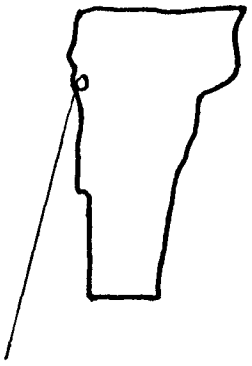
THE GREEN MOUNTAIN GEOLOGIST



QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

SPRING 1988 VOLUME 15 NUMBER 1

This will be the 15th annual

PRESENTATION OF STUDENT PAPERS

SATURDAY, APRIL 30, 1988 9:00 A.M.

FLEMING MUSEUM ROOM 101

UNIVERSITY OF VERMONT

BURLINGTON, VERMONT

Directions: Fleming Museum is adjacent to Perkins Geology Building facing Colchester Ave. Room 101 can be reached through the entrance facing Perkins. There is visitor parking in a lot on the east side of Fleming Museum, reached from the road leading to the Medical Center Hospital.

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PRESIDENT'S LETTER

Dear Friends,

In my last letter I mentioned the need for the Society to stay vital by being open to new ideas and approaches. I believe this. Sometimes when we have a good thing going, through overuse it becomes stale and ineffective. The Executive Committee has been discussing having a computer application workshop in lieu of the winter meeting of speakers next year. Computers are so much a part of our daily lives that perhaps we could learn new uses in geological education, data management, graphics, etc. Also, as much as I have been stimulated by the papers presented in the past, it is increasingly difficult to fill a program solely on Vermont field geology or environmental geology. The hard thing is that good arguments may be made for both programs. I ask you to share your thoughts with any of us on the Executive Committee on this matter of the winter meeting or on any other subject.

I am pleased to announce that Dr. Bud Ebbett of Lyndon State College has offered to lead a field trip in the Northeast Kingdom next fall. Some years ago Bud led a very interesting trip on the glacial geology of the Lake Willoughby area, which, by the way, he has written up for the newly printed Volume 5 of Vermont Geology. Bud is willing for the subject of the field trip to be either the igneous plutons of the Northeast Kingdom or the glacial geology of the Passumpsic River Valley. Let your choice be known to Bud or the Executive Committee and watch for announcements in the summer and fall GMGs.

I encourage as many of you as possible to attend the Saturday, April 30th meeting of presentations of student papers at UVM. I look forward to seeing you there.

Sincerely,

Jeff Pelton, President

GEOLOGICAL EDUCATION COMMITTEE REPORT

An open letter to VGS members and other interested geologists and non-geologists:

As the Geological Education Committee chairperson, I would like to express some concerns and thoughts on the direction VGS is progressing with respect to geologic education. I see three major areas with great potential to improvement.

First, let's get them young. Elementary school kids are interested and eager to find out about the world around them. If we encourage them to ask questions, and if we are willing to answer these questions through talks at schools and information to teachers, we will help create a whole new generation of geologists and geologically and environmentally knowledgeable adults.

[Continued on page 13.]

SPRING PROGRAM

April 30, 1988
Fleming Museum Room 101
University of Vermont, Burlington, VT

COFFEE AND DONUTS 8:30

MORNING SESSION: Barry Doolan presiding

1. Mark Held: The Nature and Origin of Arches in the Crystalline Basement of the Buckskin Mountains Metamorphic Core Complex, Western Arizona 9:00
2. James Taylor: The Structural and Metamorphic History of the Green Mountain Front in the Vicinity of East Middlebury, Vermont. 9:20
3. Patrick Stern: Balanced Cross Section Across the Middlebury Synclinorium, West-Central Vermont . . 9:40
4. Geoff Christe: The Depositional Environment of the Pre-Olenellus White Brook Dolomite, Lower Oak Hill Group, Southern Quebec: The Effects of Extensional Tectonism and Sea Level Fluctuations on Syn-rift Stratigraphy 10:00
5. Timothy Mock: Deformational History of the Richford-Cambridge Syncline, Northern Vermont . . 10:20

COFFEE BREAK 10:40

6. Gregory Walsh: Tectonic Lithostratigraphic Units of the Camels Hump Group in the Vicinity of Fayston, Vermont 11:00
7. Samuel Haydock: Tectonic Geology of the Waits-field-Warren Area, Central Vermont 11:20
8. Thomas Armstrong and Maurice Colpron: Correlation of Rift, Transitional, and Drift-Stage Sequences in the Taconian Orogenic Hinterland of the Northern Appalachians: A Preliminary Report 11:40

LUNCH: (Brown bag or local eateries) 12:00

EXECUTIVE COMMITTEE MEETING [Agenda on page 14.]

AFTERNOON SESSION

9. Joseph Fiacco, Shawn Healy and Michael Smith: Bedrock Chemistry Compared to Groundwater Quality Across the Richardson Memorial Contact in Central Vermont. 1:30
10. Christopher Sinton: Geochemistry and Tectonic Setting of Eastern Adirondack Dikes. 1:50
11. Eve Witten: Paleoenvironmental Interpretation and History of Uranium Enrichment and Resultant Radon Gas Genesis of the Clarendon Springs Dolostone, Milton, Vermont . . . 2:10
12. Kristen Peat: The Petrology of the Coleraine Breccia, Coleraine, Quebec. 2:30
13. Darren Gainer and William Lukaskiewicz: Results of Magnetic and Gravity Surveys over a Suspected Granite Body near Northfield Falls, Vermont 2:50

AWARDS 3:20

ABSTRACTS

CORRELATION OF RIFT, TRANSITIONAL, AND DRIFT-STAGE SEQUENCES IN THE TACONIAN OROGENIC HINTERLAND OF THE NORTHERN APPALACHIANS: A PRELIMINARY REPORT

Armstrong, Thomas R. and Colpron, Maurice, Department of Geology, University of Vermont, Burlington, VT 05405

Correlation of the rift, transitional, and drift-stage lithologies within the northern Taconide hinterland is complicated by along strike and across strike variations; the drift-stage sequences, relatively invariant where present along strike, exhibit across strike changes. The proximal group (relative to the carbonate platform) consists of dark slates, massive mature quartzite, and dolomite of the Skeels Corner/Sweetsburg formations (southern Quebec and northern Vermont) and the regionally extensive Cheshire and Dunham formations. The intermediate group includes dark slates, thin quartzite, and dolomitic horizons of the Sweetsburg (Quebec/northern Vermont) and the West Castleton-Hatch Hill formations (Taconic allochthons). The distal group contains graphitic schists, thin white quartzite and thick dark quartzite, occasional serpentine, and several exotic lithologies of the "Underhill", Hazens Notch, Pinney Hollow, Stowe, and Ottaquechee formations (Vermont), and the Sutton Schist (Quebec). The absence of dolomite, and the abundance of graphite in some of these formations indicates they were deposited in a deeper, more distal part of a thermally subsided basin. Rift-stage lithologies, characterized by coarse clastic deposits and/or meta-igneous mafic sequences, vary both along and across strike. In Quebec, proximal drift-stage rocks are underlain by coarse clastics, sporatic dolomite, and thick intraplate alkaline volcanics. In central Vermont, coarse clastics and conglomeratic facies unconformably overlie Middle Proterozoic basement and post-Grenville mafic dikes of the Lincoln massif. Intermediate group rocks are underlain by metawacke and schist interbedded with thinner intraplate volcanics. Distal group rocks stratigraphically and tectonically overlie thick sequences of fine-grained schist with minor metawacke and thin, but pervasive, transitional volcanics. Transition-stage lithologies record a change from rift to drift subsidence. This stage included thick sequences of West Sutton, Frelighsburg, and Underhill formations (Quebec and northern Vermont) and the thin aluminous schists of the Metawee/Truthville, Mt. Abraham and Fairfield Pond/Moosalamoo formations (Taconics and central Vermont). Differences in transition-stage thicknesses may be a consequence of north to south variation in subsidence rates during the change from initial (airy) to thermal (Pratt) subsidence.

Correlation of these various sequences indicates that the amount of subsidence during rift-stage increased north to south and west to east. The thickness of the transition-stage is inversely porportional to the rate in rift-drift transition. Drift-stage subsidence increases from west to east, but is fairly constant from north to south. This north-south consistency is a product of transition-stage "equilibration" which compensates for diachroneity in rift-drift transition along the reentrant. Based upon this interpretation, many of the earlier correlations across this region are incorrect and require reinterpretation.

THE DEPOSITIONAL ENVIRONMENT OF THE PRE-OLENELLUS WHITE BROOK DOLOMITE, LOWER OAK HILL GROUP, SOUTHERN QUEBEC: THE EFFECTS OF EXTENSIONAL TECTONISM AND SEA LEVEL FLUCTUATIONS ON SYN-RIFT STRATIGRAPHY

Christe, Geoff, Department of Geology, University of Vermont, Burlington, VT 05405

The White Brook Dolomite, as first defined by Clark (1934; 1936), is part of the syn-rift, pre-Olenellus, Oak Hill Group in southern Quebec and is composed of 1 to 30 m of brecciated dolostone interbedded with hematitic slate and doloarenite. The unit overlies the deltaic, nearshore and beach face sediments of the Pinnacle Formation and is in turn overlain by the West Sutton Slate.

The sedimentary sequence as preserved in the Lower Oak Hill Group resembles that of Middle Miocene rocks on the Red Sea continental margin of Egypt which were deposited during periods of alternating prograding-fluvial and transgressive-carbonate sedimentation in response to both local tectonism and regional sea level fluctuations. It is proposed here that the White Brook Dolomite represents a similar type of transgressive carbonate unit deposited during a sudden rise in sea level along the young, mobile, proto-Iapetus continental terrace of southeern Quebec. The apparent wane in clastic sedimentation and absence of heavy mineral placer deposits noted across the Pinnacle-White Brook contact in southern Quebec (Dowling, 1988), does not therefore reflect the peneplanation of Grenvillian source terranes to the west as proposed by recent workers, but instead records the instantaneous drowning of the fluvial-deltaic-nearshore depositional system in response to a rapid marine transgression across the mobile, continental terrace.

BEDROCK CHEMISTRY COMPARED TO GROUNDWATER QUALITY ACROSS THE RICHARDSON MEMORIAL CONTACT IN CENTRAL VERMONT

Fiacco, R. Joseph, Jr., Shawn D. Healy and Michael A. Smith, Norwich University, Northfield, VT 05663

Groundwater and bedrock samples were collected from two chemically diverse regions in an area north of Montpelier, Vermont. The western noncalcareous region is underlain by the Moretown Formation; the eastern calcareous region is underlain by the Northfield and Waits River formations. The Richardson Memorial Contact (RMC) separates these two geologically diverse regions and closely corresponds to the local water shed divide. This relationship prevents the mixing of groundwater from the different bedrock regimes.

Characteristics of sixty water samples were determined using the pH meter (pH), electrical conductivity meter (TDS), ion chromatograph (Cl^-, SO_4^-, NO_3^-), atomic absorption spectrophotometer (Ca^{2+}, Mg^{2+}, Na^+, K^+) and alkalinity titrations (HCO_3^-). Twelve whole rock analyses (of major, minor, and trace elements, plus Cl, S, and CO_2) were obtained commercially using XRF methods.

The calcium/calcium, carbon dioxide/bicarbonate, calcium/bicarbonate relationships, as expected, showed a positive correlation between the bedrock/groundwater systems on opposite sides of the RMC. For example, the water contained little calcium and bicarbonate in the western region and contained higher amounts in the eastern region. Total dissolved solids (TDS) was notably higher in the water collected east of the RMC, as was the pH(6.5 vs. 7.5). Magnesium, sodium, and potassium, however, were found to have a negative correlation. The western bedrock contains a higher percentage of magnesium, sodium, and potassium than does the eastern bedrock, but water in the east has higher magnesium, sodium, and potassium contents than does that in the west. The magnesium in the western region is found in insoluble silicate minerals whereas the magnesium in the eastern region is found in part in soluble carbonate minerals, perhaps explaining this negative correlation. The sodium and potassium relationships cannot be explained so easily. They may be due to differences in groundwater residence time, groundwater contamination, or the randomness of bedrock sampling. No correlation could be made for chlorine or sulfur because the bedrock samples contained amounts of these elements below the detection limits.

RESULTS OF MAGNETIC AND GRAVITY SURVEYS OVER A SUSPECTED GRANITE BODY NEAR NORTHFIELD FALLS, VERMONT

Gainer, Darren M. and Lukaskiewicz, William A., Department of Earth Science, Norwich University, Northfield, VT 05663

Outcrops of the Moretown Formation surround a triangular topographic depression located between 2 and 3 km northwest of Northfield Falls, near the center of the Northfield, Vermont 7.5' quadrangle. Glacial till, varved clay, and terraced stream sediments are exposed in most of the area of the topographic low, but along the eastern edge (N15E) abundant granitic boulders exist. The area is drained by Cox Brook which defines the western edge of the study area (N25W).

