ottauquechee Formation and the Underhill slice. It is unfortunate that Stanley and Ratcliffe chose to name the contact between the RTZ and the Hazens Notch slice, the Belvidere Mountain fault. This useage is a carry over from the mapping of Cady and others (1961) who defined the contact between the Hazens Notch and Ottauquechee formations (western unit of RTZ) in part by the "stratigraphic" position of the Belvidere Mountain amphibolite. Work by Stanley and Dana Roy (Roy, 1982; Stanley and Roy, 1982) north of Belvidere Mountain has clearly shown the contact is faulted and highly imbricated and not defined in this area by the Belvidere Mountain amphibolite alone. As previously discussed, however, Gale (1980) has shown that the Belvidere Mountain amphibolite does trace an earlier and tectonically important fault surface above the Hazens Notch Formation. The fault between the BMA and the Hazens Notch, and the fault between the RTZ and the Hazens Notch should not be confused; by defining them as one and the same could lead to errors in interpretation.

My second point of disagreement with the Stanley and Ratcliffe model concerns the problem of taking it north across the international border. Although the purpose of their paper was to explain western New England geology, any model explaining Taconian geology in Vermont should not be in conflict with along strike geology in the Eastern Townships where Acadian overprint appears far less severe. It is beyond the purpose of this discussion to rehash the geology of the Eastern Townships (see for example, St. Julien and Hubert, 1975; Laurent, 1979; Williams and St. Julien, 1982; Doolan and others, 1982). However, significant alteration of the model appears necessary to explain the occurrence of well developed ophiolite suites and their cover rocks in Quebec. In addition, it is difficult to find

correlatives of the Stowe-Moretown parts of the RTZ north of the border although as Stanley and Ratcliffe demonstrated it is persistent for such great distances southward.

I would be remiss if I ended the discussion without suggesting alternative solutions to resolve some of these apparent conflicts between my understanding of the rocks and the model of Stanley and Ratcliffe. Like their model, these suggestions are not meant to be definitive but rather provide a vehicle for further discussion of the differences between our interpretations. The suggestions which follow specifically address the early emplacement history of the BMC and Hazens Notch Formation and assume, on the basis of points raised earlier in this discussion, that the Hazens Notch and underlying Ottaquechee and Underhill Formations were folded eastward prior to the final emplacement of the RTZ. To do this in the simplist way is to invoke a three plate model which from west to east are referred to as the North American craton, the Dunnage terrane (oceanic crust and mantle) and the RTZ (see Fig. 1).

Figure 1A occurs during cross section 8 time of Stanley and Ratcliffe and involves the formation of an oceanic trench which subducts oceanic crust into the realm of blueschist metamorphism (20-30 km.). The formation of the Belvidere Mountain complex (~500 mybp) occurs at this time. Obduction of the oceanic slab to the continental margin results in an easy way to emplace blueschist assemblages onto upper levels of continental crust (Coleman, 1971). As the obduction proceeds, more of the continental margin clastic rocks are incorporated into the melange, resulting in the formation of an ophiolite melange (Hazens Notch slice) which probably reached the surface as an olistostromal melange thrust over the Underhill Formation probably within the pelitic rocks of the Ottauquechee Formation (see abstract by Doolan in this issue of the GMG). (Fig. 1B: time is equivalent to cross section 7 of Stanley and Ratcliffe.) Continued subduction between the obducted Dunnage plate and the RTZ results in the formation of east verging folds. These F2 folds are conceived in this model to be the result of subduction of an elevated accretionary prism down the Dunnage-RTZ subduction zone (Fig. 1C). Continued movement on lower faults in the North American craton are a reasonable mechanical consequence resulting in the formation of coeval west verging folds in the Giddings Brook and western reaches of the Underhill slices. (I defer to Stanley and Ratcliffe concerning the orientation or early sequence of fold events in the higher Taconic slices.) Further collision of the RTZ against the North American craton results in activation of deeper basement slices which may explain the diverticulation of earlier emplaced thrust faults in the Taconic slices (Fig. 1).