Locally discordant and discontinuous granitic sills up to 25 m wide are exposed along regional strike over a distance of 500 m north of the area. Similar sills are exposed 1 and 2 km south of the area, and the Northfield granite is exposed 5 km south of the area. All of these rocks formed from very similar magma, and are exposed along a line parallel to the NNE regional strike. The Northfield granite and the fine grained sills are leucocratic, and consist of one feldspar (Ab-rich), quartz and muscovite. Feldspar and quartz tend to be euhedral in the sills, and feldspar is subhedral in the plutonic rocks.

Boulders both within and to the south of the topographic low were suspected to have come from an unexposed granite body located within the low. Magnetic and gravity surveys were carried out to test this hypothesis. Traverse lines for these surveys were spaced 50 m and 100 m apart, respectively, with stations located every 25 m and 50 m, also respectively.

The magnetic study reveals a flat-bottomed, 500 gamma, negative anomaly under the eastern half of the study area. It is 600 m long (N13E), 250 m wide, and its axis corresponds with a line connecting exposures of granitic sills north and south of the area. The anomaly is ovoid in shape, with a wider northern end, and cleavage in the surrounding country

rock locally parallels this shape. Corrected gravity readings reveal 1 to 2 mgal anomalies. This data can be modeled using realistic thicknesses of cover and the presence of underlying granite. The most prominent gravity low occurs in an area underlain by the thickest section of till, varved clay, and gravel. This low also correlates with the location of granitic rock as suggested by the magnetic data mentioned above.

TECTONIC GEOLOGY OF THE WAITSFIELD-WARREN AREA, CENTRAL VERMONT

Haydock, Samuel R., Department of Geology, University of Vermont, Burlington, VT 05405

From west to east, the Underhill Formation, the Mount Abraham Schist, the Hazens Notch, Pinney Hollow, and Ottaquechee formations crop out in the Waitsfield-Warren area. Detailed 1:12000 field mapping demonstrates that depositional and tectonic contacts separate these metamorphosed pre-Silurian rocks. Depositional contacts separate the silvery-green schist and greenstone member of the Pinney Hollow Formation, the white albitic schist and the greenstone member of the Hazens Notch Formation. and the white albitic schist and carbonaceous albitic schist of the Hazens Notch Formation. Tectonic contacts coincide with lithologic boundaries such that the Underhill, Mount Abraham, Hazens Notch, Pinney Hollow, and Ottaquechee slices may be defined. An additional slice, the Lincoln Gap slice, is composed of the carbonaceous schists of the Hazens Notch Formation. Important fault criteria at the map scale include the truncation of stratigraphic units from adjacent slices across the fault zone, imbrication of rocks from adjacent slices as discontinuous slivers of varying length, complex fold structures, and the presence of exotic slivers. Important fault criteria recognized at the outcrop include a pervasive (Sn) schistosity, sharp lithic contacts, a prominent mineral lineation drawn out down the dip of the schistosity, isoclinally folded quartz veins, refolded folds, and reclined folds that have sheared out limbs, and microscale shear bands. Important fault criteria recognized in thin section include rotated porphyroblasts with helicitic inclusions and porphyroclast systems with asymmetric tails.

Fault and fold history is complex. At least three generations of each are recorded in the rocks. Pre-metamorphic faults are responsible for the major displacement and the lithic distribution across the Waitsfield-Warren area. They have been extensively folded by two generations of folds, (Fn-1) and (Fn). Pre-metamorphic faults separate the Hazens Notch slice from the Mount Abraham slice, and the Lincoln Gap slice from the Hazens Notch slice. Eighty percent of the faults are syn-metamorphic faults. Syn-metamorphic faults formed during the peak metamorphism associated with the development of the dominant schistosity (Sn). They parallel (Sn) and are axial planar to (Fn) folds. Syn-metamorphic faulting is most intense along the Mad River Valley and within the Pinney Hollow Formation. Post-metamorphic faults reactivate older faults. They are rare in the Waitsfield-Warren Area.

THE NATURE AND ORIGIN OF ARCHES IN THE CRYSTALLINE BASEMENT OF THE BUCKSKIN MOUNTAINS METAMORPHIC CORE COMPLEX, WESTERN ARIZONA

Held, Mark P., Department of Geology, Middlebury College, Middlebury, VT 05753

Since the late 1970s, a belt of enigmatic terranes along the western flank of the cordilleran mountain system from British Columbia to Sonora, Mexico has received a large amount of attention. The terranes, called metamorphic core complexes, share a unique set of characteristics. These include a cyrstalline basement made up of rocks of Proterozoic to Cenozoic ages, all of which grade upwards in to a well mylonitized gneiss below a detachment fault; the detachment fault, a large, flat decollement that can stretch over 10,000 km^2 and have a displacement (to the northeast, commonly) on the order of tens of kilometers; a brittlely deformed upper plate of Paleozoic to Cenozoic sedimentary, volcanic, and plutonic rocks; and an arching or doming of the basement.

Important geologic features of western Arizona (to this study) are a 1.7 b.y. banded gneiss (the basement), Mesozoic thrust-faulting, and lower plate arching. Data were collected along a northwest striking, northeast dipping Basin and Range normal fault scarp that cuts across the Planet arch (northernmost of three) of the Buckskin mountains. Map and petrologic data show that gneissic foliations of the basement describe an arch morphology, though they are affected by southeast-dipping paleoattitudes and a Mesozoic thrust fault.

A good model to explain the arching is based on a hypothesis that 1) a tectonic denudation on the scale seen in core complexes (2-10 km of thickness) causes a disequilibrium in crustal body forces that must be accommodated by apparent shortening, and 2) the fact that the flexural rigidity of the crust is proportional to the cube of the thickness means that small amounts of denudation over a detachment fault cause large drops in the flexural rigidity of the crust, and therefore a compliance with the re-equilibration folding forces mentioned above.

DEFORMATIONAL HISTORY OF THE RICHFORD-CAMBRIDGE SYNCLINE NORTHERN VERMONT

Mock, Timothy D., Department of Geology, University of Vermont, Burlington, VT 05405

The Richford-Cambridge syncline (RCS) lies on the western flank of the Green Mountain anticlinorium (GMA) in northern Vermont. The rocks within the RCS are part of the Proterozoic Z-Cambrian rift clastics of the Camels Hump Group (Tibbit Hill, Pinnacle, and Underhill formations) and the drift stage Cambrian cover sequence (Sweetsburg Formation). Detailed mapping (scale 1:5,000) of a 24 km^2 area in the Fletcher and Bakersfield townships has delineated seven mapping units. The Tibbit Hill Formation is composed of calcareous greenstones and volcanoclastic sediments interbedded with metawackes of the Pinnacle Formation. The Pinnacle Formation is a qtz-ser-alb±bio metawacke distinguished by blue quartz pebbles. The Underhill Formation is a heterogenous qtz-ser-ch±alb±mag schist of variable grain size. Overlying the Underhill are carbonaceous phyllites and carbonates of the Sweetsburg Formation interpreted to be deposited in the more distal part of the basin.

The rocks within the RCS have undergone at least three periods of deformation. The map pattern reflects a Ramsay Type 3 fold interference pattern between the first two phases of deformation (D1 and D2). The second phase of folding produced the dominant schistosity S2 which is axial planar to upright north-south isoclinal folds. F3 folds are shallow plunging open folds associated with the formation of the GMA. The F3 folds have a steeply east dipping crenulation cleavage of varying intensity but do not greatly affect the map pattern.

Metamorphic intensity decreased over time in agreement with the fold data. Chlorite pseudomorphs after garnet indicate that early metamorphism reached at least 550°C during D1. The entire region was retrograded to greenschist facies (300-400°C) metamorphism as evidenced by the growth of chlorite and albite during D2. This is interpreted to represent upright to east facing deformation in the RCS at higher crustal levels during the later stages of the Taconian orogeny.

THE PETROLOGY OF THE COLERAINE BRECCIA, COLERAINE, QUEBEC

Peat, Kristen M., Department of Geology, University of Vermont, Burlington, VT 05405

The Coleraine Breccia is a polymictic breccia composed of clasts of igneous, metamorphic, and sedimentary origin. The breccia overlies the volcanic stratigraphy of the Thetford Mines ophiolite and presumably underlies the St. Daniel Formation.

Clasts within the unit are angular to subrounded (in order of decreasing abundance): diabase/microgabbro; pyroxenite/uralitized pyroxene gabbro; basic volcanics; trondjhemite /diorite; metamorphosed quartz rich sediments and amphibolite; red argillite; chert/felsite. The fine to medium grained matrix is interpreted as sedimentary based on the observed bedding features; and the presence of clasts and radiolarians. Late stage diabase locally intrudes the matrix. Some clasts have undergone deformation prior to being incorporated into the breccia. Greenschist (?) or lower metamorphism postdates the last deformation of the breccia.

The Coleraine Breccia records the fragmentation and redeposition of the mid to upper levels of rocks from the adjacent ophiolitic suite. The range in size and shape of the clasts suggests rapid deposition from local source areas. The appearance of radiolarians suggests that the depositional site is either a restricted or deep water basin. A possible environment of deposition that incorporates these data is a scree deposit along a transform fault.

GEOCHEMISTRY AND TECTONIC SETTING OF EASTERN ADIRONDACK DIKES

Sinton, Christopher W., Department of Geology, Middlebury College, Middlebury, VT 05753

Mafic dikes of the eastern Adirondack mountains have been analyzed for major, trace, and rare-earth elements (REE). Late Precambrian basaltic dikes that cut Grenville-age basement rock are altered, but retain original igneous textures. Lamprophyre dikes that intrude Ordovician limestone are relatively unaltered.

Major and trace element diagrams suggest that the Precambrian basalts are alkalic. They are high in TiO_2, P_2O_5, Zr, Y, and are enriched in the light rare earths relative to the heavy rare earths. The lamprophyre dikes are more enriched in the LREE, Ba, and Sr relative to the Precambrian basalts. Crystal fractionation trends indicate that the basaltic dikes are related to a single magma at different stages of fractional crystallization or melting. Chemical discriminants indicate that these basalts formed in a within-plate environment. It is possible that the magma for these dikes was formed by small degrees of melting a garnet peridotite mantle at depths greater than 60 km.

These basalts closely resemble the Bakersville dikes of North Carolina, the Hudson Highlands metadiabases, the Tibbit Hill volcanics of Vermont, and the Long Range dikes of Newfoundland. All these have been interpreted as rift volcanics that formed during the opening of the Iapetan basin. It is proposed here that the Adirondack basalts [are] pre-rift extensional features that formed during this period.

BALANCED CROSS SECTION ACROSS THE MIDDLEBURY SYNCLINORIUM WEST-CENTRAL VERMONT

Stern, Patrick, Department of Geology,
Middlebury College, Middlebury, VT 05753

The Middlebury Synclinorium is a fold and thrust belt located in west-central Vermont. Surface data have been compiled, and collected where not available, to construct a balanced cross section, at the scale of 1:12,000, and to interpret the subsurface geometry and history of the foreland structure. The area is subdivided into several zones according to structural styles. The eastern section, just west of the Green Mountain Front, can be considered the transitional zone between the large ductile structures to the east in the hinterland, and the smaller amplitude, fault related structures in the foreland area. Within the foreland area, the structural character changes from large, close, fault-related structures in the eastern section, to smaller amplitude, close, fault related structures in the central zone, and finally broad open folds in the west, possibly generated by a basal thrust. Generally, the whole region is characterized by fault-related fold structures. The retrodeformation of the balanced cross section, and an estimation of the total shortening in the region are the final objectives of this paper.

THE STRUCTURAL AND METAMORPHIC HISTORY OF THE GREEN MOUNTAIN FRONT IN THE VICINITY OF EAST MIDDLEBURY, VERMONT

Taylor, James Z., Department of Geology,
Middlebury College, Middlebury, VT 05753

The western cover sequence was structurally and petrologically analyzed from South Mountain to Bryant Mountain to determine the stratigraphic contacts and their relationship to the structure of the Green Mountain Front. In the field, evidence for two episodes of deformation and related faults was found. Along the eastern zone of the field area east-verging fold structures and their axial planar cleavages are found. To the west, these D1 structures are found rotated by west

verging fold structures, formed later during a second episode of deformation. In the western zone of the field area, between Pinnacle Formation and the Cheshire Formation, a fault zone is found involving the relatively incompetent Moosalamoo Phyllite Formation. In petrology studies, compositional layering of quartz-feldspar rich bands and biotite-chlorite rich bands are found parallel to the dominant schistosity. An S1 schistosity is found in samples taken from the western region of the Green Mountain Front where it is rotated by a D2 crenulation cleavage. Large grains of biotite and stilpnomelane overgrow the pre-existing S1 fabric, representing an M2 event. The data is related to present structure models of the Green Mountain Front and applied to the theories about suspect terranes by Coney and others (1980).

TECTONIC LITHOSTRATIGRAPHIC UNITS OF THE CAMELS HUMP GROUP IN THE VICINITY OF FAYSTON, VERMONT

Walsh, Gregory J., Department of Geology, University of Vermont, Burlington, VT 05405

The Late Proterozoic to Cambrian rocks of the Camels Hump Group include the Underhill, Hazens Notch, Mount Abraham, and Pinney Hollow formations. Recent mapping at a scale of 1:12000 indicates that each formation can be subdivided into several lithostratigraphic units, and that the majority of the contacts between these units are tectonic. The presence of quartz-rich metawackes, metaquartzites, coarse-grained quartz-albite-sericite-chlorite schists, and greenstones with chemical affinities to continental-rift volcanics within the Underhill, Hazens Notch, and Pinney Hollow formations suggests that they are rift clastics related to the opening of Iapetus. Mapping indicates that the Mount Abraham Formation is far more extensive than originally recognized. Previously unreported greenstone and quartz metawacke units are found within the aluminous schist of the Mount Abraham Formation suggesting that the Mount Abraham is also a rift clastic. Mapping also demonstrates a delicate lithotectonic interlayering of the fine-grained quartz-sericite-chlorite-chloritoid schist of the Mount Abraham with the quartz-sericite-chlorite-albite schist of the Pinney Hollow suggesting that these units have a common origin. Lithic similarities exist between the white albitic schists of the Underhill, Hazens Notch, and Pinney Hollow formations. Metawackes and metaquartzites are more common towards the west within the Underhill and become less common towards the east within the Pinney Hollow. The quartz-rich white albitic schists are also coarser grained in the west than in the east. This evidence is interpreted as a west to east rift-clastic facies change.

PALEOENVIRONMENTAL INTERPRETATION AND HISTORY OF URANIUM ENRICHMENT AND RESULTANT RADON GAS GENESIS OF THE CLARENDON SPRINGS DOLOSTONE, MILTON, VERMONT

Witten, Eve, Environmental Studies Program, University of Vermont, Burlington, VT 05405

In 1985 elevated levels of radon gas were discovered in private water wells in Milton, Vermont. At that time workers suspected, but did not conclusively know that the source of radon was uranium contained in the underlying Clarendon Springs Formation (Late Cambrian - Early Ordovician).

This investigation characterized the rock types within the Clarendon Springs to determine whether uranium minerals exist there, and if present, to build a foundation for understanding the nature of their occurrence.

Three lithofacies were identified: 1.) mobil ooid shoal sands, 2.) platform interior carbonate sands, and 3.) subtidal channels.

Detailed analysis of earth materials collected from areas of high gamma emission intensity revealed finely disseminated uranium minerals. Uranium is associated with accessory detrital minerals (zircon, monazite, apatite, sphene) and hydrothermal minerals (sphalerite, galena, pyrite). The hydrothermal association is characterized by higher gamma ray spectrometer readings and elevated radon levels.

Uranium was introduced to the Clarendon Springs as a component of a primary accessory mineral suite. During later tectonism uranium was mobilized and redistributed by pore fluids, probably of hydrothermal origin.

This investigation clearly indictes that the Clarendon Springs Dolostone is the uranium bearing source of radon gas in the Milton area. This finding demonstrates that carbonate rocks cannot be discounted as radon sources.

WINTER ABSTRACT

The following abstract was received too late to be printed in the winter GMG.

REMEDIATION STRATEGIES FOR MITIGATION OF LEAKED UNDERGROUND PETROLEUM PRODUCT IN NORTHERN VERMONT: REPORT OF WORK IN PROGRESS

Allen, Chris, Groundwater Technology, Inc.,
1433 Williston Road, South Burlington, VT 05403

More than 1,000 gallons of gasoline leaked from underground storage tanks at a gasoline station in Northern Vermont. Petroleum contaminated the subsurface as vapor, petroleum adsorbed on soil, floating free product, and hydrocarbons dissolved in ground water. Neighboring residences were impacted by vapors. Dependence on town water precluded aquifer potablilty concerns. At this site, soil ventilation was used to control vapors. Free product recovery retreived more than 300 gallons of petroleum product. Air stripping with granular activated carbon (GAC) polishing was used for ground water treatment.

Bioreclamation is a process whereby natural biodegradation processes are deliberately enhanced to remediate subsurface contamination. Bioreclamation has been implemented at the site to address residual and adsorbed hydrocarbons. Addition of oxygen and nutrients will enhance hydrocarbon-utilizing bacterial populations.

Total clean-up time for the site is estimated to be 4-5 years; total cost about $1 million.

VGS BUSINESS & NEWS

NEW MEMBERS

Chris Allen	Starksboro, VT
Stephen F. Wright	Winooski, VT
John Klimenok	Portland, CT

GEOLOGICAL EDUCATION COMMITTEE [continued from page 2.]

This brings me to the second category of people who are interested (or should be interested) in geology. We have a good part of the adult population in this state concerned with planning, growth, and development. Wouldn't it be great if all these people knew how geology applied to environmental issues! Are there many geologists who don't believe that geology strongly influences or controls topography, physiography, drainage patterns, soils, the distribution of economic rock and mineral products and sand and gravel, vegetation, and groundwater flow and availability? Let's let people know how and why geology is so influential. It's tougher to get through to adults, but it can be done with patience and repetition.

Lastly - and perhaps most immediate to many people at this spring VGS meeting - let's not forget the college students. These people have already expressed an interest in geology and related fields. For the most part, they have good backgrounds in many areas of science. And a fair number of the geology majors are here at this meeting. The current students are the future VGS members. A number of them are VGS student members; many more of them could be student members. Let's get the word out to the students. If they know who we are before their senior or final year, we may see more of them at more of the meetings.

Knowledge is the key to understanding. We all have the potential to reach the people around us and let them know what geology and VGS is all about.

If anyone has any questions, comments, or ideas, on geology or geological education - or know of someone with questions - please feel free to contact me at the following address:

Sharon O'Loughlin
Office of the State Geologist
103 South Main Street - Center Building
Waterbury, VT 05676
(802)244-5164

MEET THE NEW OFFICERS

John Malter, our Vice President, is not really new, but one of the "Founding members" of VGS. Since receiving his undergraduate geology degree form SUNY Potsdam and his Master's in Geology from UVM in 1973, John has worked for the State of Vermont, Department of Water Resources in many capacities, dealing with the many problems of hazardous materials - spills, clean-up, disposal, prevention control and enforcement regulation. At present, he is Director, Hazardous Materials Management Division, Vt. Department of Environmental

Conservation, responsible for management of the Vt. Superfund Program, Underground Tank Program and Hazardous Waste Management Program.

John is an avid mineral collector. As the first VGS treasurer, he requested dues in cash or the equivalent value in gems. The offer was taken up by one member, and for several years the treasury included this currency. John has often opened his home for Executive Committee meetings because of its central location for those of us traveling from all directions. Under the pseudonym of "JRock", John contributes poems for the GMG.

NOMINATIONS COMMITTEE

The committee composed of Shelley Snyder, Chair, Chuck Ratte' and Barry Doolan have been at work selecting nominees for the fall election of officers.

PUBLIC ISSUES UPDATE 4/15/88

At this writing, passage of the Geological Publications Bill (S.206) looks "favorable" according to Chuch Ratte, who testified yesterday before the House Government Operations Committee.

Numerous geologists and related professionals from state, academic and private sectors were treated to a thoroughly interesting two day short course taught by Dr. Richard Parizek on March 24th and 25th as part of UVM's Visiting Lecture Series. The course, entitled "Concepts of Hydrogeology as Revealed in Case Studies", progressed from basic hydrologic principles and their limitations through glacial geology and fracture trace analysis, and concluded with the topics of diffuse contamination and the use of geology for planning. Although little discussion of Vermont's hydrogeologic problems was stimulated, the good turnout showed the widespread interest in both the subjects and the local availability of this type of educational opportunity.

Submitted by Eric Lapp

AGENDA

Executive Committee Meeting
April 30, 1988

1. Secretary's Report
2. Treasurer's Report
3. Old Business
   a. By-laws Committee Report
   b. Grant-in-Aid
   c. Summer Field Trip? for teachers?
   d. Computer workshop / Winter Meeting
   e. Society review committee for published abstracts and papers.
4. New Business
   a. Fall Field Trip
   b. Annual Meeting
   c. Other

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CONTENTS

C. Stratigraphy and Structure of the Camels Hump Group along the Lamoille River Transect, Northern Vermont
Barry Doolan
33 pages 12 figures

F. The Beekmantown Group in the Central Champlain Valley
Paul A Washington
Steven A. Chisick
17 pages 6 figures

G. Taconic Geology near Fair Haven, Vermont
Brewster Baldwin
Andrew V. Raiford
13 pages 4 figures

H. Pleistocene Glaciation at Lake Willoughby, Vermont
Ballard Ebbett
32 pages 14 figures

I. Structural Character of the "Pre-Silurian" and "Silurian" Rocks and the Nature of the Boundary between them in Central Vermont
David S. Westerman
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EXECUTIVE COMMITTEE MEETING - February 20, 1988

The secretary's report was accepted as was the Treasurer's report. The Society had, at meeting time, $2,680.89 in the treasury. The By-Laws Committee will have a report for the spring meeting. Volume 5 of Vermont Geology was to be ready for 1 March deadline. There will be about 100 pages with 5 fieldtrips. It is hoped to have it for the GSA meeting.

Student papers will be presented on 30 April at UVM. It was suggested that Bud Ebbett's rocks in the Northeast Kingdom would be a desirable field trip.

The winter meeting change of format was discussed. It was suggested that a working shortcourse on Aspects of the Consulting Business, legal, contracts, and case studies, for example, would be of interest to many members. Half of that day might be devoted to computer applications in geology.

Respectfully submitted, Shelley F. Snyder

EXECUTIVE COMMITTEE MINUTES - March 16, 1988

Present: Eric Lapp, John Malter, David Westerman, Sharon O'Loughlin, Alan Liptak, Jeanne Detenbeck

The meeting began at 7:20 p.m. at John Malter's house in Waterbury Center. Neither a Secretary's Report for the Executive Committee Meeting of February 20, 1988, nor a Treasurer's Report were available. The treasurer indicated the Society to be in good financial shape. [A subsequent report shows a balance of $2208.19.] No new applications for membership have been received since the last meeting.

Old business was discussed first. Proposed by-law changes were commented upon, with minor word changes suggested. These changes will be voted upon at the Annual Meeting. The Geological Society of America Meeting in Portland, Maine, was described. VGS ran a cooperative booth at the meeting with the Vermont State Geologist's Office. The Society handed out about 100 informational packets and broke even financially, short term. Volume 5 of the Vermont Geology periodical has been printed. The cost is to be determined by a publication committee consisting of the Society treasurer and the Editor, with the approval of the Executive Committee. The publication committee will also determine the cost of the five volume set of Vermont Geology.

Legislative activity was discussed. Several pending bills were described, including the Publication Account Bill, the Growth Bill, the Low-level Radioactive Waste Bill, and the Environmental Enforcement Bill. The need for and type of Society comment for each bill was discussed. A report on Geological Education issues was received. The possibility of replacing the next winter meeting with a computer application workshop was discussed at length.

New business: The spring meeting on April 30, 1988, will be a student paper presentation. Judges will be: Alan Liptak, Eric Lapp and Sharon O'Louglin. The annual meeting will be held on October 8, 1988. The possibility of a Northeast Kingdom trip focusing on bedrock issues was discussed. Finally, discussion ensued on the topic of a society review committee for published abstracts and papers, as opposed to the current unedited policy. It was suggested that the Society should consider such a function.

The meeting ended at 10:15 p.m.

Respectfully submitted, Alan Liptak

STATE GEOLOGIST'S REPORT

Mineral Resources and Land Use Planning

The mineral deposits of Vermont are recognized as a natural resource. The presently exploited mineral resources of the State include granite, marble, talc, asbestos, slate, verde antique, sand and gravel and crushed rock aggregate. The potentially significant areas of mineral resources in Vermont are identified on maps available through the State Geologist's Office.