An alternative model involves making the RTZ-Dunnage boundary a left lateral transform fault with an east dipping subduction component of motion (Doolan and others, 1982). This model is preferred since it more effectively extinguishes subduction on the North American-Dunnage trench which would conceivably result in isostatic uplift of the North American margin prior to the juxtaposition of the RTZ. Since the RTZ is not known to have been transported westward over the North American margin anywhere in the New England or Quebec Appalachians, this mechanism provides the means for keeping it in

its eastern position relative to the underlying Underhill, Hazens Notch and ophiolitic slices.

Either of the two suggested models can explain the occurrence of ultramafic rocks in the RTZ by further dismemberment of the Dunnage terrane during the juxtaposition of the RTZ with the already deformed North American craton. This leaves me with the question of the origin of the RTZ rocks. Stanley and Ratcliffe are correct in originating these rocks well away from the North American craton (their cross section 8). If the emplacement of ultramafic rocks within the RTZ represents a relatively late stage in their formation, as suggested here, there is little evidence to suggest that they represent an accretionary prism built above oceanic crust subducting beneath the Bronson Hill volcanic arc. More work certainly needs to be done on the pre-Moretown and pre-Albee rocks of Vermont-New Hampshire and Maine to resolve their origin. As Stanley and Ratcliffe clearly show, they represent an important and continuous lithotectonic horizon in the New England Appalachians which separates rocks originating on opposite banks of an ancient ocean basin.

The proposed models, while not seriously affecting the overall conclusions drawn by Stanley and Ratcliffe, provide reasonable alternatives to correlation of Vermont geology to Quebec, which are inappropriate to discuss here. They also focus attention on the origin and significance of ultramafic rocks, melanges, blueschist formation and fold generation in the Vermont Appalachians, which are of great importance in the regional context. I again applaud the efforts of Stanley and Ratcliffe in providing their review of the pre-Silurian evolution of western New England in such a lucid and comprehensive form. Their format provides a basis for stimulating further discussion of complex geology both in the literature and in the field.

References cited

Aubrey, W.A., 1977, The structure and stratigraphy of the northern ridges of Camels Hump Mountain, Camels Hump Quadrangle, North Central Vermont [M.S. thesis]: Burlington, Vermont, University of Vermont, 57p.

Boudette, Eugene L., 1982, Ophiolite assemblage of early Paleozoic age in Central Western Maine: in Major structural zones and faults of the Northern Appalachians, P. St. Julien and J. Béland, Geol. Assoc. of Canada, Special paper 24, p. 210-230.

Cady, W.M., Albee, A.L. and Chidester, A.H., 1963, Bedrock geology and asbestos deposits of the upper Missisquoi valley and vicinity, Vermont: U.S. Geol. Survey Bulletin 1122-B, p. B1-B78.

Carter, Craig M., 1979, Interpretation of the Hinesburg thrust north of the Lamoille River, northwestern Vermont [M.S. thesis]: Burlington, VT, University of Vermont, 84p.

Chapple, W.M., 1973, Taconic orogeny; abortive subduction of the North American continental plate?: GSA Abstracts with Program, v. 5, p. 573.

Clague, D., Jason Rubin and Russell Brackett, 1981, The age and origin of the garnet and amphibolite underlying the Thetford Mines ophiolite, Quebec: Canadian J. of Earth Science, v. 18, p. 469-486.

Coleman, R.G., 1971, Plate tectonic emplacement of upper mantle peridotites along continental edges: Jour. Geophys. Res., v. 76, p. 1212-1222.

Doolan, B.L., M.H. Gale, P.N. Gale and R.S. Hoar, 1982, Geology of the Quebec reentrant: possible constraints from early rifts and the Vermont-Quebec serpentine belt: in Major structural zones and faults of the Northern Appalacians, St.Julien, P. and Béland, J., Editors, Geol. Assoc. of Canada, Special Paper No.24, p. 87-115.

Dorsey, R.J., P.C. Agnew, C.M. Carter, E.J. Rosencrantz and R.S. Stanley, 1983, Bedrock geology of the Milton quadrangle, northwestern Vermont, Vt. Geol. Survey, Special Bulletin No. 3, 14p., 4 pl.

Eiben, D.B., 1976, Stratigraphy and structure of the Stimson Mountain area, Camels Hump Quadrangle, north and central Vermont [M.S. thesis]: Burlington, VT, Univ. of Vt., 112p.

Gale, M.H., 1980, Geology of the Belvidere Mountain complex, Eden and Lowell, Vermont [M.S. thesis]: Burlington, VT, University of Vermont, 169p.