In some areas of Vermont, the availablilty of sand and gravel deposits is in short supply. Many towns have to pay exorbitant fees to transport sand and gravel long distances. Inproved intramunicipal cooperation is viewed as a means to identify and plan for extraction sites and assist municipalities whose supply of sand and gravel is limited.

Municipalities are encouraged to provide for the exploration and extraction of minerals in their town plans and zoning ordinances. **CONSULTATION WITH THE STATE GEOLOGIST** for any extraction should be included in a zoning ordinance and town plan provision.

Sand and gravel resources are significant for use as fill, the construction and upgrading of roads, erosion control measures, and the manufacture of concrete. At the same time, snad and gravel sites may be closely associated with sites having potential for subsurface sewage disposal and groundwater recharge. Because of the value of the resource, measures to accommodate these competitive uses, where possible, are encouraged. The following guidelines are a means to implement this recommendation:

Through local plans, municipalities are encouraged to identify the sand and gravel areas significant for groundwater recharge, and make recommendations to their appropriate use.

Through local buylaws, municipalities should specify that a proposed development will not significantly reduce the capability of the land for subsequent sand and gravel extraction.

The extraction of sand and gravel should be compatible with surrounding land uses and must not be detrimental to the environmental quality of the area. A rehabilitation plan and an alternative use plan must be included with any proposal.

The recovery or extraction of a mineral should not take place beneath the surface of a water body of inpoundment, except as approved or provided for by the Department of Environmental Conservation and applicable regulations.

Gravel mining and washing operations in rivers and streams is subject to stream alteration regulations under 10 V.S.A. Section 1021.

Any proposal for extraction of a mineral should include a rehabilitation plan and a plan for an alternative use. **CONSULTATION WITH THE STATE GEOLOGIST IS VIEWED AS NECESSARY.**

The locations of existing and potential rock and mineral resources in Vermont are either well known or capable of being quite accurately predicted. Planning for their protection and eventual exploitation is essential to the process of harmonious growth and development in the State of Vermont. If the State's mineral resources are explored and extracted in a sound manner, they can provide an economic and environmental benefit. Plans that protect surface waters and ground waters, control erosion and rehabilitate the land are necessary to mineral extraction activities and must be implemented to protect the State's scenic landscape and environmental quality.

Source: Central Vermont
Regional Plan adopted 1985.

Charles Ratte', State Geologist

COMMENT & REPLY

GEOLOGY OF THE WESTERN VERMONT MINERAL BELT

Washington, Paul A., Environmental Compliances Services, West Springfield, MA 01089 and Department of Geology and Geophysics, University of Connecticut, Storrs, CT 06268

The western Vermont mineral belt consists of a series of more than nine hydrothermal ore bodies aligned in a belt extending from Ferrisburg to Searsburg. These ore bodies are associated with a string of post-tectonic (?Late Cretaceous) plutons, mostly non-emergent; three of these bodies (North Ferrisburg, Barber Hill, and Shelburne Point) do not have significant associated ore bodies. Within the mineral belt, there is a sequence of areally-ordered variations in ore content. The northern end is dominated by base-metal sulphides; the most notable of these deposits are the Brandon Copper-Lead-Zinc and Cuttingsville Pyrrhotite deposits. The southern end is dominated by precious metals and rare earths; these deposits include the Plumouth gold deposit, the Jamaica Uranium deposit, and the Searsburg Ridge Thorium deposit.

COMMENT ON "GEOLOGY OF THE WESTERN VERMONT MINERAL BELT".

David S. Westerman, Department of Earth Science, Norwich University, Northfield, Vermont 05663
Charles A. Ratte, State Geologist, 103 South Main Street, Center Building, Waterbury, Vermont 05676

The primary purpose of this comment is to address the quality of the science in an abstract recently published in the GMG (Washington, 1988). Our concern is with the circular reasoning, lack of logic, misuse of terms, etc., in the abstract. Where reasonable, points are addressed in the order they were presented. Because of this approach, no level of importance should be attached to the order of comments. Although it was not our original intention to address the validity of statements about geologic fact, we have been unable to entirely restrain ourselves in this area. Comments regarding the geology itself are contained in brackets ([....]).

1). "The western Vermont mineral belt consists of a series of more than nine hydrothermal ore bodies aligned in a belt extending from Ferrisburg to Searsburg." How far east can one go and still be in western Vermont? Both Plymouth and Jamaica are in the eastern half of the state. As defined in the Glossary of Geology (Bates and Jackson,

1980) a mineral belt is "an elongated region of mineralization, an area containing several mineral deposits". A belt does not consist of a series. A series, again from the Glossary of Geology, is "any number of rocks, minerals, or fossils having characteristics, such as growth pattern, succession, composition, or occurrence, that make it possible to arrange them in a natural sequence". A belt is an area. A series is a group of rocks. [It has to be questioned whether the mineralized rocks discussed can be "arranged in a natural sequence" and thus be considered a series, but that is not within the purview of this discussion.]

Are there "more than nine"? If so, then at least one more (namely ten) must be known and the correct expression would be "at least ten". If not, then the correct expression is "at least nine".

[To conclude that all of the "ore" referred to is of hydrothermal origin is inappropriate. For example, the gold that was "profitably" extracted at Plymouth in the mid-1800's came exclusively from placer deposits. Perry (1929) reports that the veins are not ore, having never been profitable, but he concludes they are probably the source of the placer gold.]

According to the Glossary of Geology, there are things called orebodies ("continuous, well-defined masses of material of sufficient ore content to make extraction economically feasible") and there are things called mineral deposits ("masses of naturally occurring mineral matter, such as metal ores, usually of economic value, without regard to mode of origin"). If at some locations there are orebodies and at others there are uneconomical mineral deposits, then it is incorrect to call them all orebodies. [The fact is there are no proven orebodies of metallic sulfides, hydrothermally originated or pluton connected, in Vermont. Cuttingsville comes closest to this classification, but its mineralization has yet to be proven as an orebody.]

The phrase "aligned in a belt" completes a circle. We have a belt, consisting of a series, aligned in a belt. With respect to the location of the northern end of the "belt", the abstract refers to eight locations for "ore bodies", the northernmost being at Shelburne Point. That is 13.5 miles north of Ferrisburg. If that's the north end of the "belt", then that's what should be stated. [Regarding the choice to terminate the "northern end" of the belt in the Ferrisburg area, we have to wonder why, having gone that far, one would choose to stop there. There is known lead-zinc mineralization in the Dunham Dolomite in Franklin, VT, copper in Fairfax, iron in Fairfield, etc.]

2. "These ore bodies are associated with a string of post-tectonic (?Late Cretaceous) plutons, mostly non-emergent; three of these bodies (North Ferrisburg, Barber Hill and Shelburne Point) do not have significant associated ore bodies." In the first sentence of the abstract, orebodies were created that are not known to exist, and here in the second sentence plutons that are not known to exist are created, and then the orebodies and plutons are declared to be "associated". To add insult to injury, the plutons are assigned a post-tectonic setting and an age. No one wants to deny an author the freedom to take some fact or facts (such as the presence of Mesozoic dikes in the Lake Champlain area), and to then speculate that possibly some magma got trapped at depth at the time the dikes were being emplaced, and that possibly some ore-bearing fluids were generated during the same time interval. What should be denied is the freedom to throw the rules of logic and scientific inquiry out the window and to then present speculative statements as if they were fact.

It is necessary to identify to what tectonic episode one is referring before it is meaningful to call plutons "post-tectonic". In the Cretaceous, active extensional tectonics were modifying the geology of Vermont. Anything that happened during that time was not post-tectonic. [Assignment of a ?Late Cretaceous age to all of the mentioned mineralization is unsupported. Armstrong and Stump (1971) report an age for the Barber Hill syenite at 111 $\pm$2 my and an age for the Cuttingsville syenite at 101 $\pm$ 2my. Both of these ages have been

corrected for recommended decay constants and are Early Cretaceous (Palmer, 1983). As for the age of the gold occurrence at Plymouth, Chang and others (1965) indicate that the quartz veins occur in the Pinney Hollow and Stowe formations. As far as we can determine, the age of those veins is not known. If they're deformed like all the quartz veins we've seen in those formations then they are not Cretaceous. The pods containing uranium minerals in the Okemo area are clearly syn-metamorphic, constraining their age to Devonian or older. The deposits in the Jamaica area are most likely the same age. The Cretaceous dikes around Lake Champlain, several hundred of which have been found with no linear pattern at all to their distribution (McHone, 1987), do not have mineral deposits associated with them.]

The use of the phrase "mostly non-emergent" implies to us that more than half of the proposed plutons are not known to exist. Furthermore, when no orebodies are known in areas in which plutons are postulated to exist at depth, it is inappropriate to say that the "plutons" do not have significant associated orebodies. In these cases there are no orebodies, not some insignificant numbeer such as one or more.

3. "Within the mineral belt, there is a sequence of areally-ordered variations in ore content." The word "sequence" implies order, making one part of the following term redundant. The following sentences imply that the "sequence" is arranged in a linear rather than areal order, making the non-redundant part of this term inappropriate.

4. "The northern end is dominated by base-metal sulfides; the most notable of these deposits are the Brandon Copper-Lead-Zinc and Cuttingsville Pyrrhotite deposits." The end of a belt refers to the end. If one is referring to the northern third or portion, or some other segment of a line, then they should so indicate. The northern "end" of the described "belt" is near Ferrisburg and Burlington. This is the area "not having significant associated ore bodies", but it still is the northern end as defined. Brandon and Cuttingsville are clearly in the middle of the "belt". Keeping with the model (which becomes absurdly complicated when written out), the northern third of the mineral belt is characterized by not having any mineralization. The middle third is characterized by sulfides.

5. "The southern end is dominated by precious metals and rare earths; these deposits include the Plymouth Gold deposit, the Jamaica Uranium deposit, and the Searsburg Ridge Thorium deposit." If Cuttingsville is included in the preceeding sentence with the group representing the "northern end", then it becomes very difficult to include Plymouth in the "southern end" since Plymouth is located closer to the northern end of the "belt" than is Cuttingsville. This appears to be another example of wishful thinking, the cart before the horse, and circular reasoning all rolled into one. Having recognized sulfide minerals at Brandon and Cuttingsville and uranium and thorium at Jamaica and Searsburg Ridge, respectively, the question appears to have been asked is "how would the deposit at Plymouth fit into the scheme of things?" Spatially it goes with the sulfides, but it appears that an assumption was made that gold "should" go with rare earths. Once that was done, the only "logical" following statement would be that Plymouth is at the southern end of the belt. That way the assumption remains true, despite the fact that Plymouth is in the middle part of the "belt". [Perry (1929), reports analyzed "ore" material from Plymouth that contained gold=none; silver=1.27 oz.; copper=6.19 oz.; and lead=6.26 oz. He does not report the weight of the analyzed sample to which these numbers correspond, but the numbers certainly look like they came from a sulfide assemblage. Eric Lapp (personal communication, 1988) confirms that the veins are commonly pyrite-bearing. In addition, gold more often occurs with sulfides than with rare earths.]

It is our conclusion that the abstract reviewed here lacked the basic tenants [sic] of sound scientific thought, and it is not, therefore, surprising that the conclusions reached are highly untenable.

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GEOLOGY OF THE WESTERN VERMONT MINERAL BELT: REPLY

Paul A. Washington, Environmental Compliance Services, 229 Armory St., Springfield, MA 01104; and Department of Geology & Geophysics, University of Connecticut, Storrs, CT 06268

Although it is unusual to be responding to a comment on an abstract, I welcome the opportunity to expand on the necessarily brief report I made in the abstract and accompanying oral presentation. The comment is primarily concerned with semantic arguments, most of which I disagree with, but it also raises some legitimate geologic questions. I will attempt to respond to all of the points raised in the comment; to do so I will treat them in the order the authors of the comment present them (as far as reasonable) so the comment and reply can be easily compared for accuracy and quality of scientific thought.

1. "The western Vermont mineral belt consists of a series of more than nine hydrothermal ore bodies aligned in a belt extending from Ferrisburg to Searsburg." To begin with, I applied the name "western Vermont mineral belt" to distinguish this belt from the well-known Vermont mineral belt that lies to the east. The use of the term "western" may appear somewhat loose considering that the Bridgewater and Plymouth deposits lie east of the central axis of the state and the Jamaica deposit lies astride the central axis of the state, but the majority of the belt truly lies in western Vermont.

Otherwise, there are three points that Westerman and Ratte criticize in the first sentence: 1) the use of "series" and "belt"; 2) the use of "more than" rather than "at least"; and 3) the use of "ore".