Gansser, A., 1974, The ophiolite melange, a worldwide problem on Tethyan examples: Eclogae geologicae Helvetiae, v. 67, p. 479-507.

Hall, Leo M. and Peter Robinson, 1982, Stratigraphic-tectonic subdivisions of southern New England: in Major structural zones and faults of the Northern Appalachians, St. Julien, P. and Béland, J., Editors, Geol. Assoc. of Canada, Special Paper 24, p. 15-41.

Laird, Jo and A.L. Albee, 1981, High pressure metamorphism in mafic schist from northern Vermont: AJS, v. 281, p.127-175.

Laird, Jo, M.A. Lanphere and A.L. Albee, 1984, Distribution of Ordovician and Devonian metamorphism in mafic and pelitic schists from northern Vermont: AJS, in press.

Lanphere, M.A., Jo Laird and A.L. Albee, 1983, Interpretation of 40Ar/39Ar ages of polymetamorphic mafic and pelitic schist in northern Vermont: GSA Abstracts with Programs, Northeastern Section, v. 15, p. 147.

Laurent, R., 1977, Ophiolites from the Northern Appalachians of Quebec: in North American ophiolites, Coleman, R.G. and Irwin, W.P., Editors, State of Oregon Dept. of Geol. and Mineral Industries, Portland, Bulletin 95, p. 25-40.

Lowdon, J.A., C.H. Stockwell, H.W. Tipper and R.K. Wanless, 1963, Age determinations and geological studies, including isotopic ages: Report 3, Canada Geol. Survey Paper 62-17.

Osberg, P.H., 1978, Synthesis of the geology of the Northern Appalachians, U.S.A.: in Caldonian-Appalachian orogen of the North Atlantic Region, Tozer, E.T. and Schenk, Paul E., Editors, Geol. Survey Canada Paper 78-13, p. 137-147.

Robinson, Peter and L.M. Hall, 1980, Tectonic synthesis of southern New England: in Wones, D.R., Editor, Proceedings "The Caldonides in the U.S.A.", Memior No. 2, Dept. of Geol. Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA, p. 73-82.

Rowley, D.B. and W.S.F. Kidd, 1981, Stratigraphic relationships and detrital composition of the medial Ordovician flysch of western New England: implications for the tectonic evolution of the Taconic orogeny: Jour. of Geol., v. 89, p. 199-218.

Roy, D.L., 1982, Structure and stratigraphy of the Cambrian-Ordovician sequence in the ultramafic belt near Troy, Vermont [M.S. thesis]: Burlington, VT, Univ. of Vt., 122p.
St. Julien, Pierre and Claude Hubert, 1975, Evolution of the Taconian orogen in the Quebec Appalachians: AJS, Rogers Volume, v. 275-A, p. 337-362.
Stanley, Rolfe and Nicholas Ratcliffe, 1983, Simplified litho-tectonic synthesis of pre-Silurian rocks in western New England: Vt. Geological Survey Special Bulletin No. 5, 9p.
Stanley, R.S. and D.L. Roy, 1982, Tectonic geology of the northern Vermont ultramafic belt: GSA Abstracts with Programs, v. 14, p. 85.
Thompson, Peter, 1975, The stratigraphy and structure of Shattuck Ridge, Bakersfield and Waterville, Vermont [M.S. thesis]: Burlington, VT, University of Vermont, 68p.
Williams, Harold and Pierre St. Julien, 1982, The Baie-Verte - Brompton Line: Early Paleozoic continent-ocean interface in the Canadian Appalachians: in Major structural zones and faults of the Northern Appalachians, St. Julien, P. and Béland, J., Editors, Geol. Assoc. of Canada, Special Paper 24, p. 177-207.

This forum is open to a REPLY from Messers Stanley and Ratcliffe in a future issue of the GREEN MOUNTAIN GEOLOGIST.

FOSSILS

MUNSON QUARRY - GRAND ISLE

Grand Isle is well-known for its fossil collecting (see GMG, v. 4, #3 Lessors Quarry). There is a Crown Point quarry site on Route 2 south of the town line between South Hero and Grand Isle. The access road is on the east side of the road beside two storage garages used by the town. Park behind the buildings and walk into the quarry. The quarry floor is apparently wet, so the west side of the quarry is recommended as the easiest approach. Please note that this area is not recommended to the inexperienced bush-wacker or children.

The rocks are fine-grained with patches of coarser grains and are bluish gray on fresh surfaces. Weathered surfaces are light to medium gray with patches of brown. They have fossils showing in relief. On bedding surfaces, Maclurites up to 5 inches in diameter were found. Laminated structures that look like algae were present as well as fossil hash composed of crinoid stems, trilobite parts and less identifiable pieces. The high point of the day was the sponge, Zittelella. The individual we found was about 2 inches in diameter.

This quarry is owned by Munson Earth-Moving Corp. and access to the quarry is granted under the following conditions:

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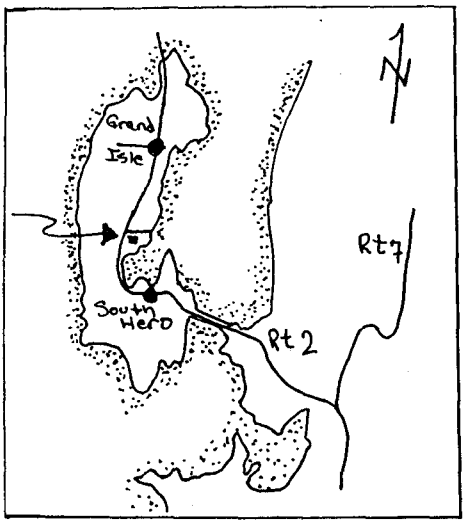

Map showing location of Munson Quarry

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Submitted by

Shelley Snyder

PHOSPHORUS FLUXES FROM ST. ALBANS BAY, LAKE CHAMPLAIN, SEDIMENTS

Fowler, Bruce A., Dept. of Civil and Mechanical Engineering,
Drake, J.C., Dept. of Geology and Hemenway, D.R., Dept. of Civil and Mechanical Engineering, University of Vermont, Burlington, VT 05405

Phosphorus exchange at the sediment-water interface has been investigated by monitoring the supernant chemistry of undisturbed sediment cores stored under both static and simulated flow (dynamic) conditions. A reservior-pumping system has been developed that allows systematic variation in flow velocities on the range of (0-30 cm.min.). Experiments have been conducted under varying conditions of temperature, dissolved oxygen, light intensity and flow rate utilizing both distilled water and filtered lake water. These experiments demonstrate the importance of P exchange from sediments even in aerated waters.

Similar supernant compositions were obtained after only 120 hours in experiments containing P-spiked and unspiked supernant, indicating the rapidity with which the system equilibrates and thus providing information on the rate of P sorption/desorption process. P release from static cores was substantially less than that from 'dynamic' cores indicating the importance of water movement in phosphorus release. Serial sectioning of cores illustrated that the majority of the phosphorus released during incubation studies came from the uppermost 4 centimeters of sediment. Decrease in temperature and/or increase in light intensity resulted in an order of magnitude decrease in P supernant concentration. The experiment design will permit continued investigation of the effects of both physical and chemical factors on the release of P at the sediment-water interface.

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TENTH ANNIVERSARY SPECIAL

Included in this series of reflections from our past presidents about the first ten years of VGS are the recollections of one of our present members who was a student at Middlebury College when the events he describes here occurred. Robert Badger also participated in our Spring student presentation of papers as a graduate student at the University of Vermont where his thesis topic was "The Umbrella Hill Conglomerate: Subaqueous Grain-Flow" (Abstract in the Spring 1976 GMG, vol. 3 #1). Having worked as a geologist at the Vermont Marble Company for a number of years, Bob has now returned to the academic world to study the southern Appalachians, as he pursues an advanced degree at Virginia Polytechnic Institute at Blacksburg, VA. Maybe at some future meeting, Bob, we can persuade you to present a third paper to VGS on your current research.

I would like to offer a few recollections of my own on the founding of the Vermont Geological Society.

As I recall, the VGS was born out of the Vermont Academy of Arts and Sciences. Each year this group, dominated by the geologists, would get together at Middlebury or UVM to present student papers. Mostly the respective departments of geology at Middlebury College and UVM took advantage of this get together to allow seniors to present their theses, and also get a publication, as I believe the Academy would publish the abstracts. I vaguely remember that some of the sciences would occasionally participate, but do not recall the extent of their research presentation.