The use of "series" has long been a problematic issue for geologists because the word has specific definitions in stratigraphy, mineralogy, and paleontology, among others. At the same time, it is a much used and fairly broad collective term in standard English. I find limitation of the definition for this word to the narrow scientific terminologic senses unacceptably restrictive, especially where its common usage makes it the most suitable word and the discussion is not specifically dealing with one of the aforementioned subdisciplines where confusion could result. Reference to the Webster's New Collegiate Dictionaly (1981 edition) finds series defined as "1: a number of things or events of the same class coming one after another in spatial or temporal succession". Within this definition, this group of mineralized zones is indeed a "series", and there is no scientifically specific usage of the word in relation to mineral belts or ore bodies to the best of my knowledge.

As for the usage of "mineral belt", by their own reference, Westerman and Ratte find it to be defined as "an elongated region of mineralization; an area containing several deposits". This belt as I

defined it definitely contains several mineral deposits and they are arranged in an elongate region. It is true that the mineralization is discontinuous, but that is almost necessary when several different deposits are included; besides which, of all the mineral belts throughout the world that I have encountered in my various researches, I have yet to find one with continuous mineralization. Thus, there is, as defined, a "mineral belt [consisting] of a series" of mineral deposits.

On my usage of "more than nine" as opposed to "ten or more", there is not a "correct" scientific mode of expression; this is simply a case of stylistic choice. The phrase "more than" is linguistically, mathematically, and scientifically correct and accurate. It also carries with it an implication (fully intended) of greater inexactness of knowledge of the number. Because of difficulty in distinguishing between separate deposits vs. separate portions of the same deposit in some portions of the belt, I intended this additional degree of inexactness.

Prior to launching into a discussion of the origins and historical development of the Plymouth gold deposits, I wish to accept the technical correction that my usage of "ore bodies" instead of "mineral bodies" is somewhat loose. The usage is within common scientific vernacular, but is not truly correct. It should be pointed out, however, that 5 or 6 of these bodies were mined profitably and another one might well have been if state law had not been changed.

Apparently the authors of the comment were unaware that the Cuttingsville phyrrhotite deposit was mined profitably for the iron sulfide for over three decades in the early to middle 1800s (Hance, 1980). The ore was processed to produce copperas, a tanning acid (hence the name of the hill on which the deposit lies - Copperas Hill). This deposit also contains several other interesting minerals which have caused sporadic exploration over the years (e.g., Doll, 1969). Likewise, lead and copper were mined from the Brandon Pb-Zn-Cu deposit during the middle to late 1800s (Jacobs, 1942; Beers, 1870, 1871). The copper was used variously and the lead was used in the manufacture of paint.

Pyrite was mined during the late 1700s and at various times during the 1800s in Chittenden for iron and smelted locally. Some of these operations became quite large (Perkins, 1921). The iron ores of Monkton may or may not all be related to the southern Ferrisburg system. They were extensively mined in the 1700s and 1800s (Swift, 1859), however. The presence of this iron may have been the cause of the very early settlement (see Washington and Washington, 1977) in these otherwise marginally arable hills.

The placer gold deposits in Plymouth have long attracted considerable attention. Concurrent with the placer operations, there were also several vein mining operations. Although none of these were ever tremendously successful, some made better than expenses (=economic) for a few years (see Graffagnino, 1983). The first gold discovery in Bridgewater was actually a quartz vein deposit. This and several other veins were mined successfully over a period of nearly 60 years, although the operations were generally very small (Adams, 1976).

Besides the aforementioned "ore" deposits, the exploration of the Jamaica uranium deposit in 1978 by Urangesellschaft UAS (I was part of the field crew and very much involved in this project) indicated that this would probably have been an economic deposit. In response to this discovery, a law was enacted by the State of Vermont that virtually prohibits uranium mining in the state, so the follow-up investigation was never carried out. It should be noted that this work was done and the legislation passed during Ratte's tenure as State Geologist.

Finally, there has been considerable exploration, some of which involved the opening of fairly substantial pits and shafts, in the Devil's Den (which was overlooked during the Wilderness Mineral Potential assessment [Slack and Sabin, 1984]) and Searsburg deposits. Although these explorations are suspected to have been uneconomic (see Hubbard, 1924, and Skehan, 1961, for the Searsburg deposit), there is actually no known data on the profitability of the operations. In addition, uranium deposits of sufficient size to warrant additional

exploration were discovered by Urangesellschaft USA on Okemo Mountain (several places), in the Lye Brook Wilderness area, in Woodford, in Pownal, and in Stamford (the last three may or may not be related to the belt in question).

To return to the origin of the mineralization, field inspection shows all of these to be definitely of hydrothermal origin. The "ore" mineral associations, the association with quartz and other dikes, and the areal distribution of the mineralization clearly points to a hydrothermal origin. Furthermore, the hydrothermal fluids clearly acted after the last phase of compressive tectonism.

2. "These ore bodies are associated with a string of post-tectonic (?Late Cretaceous) plutons, mostly non-emergent; three of these bodies (North Ferrisburg, Barber Hill, and Shelburne Point) do not have significant associated ore bodies."

In this sentence, there was an error made during the final preparation of the abstract - the phrase "three of these bodies" should read "three of these plutons". It is understandable that Westerman and Ratte were confused by this. To clarify, there is a series of plutons which are associated with (and acted as sources for) the series of mineral deposits. Except for Barber Hill, North Ferrisburg, and Cuttingsville , these plutons have not been fully unroofed. Major pipes and/or dense dike swarms are observed at Shelburne Point, Plymouth, and Searsburg Ridge. Fault arrays indicating localized uplift are apparent in all of these sites except Searsburg Ridge. If Westerman and Ratte wish to disbelieve my interpretation concerning the presence of plutons until there is direct evidence (e.g., the plutons are drilled), that is their privilege. I feel, however, that the data is more than sufficient to infer their existence (I find odd Westerman and Ratte's reference in #4 to a written out version of the structural model which explains the formation of these associations, since I have yet to completely develop the model in full manuscript form and I know they have not seen my partial drafts; if I am duplicating someone else's model, I wish they would let me know. For the record, the structural model is really quite simple and requires only a very rudimentary understanding of fluid and fracture mechanics).

The mineral deposits are areally associated with these phenomena, generally being along or near the post-tectonic fault surfaces or along intersecting pre-existing thrusts. As far as I have been able to determine to date, the only three intrusions within this belt not associated with mineralization are North Ferrisburg, Barber Hill, and Shelburne Point. Thus, the plutonic belt extends from Searsburg Ridge to Shelburne Point, whereas the mineral belt extends only from Searsburg Ridge to South Ferrisburg.

Westerman and Ratte next question the post-tectonic designation and the ?Late Cretaceous date. The date is not meant to be definite; thus the use of "?" as per standard stratigraphic notation. There are, however, some additional dates reported for the Cuttingsville and Barber Hill stocks in Senior Theses at Middlebury College (I am unable to cite the authors because of distance from the collection and lack of time to get there before this reply must be completed) which are actually Late Cretaceous. Inferring the age of all the intrusions based on a couple of K-Ar dates is dangerous anyway, so the date was intended to only be a ballpark approximation.

In response to the questions about my use of "post-tectonic", I have used this term in the same sense as virtually all Appalachian geologists have for over a century: anything occurring after the end of compressive tectonism is considered post-tectonic except in a few very limited areas where Mesozoic extensional tectonics dominate. As for the post-Paleozoic regional extensional event in Vermont, most of the field evidence for post-tectonic extension I have encountered so far is localized and associated with these non-emergent plutons. Although there may indeed have been a major regional extensional event, I do not feel the data is yet conclusive.

The field evidence for post-tectonic timing of the mineralization is quite clear for most of the mineral deposits. Although for obvious mechanical reasons there is a general tendency for mineral deposition to follow pre-existing foliation, there are enough instances of undeformed mineralized veins cutting across foliation to clearly indicate a

post-tectonic genesis. It is true that the uranium deposits on the east flank of Okemo do not generally provide clear evidence of a post-tectonic timing, but additional localities scattered on the west and south flanks of Okemo clearly cut across and post-date all deformational structures. If Ratte has any additional data on the timing of these deposits, I would be very interested in seeing it. The mineralized veins in both Plymouth and Bridgewater include both concordant and cross-cutting examples. The veins are not really like the ubiquitous deformed quartz veins found throughout the host rocks. Rather, they are undeformed, as indicated by morphology and texture.

The clearest cases of post-tectonic timing are the Cuttingsville pyrrhotite deposit, the Jamica uranuim deposit, and the Searsburg Ridge thorium deposit. That the Cuttingsville deposit is post-tectonic has been clearly established by Eggleston (1918) and Doll (1969) among others. For a full discussion of the timing of the Searsburg Ridge deposit, see Washington (1987). The Jamica uranium deposit, which was discovered by Urangesellschaft USA in 1977 and explored in 1978, is a vein pitchblende deposit. Veins up to 2 cm in width were seen in outcrop; analysis showed them to be over 90 percent pitchblende. The veins generally occur as fillings of planar joints cutting across all tectonic structures. In those portions of the deposit where joint frequency is low, there are shorter, non-planar veins cutting across foliation and, in a few cases, small folds. These small veins were found to have curvatures not in concordance with host structures, except in a couple of instances where they lie parallel to foliation around the hinges of open folds. Thus, the Jamaica deposit is post-tectonic.

3. "Within the mineral belt, there is a sequence of areally-ordered variations in ore content."

Although it may seem redundant to use "sequence" and "-ordered" in the same breath, there are two reasons for doing so: 1) nonspecificity of the word sequence; and 2) emphasis. Variations in ore content are often temporally sequenced, so specification of areal-ordering is necessary. Semantically, the phrase carries an added emphasis that is intended. One of the primary clues to the genetic link among the various mineral deposits is the continuity of the areally-ordered variations in mineral content. Without this unifying factor, why would anyone suspect a genetic link between the Jamaica uranium deposit and the Brandon Pb-Zn-Cu deposit?

4. "The northern end is dominated by base-metal sulfides; the most notable of these deposits are the Brandon Copper-Lead-Zinc and Cuttingsville Pyrrhotite deposits."

5. "The southern end is dominated by precious metals and rare earths; these deposits include the Plymouth Gold deposit, the Jamaica Uranium deposit, and the Searsburg Ridge Thorium deposit."

Since they are very much linked and are simply a continuation of #3, I will treat these two together. First, I admit that I used "end" somewhat improperly; "portion" or "part" would have been more accurate.

Westerman and Ratte's objections to the overlap of my northern and southern portions, however, ignores the discussion of the mineral variations included in the oral presentation (which they both attended). As I stated above, the variations are continuous along the length of the belt. There is not a discontinuity between the northern and southern portions of the belt - I simply cited the best known examples.

The northern-most mineralization within the belt includes some minor sulfides in southern Ferrisburg and adjacent Monkton. The Brandon and Chittenden deposits are the most nearly economic (in the present market) sulfide deposits. The Cuttingsville deposit is the southernmost well-documented deposit with massive sulfides. The other mineral deposits, with the possible exception of Devil's Den, all have sulfides that probably volumetrically exceed the other hydrothermal minerals, but these other minerals are of greater economic interest at the observed concentrations.

The precious metals are actually mostly confined to the center of the belt with documented gold in Bridgewater, Plymouth, and Cuttingsville (see Hitchcook and others, 1861, Perry, 1929 [he cites other analyses than the one Westernman and Ratte quote], and Doll, 1969). Uranium is found in many places from Cuttingsville southward. Although the Okemo and Jamaica uranium deposits got the press, Urangesellschaft also found uranium in Cuttingsville (note that Cuttingsville is an overlap point for all of the major types of deposits; this is quite fitting since it does lie near the middle of the mineral belt), Devil's Den, other portions of the Weston hydrothermal system besides Okemo, the Lye Brook Wilderness area, Searsburg Ridge, Woodford, Pownal, and Stamford (the work in the last three is not sufficient to definitely include them in the mineral belt). It is interesting that the most important of these (Jamiaca) lies in the middle of these localities. Between Jamaica and Searsburg there is a complete reversal of the Th/U ratio making Thorium the dominant element on Searsburg Ridge.

In conclusion, there are several mineral bodies in "western" Vermont including some that are well-known and others that have not been previously described. These mineral bodies are often associated with structural and igneous systems that suggest the existence of not-yet exhumed plutons. The mineralogy of the deposits varies in a continuous manner over the length of the belt that includes these deposits. These deposits all include evidence of post-tectonic mineralization. Thus, the western Vermont mineral belt is a definable entity, and its formation post-dates all compressive tectonism.