In 1973, in the interest of getting wider college participation, it was decided that another school would host the meeting. I do not recall whether it was Johnson, Castleton or Windham, but when we geologists sent in our abstracts, they were all rejected. Pete Coney was a bit perturbed, feeling that the geologists had been the dominating organization for years. So he got together with other faculty members from Middlebury and UVM and it was decided we would put on our own show. It was important for seniors to have the experience of presenting their research.

So one Saturday morning in the spring of 1973 we gathered in room 117 in the science center at Middlebury. Barry Doolan got up to open the show and said something to the effect:

> "Good morning ... I'd like to welcome you all here to the first annual meeting of ... What should we call it? ... The Vermont Geological Society?"

We then went on to nervously present our research and left that day with the satisfaction that we had been part of the founding of a new organization. One professor said he would see about getting the abstracts published, but alas, that never came about. I do not recall all the participants, but Middlebury was represented by Lois Ongley, Bob McGirr, Dave Twitchell, Tina Gramsey, Mike Schoenfeld, Andy King and myself. The only participant from UVM that I recall is Jeff Limoge. Perhaps Brew can look up in his "ever-present notebooks" and locate the missing names.

Every great organization has its roots and grows out of a need. I think it shoud be remembered that VGS grew out of the Vermont Academy of Arts and Sciences and its purpose was to provide an outlet for academic research.

Here's to another prosperous and enlightening 10 years.

Submitted by Robert Badger
Blacksburg, VA

Discussions on the need for an organization devoted to "Vermont Geology" were broached in late 1973 followed by an organizational meeting at the Tavern Motor Inn in Montpelier in January 1974. I believe we had about 24 members of the geological community at that meeting. We spoke about the objectives and goals of this new organization, membership criteria, meeting logistics, the name of the organization and even a stray tidbit or two on Vermont Geology.

During our first year, the Society gained recognition by co-sponsoring a presentation in Montpelier by Apollo 17 astronaut and geologist Harrison H. Schmitt. This well-attended gathering provided may Vermonters with their first face to face encounter with someone who had journeyed to the moon. An added feature of this event was a display of lunar rock samples. The most significant event that occurred during my tenure as President in 1975-1976 was the budgetary actions proposed by the legislature. Their actions would have effectively eliminated the Vermont Geological Survey and the position of State Geologist. However, through the fine efforts of many members of the Society, this situation was avoided. Brew Baldwin documented this period of time very well in the Summer 1983 issue of the Green Mountain Geologist. I look at this period as the time when the Society truly matured. For it was through the communications fostered throughout the Society and to legislators and State administrators that the Society was established as a viable, articulate force both in and outside of Vermont Geology.

The growth of the Society has been and should continue to center on effectively communicating the Story of Vermont Geology to as broad an audience as possible. Through the Green Mountain Geologist, Vermont Geology, field trips and meetings, special programs and issue papers we are serving the geological community well. At the same time we are exposing new people to the many facets of Vermont Geology. This after 10 short years is a darn good beginning. Happy Birthday VGS.

Submitted by John Malter
Montpelier, VT

MINERAL OF THE QUARTER

BLUE QUARTZ

Quartz, to quote Frederick Pough, in his "Field Guide to Rocks and Minerals", is the commonest of minerals, found in every class of rocks and forming under all sorts of conditions. Actually one-fifth of the crust of this planet is made up of quartz. In Vermont it is found in sedimentary shales in fine, clear crystals along Lake Champlain and with pyrite in the Fair Haven slates. It occurs in metamorphosed sedimentary and igneous rocks in Bennington and Orange Counties, as well as in the granite pegmatites on the east shore of Lake Willoughby.

Quartz (SiO_2) exists in both crystalline and micro-crystalline forms. The crystallized forms are often found in well-formed crystals or crusts. Clear violet colored quartz - amethyst is not found in Vermont. The rose colored variety also has not been reported here. Their absence is likely due to the lack of the type of pegmatites found elsewhere in New England (Maine, Mass. and N.H.). Milky, clear and "blue" quartz are found in Vermont.

A blue quartz collecting locality in Bennington County can be reached by taking route 9 east from Bennington toward Woodford. The rock face on the north side of the road cut about 6 miles from Bennington contains rocks of the Mt. Holly Complex. These are metamorphosed sedimentary and igneous rocks of Precambrian age. The minerals reported here are blue quartz, garnet, orthoclase and plagioclase feldspars, biotite and hornblende. Blue quartz is apparently always associated with medium to high grade metamorphic rocks. Some of the blue quartz found at this locality has been of lapidary quality.

There is still some question about the cause of the blue color in this quartz. Ray Grant, in his monograph "Mineral Collecting in Vermont" (Special Publication #2, Vermont Geological Survey), states that small inclusions of Rutile (TiO_2) may be responsible. Rutile is often found intimately associated with quartz in metamorphic rocks.

Quartz is notorious for picking up impurities and being colored by them. For this reason it is called an allochromatic mineral. Many transparent minerals, including gemstones, share this property. Titanium and iron are responsible for coloring blue sapphires and iron also is known to color spinel blue. The holes in the rather open structure of the SiO_2 lattice also can hold the smaller ions like lithium and zinc.

Structural defects in the lattice also have been implicated as being responsible for the color in transparent minerals. A great deal of study has been done on halite ($NaCl$) on this subject. It is known that irradiation can cause damage to the lattice structure in mineral crystals. The depth of color in Smoky Quartz is directly proportional to the amount of radioactivity burn it received during its formation or later geologic history. Many of the attractive smoky quartz specimens on the market today are clear, Hot Springs, Arkansas, crystals that have been irradiated before they were merchandized. Diamonds are being colored for the gem trade by this method, also.

Given the state of the art today, it would be a very interesting research project to diagnose the cause for the blue color in blue quartz found in several localities in Vermont. Ray Grant seems to feel that the causes for this color are different in the different areas.

Submitted by Ethel Schuele

[Editor's note: Titanium does indeed impart the color to blue quartz. The subject came up during our fall field trip and Paul Karabinos outlined the genesis of blue quartz. Titanium dissolves in high quartz which is subsequently transformed to low quartz. Then under metamorphic conditions of garnet grade, Ti exsolves as finely divided rutile which can be observed microscopically only under more than 50 power. The blue color is a result of light scattering from these small rutile particles (the Tyndall effect). The presence (or absence, for that matter) of blue quartz in a rock is, therefore, indicative of the thermal history of the quartz and several scenarios are possible. Interestingly enough, blue quartz is not found in the Grenville rocks because thay have undergone metamorphism at too high a grade. The rocks in question on the field trip at Okemo were chlorite grade, meaning that the quartz had been deposited as blue quartz and had, therefore, gone through a three step thermal history in EoCambrian time. In a future issue of the GMG, I plan to publish this story in greater detail with references, because I realize that blue quartz has as much fascination for Vermont geologists as do garnets.]

WATER RESOURCES

WATER POLLUTION CONTROL REGULATIONS

Brendan Whittaker, Secretary of the Agency of Environmental Conservation, has recently issued a draft of regulations covering underground injection control and discharges to injection wells. This is bureaucratically known as Subchapter 13 UIC of the Water Pollution Control Regulations. Anyone wishing a copy of these proposed regulations should contact:

David L. Clough
Director, Water Quality Division
Department of Water Resources and Environmental Engineering
State Office Building
Montpelier, VT 05602

(802) 828-2761

A hearing is scheduled for March 8, 1984 at the Pavilion Building Auditorium from 10 AM to 1 PM. The comment period will close on March 19, 1984.

WELL DRILLER'S WORKSHOP at Vermont Technical College March 24, 1984 from 9 AM to 4 PM. Emphasis on water rights, water treatment and public water systems. Contact Jim Ashley, Water Resources, Montpelier, VT, (802) 828-2761.

STATE GEOLOGIST'S REPORT

STATE SPONSORED PROGRAMS:

- Geologic and Mineral Resource Assessment of State Lands - status = field and laboratory work completed, writing in progress for Okemo State Forest.
- Ground Radiometric surveys of anomalies detected by airborne survey - status = field survey, maps and reports completed for three (3) areas, Highgate, Milton and Hinesburg.
- Bedrock and Surficial geologic mapping of the Northfield 7 1/2 - minute quadrangle - status = project started in summer of 1983.
- Ground Water Management - status = Advisory only.