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PUBLICATION

The Northeastern Science Foundation publishes two journals which may be of interest. Northeastern Geology contains original papers pertaining to geologic research conducted in northeastern North America. Subscription for 1988, volume 10, is available to individuals for $21.00. Northeastern Environmental Science contains original papers related to the natural resources and environmental health problems of northeastern North America. Past topics include: acid deposition, hazardous wastes, and natural resource management. Volume 7 for 1988 is available to individuals for $20.00. Back issues of both journals are available. Contact: Northeastern Science Foundation, P.O. Box 746, Troy, NY 12181.

MEETINGS

APR 30 **VGS SPRING MEETING**
Presentation of student papers at University of Vermont. Details on page 3.

APR 30 The South Burlington Natural Resources Committee will hold a meeting from 8:30 AM to 1:30PM to discuss "Natural Resources in Chittenden County". It will be held at South Burlington High School, Dorset Street. For more information call (802)658-7956.

JUN 11 The South Burlington Natural Resources Committee will hold a Citzen's Environmental Conference from 8:30AM to 1:00PM at the South Burlington High School. There will be a number of workshops and exhibits. For more information call (802)658-7956.

OCT 8 **VGS FALL MEETING**
Details of annual meeting to appear in the Fall GMG.

Have you ever mined for cinnabar
On an island west of Zanzibar?
Where grass is high
And eagles fly
And sin is always in a bar.

JRock

From primoridal swamps
And fern forests dense
Roamed critters illogical
And rather immense
Pterodoctyly speaking
For aerial tours
Great leaps from volcanoes
These Dinos would soar.

JRock

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

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

FIRST CLASS

THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

FALL 1988 VOLUME 15 NUMBER 2/3

After a long hot summer, join us
in the lovely Northeast Kingdom for our

FALL FIELD TRIP

Glacial Geology in the Passumpsic Valley

Ballard Ebbett, Leader

9:15 A.M. SATURDAY, OCTOBER 8, 1988

Meet at Bailey's Country Store, East Burke, Vermont

BANQUET & ANNUAL MEETING

At Cutter Inn, East Burke
SOCIAL HOUR at 5:30 P.M.
DINNER at 6:00 P.M.
DOOR PRIZE for a lucky member in attendance.

Make your reservation now!

DEADLINE THURSDAY, OCTOBER 6, 1988

[See page 3 for details.]

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PRESIDENT'S LETTER

Dear Friends,

I want to ask for your help with some organizational housekeeping chores. At Annual Meeting, Saturday, October 8, the Executive Committee and I will ask you to suspend the rules of our Constitution, specifically Article VII: Amendments. The purpose will be to discuss, and if you so vote, to enact the proposed bylaws changes printed on pages 8 and 9 of this GMG. It was my error in not producing a summer GMG to give the proper four week warning as prescribed in Article VII. Rather than wait another year to bring these changes before you, the Executive Committee and I opted for suspending the rules to take care of this business. The proposed changes will help clarify our rules and "professionalize" the conduct of our meetings.

I encourage as many of you as possible to attend our Fall Field Trip and banquet that will precede Annual Meeting. Bud Ebbett of Lyndon State College has proposed two very interesting topics relating to glacial geology, and he will lead us to some excellent field trip sites where we can observe, argue, pose more questions and so on. The trip, banquet and meeting will be held rain or shine.

PLEASE call in your reservation or fill in and mail the absentee ballot (if you do not plan to come).

Thank you for your support, interest and enthusiasm during my year as President.

Sincerely,
Jeff Pelton

UVM GEOLOGY SEMINARS

This is a late addition to this GMG issue. Seminars will be held at 4:00 P.M. in Room 200, Perkins Geology Building. Contact Dr. Barry Doolan at the Geology Department, (802) 656-0248 for more information.

SEPT 26 — Dr. Teresa Jordon, Cornell University
Pre-Cordilleran Foreland Basin of the Argentina Andes.

OCT 3 — Dr. Richard Nickelsen, Bucknell University
Evolution of Alleghanian Structure in the Appalachian Foreland of Pennsylvania.

OCT 17 — Dr. David Rowley, University of Chicago
Tectonic Evolution of Asia

NOV 7 — Dr. James Hibbard, North Carolina State University
Structure and Magmatic Response to Spreading Ridge Subduction, Cape Muroto, S.W. Japan.

NOV 21 — Dr. Leigh Royden, MIT
SHORT COURSE: Tectonic and Thermal Evolution of Extensional Basins.

NOV 28 — Dr. David Elbert, Middlebury College
Origin of Garnet Zoning during Amphibolite Facies Metamorphism.

FALL PROGRAM

FIELD TRIP

TOPIC: Tills in the Passumpsic Valley that may reflect basal conditions of the Laurentide Ice Sheets at or near their maximum extents. The relation of the Passumpsic Valley Esker to subaqueous and fluvial outwash fan sediments at the northern most extent of Glacial Lake Hitchcock.

LEADER: Ballard Ebbett

DATE: Saturday, October 8, 1988

TIME OF DEPARTURE: 9:15 A.M.

ASSEMBLY POINT: Bailey's Country Store, East Burke, Vermont. From St. Johnsbury, Vermont, drive north on I91 to first Lyndonville exit. Drive north on U.S. 5 through Lyndonville to VT 114. Drive north on VT 114 to East Burke Village.

FIRST STOP: 0.8 miles north of East Burke on Burke Hollow Road. The gravel pit is 400 feet east of the road.

LUNCH: Lyndonville Green. Stores and Restaurants are nearby.

FIELD GUIDE: A preliminary field guide will be available on the day of the trip.

SOME PROBLEMS: Do the multiple till localities supply evidence for the advance and retreat of the Ice Sheet? Do the outwash fans and associated eskers supply evidence for stagnation zone retreat? Is some of the stratified drift inwash? Can the Glacial Lake Hitchcock Lake Planes of Larsen (1987) be extrapolated to the St. Johnsbury - Burke region?

BANQUET AND ANNUAL MEETING

5:30-6:00 P.M. BAR at Cutter Inn. From East Burke, drive north on VT 114 to Burke Mountain Ski Resort sign. Drive on the Burke Mountain Road to the Cutter Inn Sign. Gravel road leads to Cutter Inn.

6:00 P.M. DINNER at Cutter Inn. Advance reservations are recommended because of Canadian Thanksgiving. Please call Ballard Ebbett, work: 802-626-9371, home:802-626-9769 or Jeff Pelton, work: 603-826-5873, home 802-885-9517 by THURSDAY, OCTOBER 6.

Price of dinner will be about $13.00 for roast duck or $14.00 for roast beef.

About 7:30 P.M. ANNUAL MEETING at the Cutter Inn.

DOOR PRIZE for a lucky member present at the annual meeting will be a bound collection of all five copies of Vermont Geology.

VGS BUSINESS & NEWS

NEW MEMBERS

Robert Hibbert	Montpelier, VT
Michael Pottinger	Burlington, VT
Christine Ward	Burlington, VT

NOMINATIONS

The Committee on Nominations, Shelley Snyder, Chair, Chuck Ratte' and Barry Doolan, have presented the following slate of officers for election at the annual meeting:

President	Eric Lapp
Vice President	Andy Raiford
Secretary	Jack Drake
Treasurer	Dave Westerman
Board of Directors 2 year term	Tom Ray

VOTING AT THE ANNUAL MEETING
AN IMPORTANT NOTICE

Due to a number of circumstances, a summer GMG was not published. Besides announcing a summer field trip when one has been planned, a summer issue serves a special purpose of giving the warning for the annual meeting of the nomination of officers and any proposed by-law changes. Because this was not done this year, the Executive Committee is asking that the membership vote to suspend the rules at the annual meeting on October 8, 1988, in order that we may hold our election and vote for some "housekeeping" changes in the bylaws. For those who will not be able to attend the meeting, we have asked you to vote to suspend the rules as part of the absentee ballot.

SPRING MEETING REPORT

The undergraduate winners of the cash prize at this year's spring presentation of student papers were Darin Gainer and William Lukaskiewicz from Norwich University. Their paper was titled: "Results of Magnetic and Gravity Surveys over a Suspected Granite Body near Northfield Falls, Vermont". Their names will also be inscribed on the plaque, "The Charles G. Doll Award for the Best Undergraduate Student Paper". The graduate student prize went to Gregory Walsh for his paper, "Tectonic Lithostratigraphic Units of the Camels Hump Group inthe vicinity of Fayston, Vermont". Judges for this years meeting were Alan Liptak, Sharon O'Loughlin and Eric Lapp. Our thanks to them for a job well done.

ABSENTEE BALLOT

[See page 4 of this GMG for explanation.]

I vote to suspend the rules. ____ YES ____ NO

(Vote YES or NO on each of the following items.)

Item 1 ____ YES ____ NO
Item 2 ____ YES ____ NO
Item 3 ____ YES ____ NO
Item 4 ____ YES ____ NO
Item 5 ____ YES ____ NO
Item 6 ____ YES ____ NO

(Vote for one for each office.)

President — Eric Lapp ☐

Vice President — Andy Raiford ☐

Secretary — Jack Drake ☐

Treasurer — David Westerman ☐

Board of Directors:

2-year term — Tom Ray ☐

If you will not be attending the VGS Annual Meeting on Saturday, October 8, 1988 at about 7:30 P.M. at Cutter Inn, near Burke Mountain, please complete this ballot and return it in an envelope with the word "BALLOT" in the lower left hand corner and your name and address in the upper left corner to:

Alan Liptak, Secretary
Vermont Geological Society
Box 304
Montpelier, VT 05602

It must be received before OCTOBER 7.

ABSENTEE BALLOT

General Items

Since my last writing I'm happy to report passage of S.206, the Geological Publications bill, and adoption of the Ground Water Protection Rule and Strategy, Chuck Ratte and Sharon O'Loughlin are now well into the publication retrieval and transport phase, while trying to keep agency management from stealing any more of their storage space.

Thanks to the diligent efforts of Dave Butterfield, Vermont's Ground Water Protection Rule and Phase I of the Strategy designed to implement the statute (10 V.S.A. Chapter 48, passed in 1985) will become effective September 29, 1988. Those of us who will work most closely with this new guidance hope to see at least steady improvement in the effective management and protection of the resource.

A final news note from the Agency of Natural Resources is that John Malter (VGS Vice President) has left his position as Director of the Hazardous Material Management Division to join the private sector. At a well attended "farewell" gathering it was noted that John's sixteen plus years of state service evolved from on-call response to oil and gas spills to management of state and federally listed hazardous waste sites...and much more. His successor has yet to be chosen.

Commentary

Instead of doing hard research on geological employment in Vermont, for the article promised earlier, I have only been able to make some brief observations. Chuck Ratte's 1974 survey of employment possibilities covered 10 organizations (8 companies and 2 state agencies) most likely to employ geologically trained people. Without citing exact numbers we could likely triple or quadruple the size of the list today. Phil Wagner's 1975 letter noted about 10 geologists in state government, most of whom served without geological title. Today, twice to three times as many are spread throughout the Agencies of Natural Resources, Health and Transportation. Although more now have titles that at least combine geology with something else, some are still disguised by names such as "hazardous materials specialists", perhaps to reflect an amount of specialization. In the private sector, a scan of the yellow pages reveals many companies and individuals unheard of five or ten years ago that employ people with geology backgrounds. These include consultants, engineers, planners, drillers, laboratories and others.

The steady increase in volume of both in-state and out-of-state requests for geological and hydrogeological information attests to the quantity and comprehensiveness of geological investigations in Vermont. It also highlights Colin Norman's (Science, May 1988) point that we are increasingly becoming an information society. The point of all this is that it appears to me that quite a number of geologists (and non-geologists) in Vermont today are working with a relatively small amount of new and appropriately detailed or updated information. I encourage the membership of VGS to work with those who need the data to begin thinking of ways to delineate and work on this problem.

Eric Lapp

PROPOSED BYLAW CHANGES

PRESENT WORDING

ITEM 1

Article IV: OFFICERS

A. The officers of the Vermont Geological Society shall be a President, a Vice-President, a Secretary, a Treasurer. These officers, together with the board of directors, consisting of 3 members, shall constitute the executive committee.

PROPOSED CHANGES UNDERLINED

Article IV: OFFICERS

A. The officers of the Vermont Geological Society shall be a President, a Vice-President, a Secretary and a Treasurer. These officers together with the board of directors, consisting of 3 members, and one representative from each of the four Permanent Committees, shall constitute the executive committee.

ITEM 2

Article V: COMMITTEE ON NOMINATIONS

B. The committee on nominations shall:

2. Report to the executive committee one month after the spring meeting, the names of the nominees, at which time additional nominations will be accepted from members submitted by prior mail addressed to the secretary.