STATE - FEDERAL COOPERATIVE PROGRAMS:

- U.S. Geological Survey, Eastern Mapping Center - topographic mapping - status = completion of two (2) 7 1/2 - minute x 15 - minute, 1:25000, metric scale topographic maps, St. Johnsbury, VT and Lancaster, NH-VT.
- U.S. Geological Survey, Office of Earthquakes, Volcanoes, and Engineering Geology - Slope stability study in Green Mountains - status = Completion of first summer of field work.
- U.S. Bureau of Mines - MOU and Cooperative Agreement - status = On-going collection of mineral resources information.
- U.S. Bureau of Mines - Waste Slate Research - status = Pilot plant economics in progress.

FEDERAL PROGRAMS:

- U.S. Geological Survey
  - a. SLAR (Side-looking Airborne Radar) - status = Glens Falls 1° x 2° sheet, Lake Champlain 1° x 2° sheet (partial), Lewiston 1° x 2° sheet completed. Albany 1° x 2° sheet and Lake Champlain 1° x 2° sheet (partial) under contract.
  - b. CUSMAP (Conterminous U.S. Mineral Assessment Program) - status = Glens Falls 1° x 2° sheet in progress, second year.

SPECIAL PROGRAMS:

- U.S. Department of Energy - Overview of Crystalline Rock Program - status = second year, grant continuing under pre-notification state status.

NEW PUBLICATIONS:

- Supplement to the "Bibliography of Vermont Geology" - status = Open-file, available from the Vermont Department of Libraries, Geologic Documents, Montpelier, VT 05602. ($2.00)
- Bedrock Geology of the Milton Quadrangle - status = published, Special Bulletin #3. ($3.00)
- Geology of the Starksboro Area - status = published, Special Bulletin #4. ($2.00)
- Simplified Lithotectonic Synthesis of Pre-Silurian Rocks in Western New England - status = published, Special Bulletin #5. ($2.00) ★

Copies are available from the Department of Libraries, see address above.

Charles A. Ratte', State Geologist
Office of the State Geologist
Agency of Environmental Conservation
State Office Building Post Office
Montpelier, VT 05602
Phone: (802) 828-3365

★ Authors are Rolfe S. Stanley and Nicholas Ratcliffe.

MEETINGS

(See also Page 32 - March 24)

FEB 18	VGS WINTER MEETING - See pages 3 and 4 of this issue.
MAR 8	HEARING: Subchapter 13 UIC of Water Pollution Control Regulations, 10 AM to 1 PM at Pavilion Building Auditorium, Montpelier, VT. See page 32 for details.
MAR 15-17	Annual meeting of the Northeastern Section of the Geological Society of America at Providence, RI (Dept. of Geological Sciences, Brown University, Providence, RI 02912). Of special interest to applied geologists is a Symposium on Hydrogeology which will focus on theory and application of advanced scientific methods and statistical approaches to hydrology and groundwater geology.
APR 28 or MAY 5	VGS SPRING MEETING - presentation of student research papers. Call for papers will go out to the colleges as soon as the date is firm.
JUNE 18-22	5th International Conference on Finite Elements in Water Resources, the University of Vermont, Burlington, VT. Contact Dr. J.P. Laible, Finite Element Conference, Dept. of Civil Engineering and Mechanical Engineering, University of Vermont, Burlington, VT 05405.
AUG	VGS SUMMER weekend field trip, probably some time during this month to Thetford Mines area, Canada. Trip leader Brewster Baldwin and possibly Roger Laurent.
OCT	VGS FALL FIELD TRIP AND ANNUAL MEETING - weekend after NEIGC. Barry Doolan will lead a field trip in the Jeffersonville, VT area.

VERMONT GEOLOGICAL SOCIETY

MEMBERSHIP INFORMATION FORM

****

NAME: _____

ADDRESS: _____

_____

PHONE NUMBER: (_____) _____-_____ EXT. _____

SPECIALTY: _____

TYPE OF EMPLOYER: SELF____, PRIVATE____, ACADEMIC____,

GOVERNMENTAL____, OTHER_____
(SPECIFY)

VGS members, please complete and return this form to:

Chris White
White Geohydrology, Inc
52 Seymour Street
Middlebury, VT 05753

Please see page 13 and the President's Letter on page 2 for the rationale behind this questionnaire.

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

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