Article V: COMMITTEE ON NOMINATIONS

B. The committee on nominations shall:

2. Report to the executive committee one month after the spring meeting, the names of nominees. Additional nominations should be submitted by members to the secretary by 31 August so that names can be published in the Fall Green Mountain Geologist.

ITEM 3

Article VI: ELECTION OF OFFICERS AND DIRECTORS

A. Method of Election:

1. Those persons who will not be able to attend the annual meeting may request an absentee ballot from the secretary and should return this ballot

Article VI: ELECTION OF OFFICERS AND DIRECTORS

A. Method of Election:

1. Those persons who will not be able to attend the annual meeting should return the absentee ballot printed in the Fall Green Mountain

from the secretary and should return this ballot in the envelope provided so as to be received prior to the annual meeting.

the annual meeting should return the absentee ballot printed in the Fall Green Mountain Geologist to the secretary so as to be received prior to the annual meeting.

ITEM 4

Article IX: ANNUAL MEETING

A. The annual meeting shall be held in the month of October and shall be considered a regular meeting.

Article IX: ANNUAL MEETING

A. The annual meeting shall be held within 30 (thirty) days of 15 October and shall be considered a regular meeting.

ITEM 5

Article X: VOTING BODY

C. At the annual meeting twenty-five percent (25%) of the membership shall constitute a quorum, two of whom shall be members of the executive committee. Business may be conducted at other duly warned meetings without a quorum. All meetings shall be warned no less than two weeks prior to the meeting.

Article X: VOTING BODY

C. At the annual meeting, those voting members present shall consititute a quorum, four of whom shall be members of the executive committee. Business may be conducted at other duly warned meetings without a quorum. All meetings shall be warned no less than two weeks prior to the meetings.

ITEM 6

Article XIII: COMMITTEES

All occurrences of "chairman" or "chairmen" shall be replaced with "chair" or "chairperson". There appear to be ten such occurrences.

GRANT-IN-AID

One proposal was submitted for the spring deadline, but it was deemed to be inappropriate for the award because it did not address the concern of integrating chemistry or hydrology with bedrock aquifer studies that is specified for the grant. Subsequently, letters were sent out this summer announcing a new deadline of September 30, 1988 for proposals. If you are an interested student, or know one, and have not received a copy of the announcement, contact Dave Westerman at Norwich University or Jeanne Detenbeck (802)-985-2390.

VERMONT GEOLOGY, VOLUME 5, SALES

The treasurer reports that about 50 copies of this volume have been sold. There are still plenty available at $10.00 (ppd) for members and $12.00 (ppd) for non-members. Send a check payable to Vermont Geological Society to: Dave Westerman, Treasurer, Vermont Geological Society, Box 304, Montpelier, VT 05602 for your copy.

TREASURER'S REQUEST - HOW SHOULD WE SPEND OUR MONEY?

Dave Westerman, our treasurer, notes that the Society is in very good financial health, all current bills having been paid. He believes that excess funds should not be allowed to accumulate, since we are a non-profit organization. Suggestions at Executive Committee meetings for appropriate use of these funds have been: scholarships; increasing annual student paper awards; expansion of Society publications; honoraria for more guest speakers at Society meetings; reimbursement for more of officer's expenses. Dave would like to hear any suggestions that members have and he will bring them to future Executive Committee meetings where I'm sure this will be a major topic of discussion in the coming year.

EXECUTIVE COMMITTEE MINUTES - April 30, 1988

The Executive Committee met in Room 206, Perkins Building, on the UVM campus. The meeting began at 12:30 P.M. Present were Jeff Pelton, Eric Lapp, David Westerman, Ray Coish, Sharon O'Loughlin and Alan Liptak.

Old Business: The secretary's report, consisting of the minutes of the meeting of March 16, 1988, was accepted as is.

The treasurer reported little change in finances from the meeting of March 16, 1988. He noted that the Society is in very good financial health and that excess funds should not be permitted to accumulate.

Three applications for membership were considered. Two of these were for full membership and one was a student application. After consideration by the Committee, all three applications were approved.

Discussion of use of surplus funds occurred. It was mentioned that GSA will begin next year to subsidize student participation at its meetings. The Vermont Geological Society might consider a similar proposal for GSA attendance. It was also suggested that excess funds could be spent on guest speakers or a computer workshop. Ray Coish agreed to write a proposal for VGS subsidation of student attendance at GSA meetings.

The issue of back dues was discussed. The current policy is to drop anybody who is more than two years behind in dues.

New Business: By-law proposed changes were distributed and commented upon. It was suggested that these could be voted upon at the annual meeting, fall, 1988.

One application was received for the VGS Grant-in-aid for research. The application pertained to a study of dissolved and particulate phosporous in Mallett's Bay. It was agreed by the Committee that the proposal was excellent; however, the guidelines for the grant specifically state that the study should involve combined ground-water and bedrock studies. The Committee did not believe the proposal pertained to bedrock and groundwater to the degree specified, so the application was not accepted. Jeanne Detenbeck was empowered to reissue the grant notice and select a new deadline for applications.

The possibility of a summer field trip was discussed. Several potential trips were discussed with the idea that the trips should be geared toward teachers. Jeff Pelton agreed to examine this issue and report to the Executive Committee.

The potential of a computer workshop at the winter meeting was discussed. Dave Westerman suggested the meeting could be at Norwich University and could include personal computer applications to geology.

The annual meeting, scheduled for October 8, 1988, will be coupled with a fall field trip, possibly to the Northeast Kingdom.

The meeting adjourned at 1:22 P.M.

Respectfully submitted,
Alan R. Liptak

EXECUTIVE COMMITTEE MINUTES - September 15, 1988

The Executive Committee met at John Malter's house in Waterbury. The meeting began at 7:14 P.M. Present were John Malter, Jeanne Detenbeck, Eric Lapp, Jeff Pelton, Sharon O'Loughlin, Dave Westerman and Alan Liptak.

Old Business: The secretary presented the minutes of the last Executive Committee meeting held on April 30, 1988. Two corrections were made by the committee.

The treasurer reported a balance in the Society's account of $2,128.29 with no outstanding bills. The Committee approved the purchase of computer paper and prestamped envelopes for the Society.

Three applications for membership were reviewed. Two applications were for full membership, one was for associate membershiip. After discussion by the Committee, all three applications were approved. The subject of dropping non-paying members from the Society was discussed. Eleven members who were two or more years behind in dues were dropped from the membership list. The new total membership is 147.

No applications for the Grant-in-aid for research had been received as of September 15, 1988. The published deadline is September 30, 1988. Formation of a committee to consider applications was discussed and Dave Westerman agreed to contact Rolfe Stanley, Brewster Baldwin and Jeff Noyes to see if they wanted to review applications.

The topic of By-law changes was discussed. Proposed revisions to the by-laws were discussed during the Executive Committee meeting of April 30, 1988. The Society rules require that proposed changes to the by-laws be warned at least 30 days prior to the annual meeting. Since the annual meeting is scheduled for October 8, 1988, it would now be impossible to provide 30 days warning. The only possible way to revise the by-laws this year is to suspend the rules for the 30 days warning by a vote of 25% of the voting membership. It was decided that this suspension could be a ballot item for the annual meeting.

New Business: The Fall Field Trip was discussed. Bud Ebbett will lead a glacial geology field trip on October 8, 1988, in the Lyndonville region. Meeting time is 9:15 A.M. at Bailey's Store in East Burke. The locaation of the annual meeting was undecided, but the Old Cutter Inn in East Burke was a strong possibility. The suggested time for the dinner was 5:30 P.M. with social hour at 4:30 P.M. and the meeting to follow the dinner. John Malter suggested a "door prize" for the meeting attendees of a complete bound set of Vermont Geology Issues 1 through 5. Members must be present to win. This idea was accepted.

The winter meeting was also discussed. The general topic will be "Personal Computers in Geology". The proposed schedule will include a morning presentation covering ranges of professional and geological applications and projections. The afternoon program will include a "hands on" session for members. The location is proposed to be Norwich University and Dave Westerman has agreed to coordinate the meeting.

Finally, the question of use of surplus funds was discussed. The Society is running an historically large surplus at the moment and the point was made that as a non-profit organization this money should be used in some way. A preliminary list of possible uses of this money was discussed and it included: scholarships; increasing the annual student paper awards; expansion of Society publications; more guest speakers at Society functions; increases in meeting attendee stipends. Jeanne Detenbeck will include a request for further suggestions in the fall GMG.

The meeting was adjourned at 8:45 P.M.

Respectfully submitted,
Alan R. Liptak

COMMENT

To the Editor:

The Comment and Reply concerning Paul Washington's abstract (GMG v. 15, no. 1, p. 19-26) were provocative, if also disconcerting. Could it be that Paul intended to promote some such reaction with his abstract and talk? Problems with semantics and style aside, the geological discussions were worthwile and informative, and I hope the authors - all friends of many of us VGS members - avoid any hard feelings about the exchange. I wish that video or audio tapes were available so that distant VGS members like myself could hear the talk by Paul and others at Society meetings.

At any rate, being heavily involved in studies of both the Cretaceous features of western Vermont, and uranium evaluations of the late 1970's, I wish to add my two cents (or whatever it is worth).

Washington's proposal of extensive hydrothermal mineralization related to Cretaceous (mostly 130-100 Ma) magmatism was similar to my own thoughts in the late 70's. Extensive sulfidic mineralization is present along the northeastern side of the Cuttingsville complex, and molybdenite is still visible in prospects within the syenite. Native gold has since been found by the USGS (Robinson, 1986). Mo has been prospected at the Barber Hill stock in Charlotte. In addition, the syenites and also trachyte (bostonite) dikes near both intrusions are mildly radioactive (5 to 10 times background), with U_3O_8 values around 10 ppm. In 1979, I thought that we might find authigenic (non-hydrothermal) concentrations of U minerals, such as occurs in the Sunapee pluton of New Hampshire, where U minerals have been leached from the rock by ground water and precipitated into fractures just below the water table. Those fractures were clearly formed during Cretaceous dike intrusion, which does confuse the issue a bit. We did not find any such uranium concentrations in Vermont, but more work might prove different.

The best evidence is that Cretaceous mineralization was limited to small deposits, now probably below ore grade, and very nearby to the plutons. Washington makes a reasonable suggestion for additional unexposed plutons, to which I would add one below the northeastern Taconics to account for trachyte dikes in that area. However, western Vermont plutons show little geographic association with Pb-Zn or iron mineralization along the Green Mountain front, which have also been recently evaluated by the USGS (Clark, 1986). But even there his model has some merit, as Pb-Zn mineralization of brecciated carbonates is associated with alkalic intrusions in other areas, such as southern Illinois.

Uranium in the Green Mountains is another beast altogether. I am surprised that Paul has found "major pipes and/or dense dike swarms" of Cretaceous age at Plymouth and Searsburg, and by implication near the other U occurrences. I have looked at all these areas and find only scattered dikes of less abundance than in many other parts of northern New England (McHone, 1984).

The major Green Mountain uranium concentrations are clearly at least partly syn-metamorphic, as pointed out by Westerman and Ratte'. Most of the uranium occurrences are within Grenvillian basement rocks and overlying Late Proterozoic formations within the eastern half of the Green Mountain massif (McHone and Wagener, 1980). The veins described by Washington are mineralized shear zones, which apparently developed beneath thrust faults that once covered the eastern basement rocks (this upper plate has eroded since uplift of the Green Mountains). In my model, metamorphic fluids - probably Acadian but possibly older - removed U from metapegmatites and gneisses and carried it into the shears and along foliations. Pegmatites of the Mt. Holly formations are remarkably like some very radioactive eastern Adirondack pegmatites, except that in the Adirondacks they have retained high U/Th ratios while in Vermont they are now mostly Th-rich. This fact reflects the relative mobilities of uranium and thorium. Because they are partly controlled by structures, the Green Mountains occurrences could be called syn-tectonic. But then again, I tend to think that nothing in geology is truly "post-tectonic".

Whether or not Paul Washington's statements and conclusions are acceptable as majority opinion (which seems to be the way geology progresses), we should admire the spirit of his defense. Such exchanges promote a beneficial interest in our science.

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Clark, S.H., 1986, Zinc-lead-copper mineralization in Cambrian shelf carbonate-siliciclastic rocks at Lion Hill near Brandon, Vermont: Geological Society of America Abstracts with Programs, v. 18, no. 1, p. 9.

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McHone, J.G. and Wagener, H.D., 1980, Distribution of uranium and thorium in central New England and northeastern New York: Geological Society of America Abstracts 12, no. 2, p. 73.

Robinson, G.R., Jr., 1986, Gold and associated metals at Cuttingsville, Vermont: Geolgocial Society of America Abstracts with Programs, v. 18, p. 62-63.

Sincerely,
Greg McHone

J. Gregory McHone
Department of Geological Sciences
University of Kentucky
Lexington, KY 40506-0059
28 April 1988

STATE GEOLOGIST'S REPORT

The Office of the State Geologist wishes to express great thanks to all the people involved with helping the passage of S.206. The Geological Publications Account has been established and looks to be a great success.

A new, well-illustrated publication on the 1983 Smugglers Notch rockfall is currently available:

Baskerville, Charles A., Charles A. Ratte', and Fitzhugh T. Lee, 1988, A Rockfall and Debris Slide at Smugglers Notch, Mount Mansfield, Cambridge, Vermont; Office of the State Geologist, Studies in Vermont Geology No. 4.

Cost is $4.00 plus 4% sales tax (in Vermont) plus $1.00 postage and handling (if mailed).

A new price has been established for the full set of Vermont Geological SURVEY publications. $135.00 (plus 4% VT tax and/or $14.50 postage and handling if mailed) purchases 1 copy of each of the in-print publications with the exception of the loose quadrangle maps (from the Bulletins) and the rock kit. This is about half off the cost of items purchased separately.

Slightly damaged and/or dirty copies of the Centennial Geologic Map of Vermont are available on a walk-in basis for 50¢ (tax included). These maps have some corner and edge damage or discoloration but are otherwise in fine shape.

The material above is available from the Office of the State Geologist, 103 South Main Street, Waterbury, VT 05676 (802) 244-5164.

As a result of the U.S. Geological Survey / State Geologist Cooperative Landslide Project, a new publication is available:

Baskerville, Charles A. and Gregory C. Ohlmacher, 1988, Some Slope-Movement Problems in Windsor County, Vermont, 1984; U.S. Geological Survey Bulletin No. 1828, 25p.

This publication is available from the U.S. Geological Survey, Books and Open-File Reports, Federal Center, Box 25425, Denver, Colorado 80225.

Submitted by Sharon O'Loughlin
Geologist/ Information Specialist

MEETINGS

OCT 8 **VGS FALL MEETING**
Details of Field Trip and Annual Meeting on page 3.

OCT 7-9 New York State Geological Association
Annual Field Trip Meeting. Plattsburgh, NY. Tom Wolosz, Center for Earth and Environmental Science, SUNY College, Plattsburgh, NY 12901; (518) 564-4031.

OCT 14-16 New England Intercollegiate Geological Conference in Keene, NH sponsored by University of NH and Keene State College. W.A. Bothner, Department of Earth Sciences, University of NH, Durham, NH 03824.

JAN or FEB **VGS WINTER MEETING** - at Norwich University
Date to be arranged. A workshop showing applications of personal computers to geologic problems.

[See page 2 for some late additions.]

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

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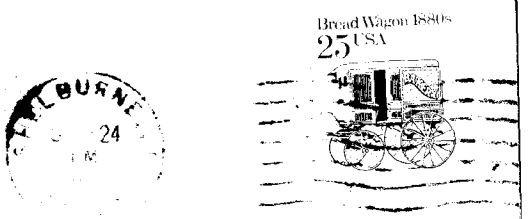
[See page 3.]



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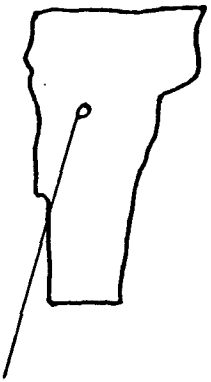

WINTER 1988 VOLUME 14 NUMBER 4

The Vermont Geological Society presents its

11th ANNUAL WINTER MEETING

SATURDAY, FEBRUARY 20, 1988

9:30 A.M.

Cabot Science Annex
Norwich University
Northfield, Vermont

Presentation of Papers
Exhibit of historical maps of Arthur Keith and T.N. Dale
Three out-of-state experiences by the Norwich faculty

See Page 3 for PROGRAM and DIRECTIONS

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PRESIDENT'S LETTER

Dear Friends,

One can scarcely pick up a Vermont newspaper these days but what the word GROWTH stares at us in bold letters. Referring to new commercial, industrial, and recreational land uses, GROWTH is apparently to be the catch-word of the latter 1980's. Future growth decisions will be made with more careful planning and with more direct participation by the citizens of Vermont. And, the scientific community -- geologists, geohydrologists, soil scientists and others will be providing the basic information on which planning will be done, and on which ultimately, decisions will be made.

The VGS has the opportunity to be a positive contributor to these decisions. With Summer and Fall Field Trips and meetings at which professional and student papers are presented, such as the VGS Winter Meeting February 20th, we become a promoter of and a clearinghouse for the dissemination of basic scientific information. Individually, our own knowledge becomes broadened, our interests stimulated, and contacts are made with people with whom we wish to further share ideas. And, with the give-and-take of argument, perhaps a collective wisdom emerges that is not possible from our own narrow perspective.

Through publication of "The Green Mountain Geologist" (four times yearly) and "Vermont Geology", other important information is made available. To date four volumes of "Vermont Geology" (consisting of fifteen individual reports) have been published, and Volume 5 is ready for printing this spring.

Finally, the VGS can support relevant bills in the State Legislature. Under the leadership of Eric Lapp, Chairperson of the Public Issues Committee, a letter from the Society was recently sent to the Senate Appropriations Committee urging support for Bill S.206. This bill establishes a geological publications account under the State Geologist and should greatly help the publication and dissemination of geological information.

The VGS can and should exert leadership to make scientific knowledge available. To do this we need to be an active, vital organization. I urge you to attend the Winter Meeting at Norwich University, and I look forward to seeing you there.

Jeff Pelton

Jeff Pelton

WINTER PROGRAM

February 20, 1988,
Cabot Science Annex
Norwich University, Northfield, VT

COFFEE and DONUTS: Room 48 . . . . . 9:00

MORNING SESSION Room 45

Opening remarks: Jeffrey Pelton, Convener 9:20

1. R. Parker and E. Witten: The Paleoenvironments and Stratigraphic Significance of Chertified Ooids in the Clarendon Springs Dolomite Upper Cambrian), Milton, VT 9:30
2. P. Washington: Geology of the Western Vermont Mineral Belt 9:50
3. B. Caswell: Time-of-Travel in Glacial Aquifers . . 10:10
4. C. Allen: Remediation strategies for Mitigation of Leaked Underground Petroleum Products in Northern Vermont: Report of Work in Progress 10:30
5. D.A. Franzi, D.J. Bogucki and E. Allen: Recent slump-earthflow in the Bouquet River Valley near Wallonsburg, Essex County, NY . . . 10:50
6. M. Erickson: Applications of Fossil Oribatid Mites to Quaternary Paleoecologic Studies . . . 11:10
7. Exhibit of maps by Arthur Keith and T.N. Dale Room 47. . . . . 11:30

LUNCH: (Brown bag or local eateries) 12:00

EXECUTIVE COMMITTEE MEETING: See page 8 for agenda.

AFTERNOON SESSION Room 45

8. M. Ferrick, G.E. Lemieux, P.B. Weyrick and W. Demont: Options for management of dynamic ice breakup on the Connecticut River near Windsor, VT. 1:00

THREE OUT-OF-STATE EXPERIENCES
Presented by the Norwich Faculty

9. D. Westerman: A comparison of the Geology of Scotland and Vermont 1:20
10. J. Reynolds: Chronostratigraphy vs. lithostratigraphy in the Andes of Western Argentina. 1:40
11. F. Larsen: A Comparison of the Waits River Formation (Devonian) of Vermont with the Jack Fork Formation (Pennsylvanian) of Arkansas 2:10

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.

ABSTRACTS

REMEDIATION STRATEGIES FOR MITIGATION OF LEAKED UNDERGROUND PETROLEUM PRODUCTS IN NORTHERN VERMONT: REPORT OF WORK IN PROGRESS

Allen, Chris, Groundwater Technology, Inc., 1433 Williston Road, South Burlington, Vermont 05403

This abstract will appear in the Spring 1988 issue of the GMG.

TIME-OF-TRAVEL IN GLACIAL AQUIFERS

Caswell, Brad, Caswell, Eichler & Hill, Inc., [Geology, Hydrology & Geophysics], West Topsham, Vermont 05086

Under recently imposed Safe Drinking Water Act requirements, "surface water sources" include municipal wells that pump water recharged from nearby lakes, ponds, or streams if the time that it takes for ground water to travel from the surface water body to the pumping well is less than 30 days. Such wells are considered to be at risk of contamination by Giardia cysts and other pathogenic organisms that are generally larger than 3 micrometers in diameter and can travel with ground water through aquifers. Giardia causes serious illness in humans when ingested. It seems to be typically associated with beavers; thus Giardia cysts are found in many surface waters. Fortunately, ground water flow through granular materials filters out these cysts and other pathogenic organisms. The 30-day travel time criterion is adopted as an indicator of sufficient natural filtering.

Two case studies involving municipal ground water supply exploration in glacial eskers are described to demonstrate some of the complexities of ground water recharge and travel time characteristics encountered in glacial aquifers. The first case is an esker crossed by a small, distant stream, while the second case is an esker adjacent to a lake and a stream. Exploration wells and pumping tests were used to identify and quantify the hydrogeologic properties of the glacial aquifers. The potential sources and mechanics of aquifer recharge had to be identified and analyzed as an important first step in the time-of-travel analysis. In the first case, the configuration of the esker aquifer was shown to provide acceptable separation between the source of surface water recharge and the pumping well. In the second case, however, the esker aquifer was shown to function as a short circuit for flow of surface water recharge to the pumping well. For this latter case, the 30-day travel time criterion is clearly violated, necessitating lengthy testing of the pumped water for turbidity and biological purity, and possible continuous treatment of the municipal supply.

APPLICATIONS OF FOSSIL ORIBATID MITES TO QUARTERNARY PALEOGEOLOGIC STUDIES

Erickson, J. Mark, Geology Department,
St. Lawrence University, Canton, New York 13617

Quarternary paleoecologists are continually refining methods for interpreting local post-glacial paleoenvironments, Most recently fossil beetles have provided this sort of close documentation of local vegetative and climatic conditions, but interpretive problems are associated with these, as with many such indices. In the case of beetles, flight dispersal and relatively poor fossilization rate each creates potential difficulty. Oribatid mites preclude such problems because they are fossilized in their local environs in goodly numbers. The Oribatida, or moss mites, are primarily vegetative decomposers occurring in greatest numbers in forest litter and soils, but they range widely through the ecosystem and are often associated with particular plant groups or microhabitats.

As fossils in lacustrine and palustrine sediments three aspects of their occurrence have been found useful as paleoecologic indices. Taphonomic interpretations based upon a range of characteristic preservation modes from nearly perfect (Class 1) to severely disarticulated (Class 5) provide insight into proximity to source and degree of transport, environment of deposition, and degree of predation.

Quantative studies, based upon 10 gm to 30 gm samples normalized to 10 gm dry weight, can demonstrate successive paleoclimatic changes in local ecosystems if continuous, cored sequences are examined. The aquatic taxa Hydrozetes sp. and Limnozetes sp. have been used successfully to demonstrate a dozen alternating wet/dry periods in post-Wisconsinan lake deposits from New Jersey.

Terrestial species may potentially be used both quantitatively, where significant numbers of individual species are fossilized, or by presence/absence data to define local habitat conditions. Oribatids do not fly, nor can they travel far during life. Their post-mortem introduction into lake and bog systems should be limited by local conditions. Models for this process and the interpretation of both presence/absence and numerical abundance data are presently being developed for several types of basins.

Fossil oribatids have a wide range of uses as paleoenvironmental indices. They will be a significant tool in our efforts toward global fine-scale paleoclimatic interpretation now under way.

OPTIONS FOR MANAGEMENT OF DYNAMIC ICE BREAKUP ON THE CONNECTICUT RIVER NEAR WINDSOR, VERMONT

Ferrick, M.G., G.E. Lemieux, P.B. Weyrick and W. Demont, USA Cold Regions Research and Engineering Laboratory, 72 Lyme Road, Hanover, New Hampshire 03755-1290

The Cornish-Windsor bridge is the longest covered bridge in the United States and has significant historical value. At a large peak flow, dynamic ice breakup of the Connecticut River can threaten the bridge and cause flood damage in the town of Windsor, Vermont. Throughout the 1985-86 winter we regularly monitored ice conditions, including a midwinter dynamic ice breakup on 27 January. We conducted controlled release tests over the operating range of the turbines at Wilder Dam upstream during both open water and ice cover conditions. These data and observations were analyzed in light of more than 60 years of temperature and discharge records. Our analysis indicates that river regulation presents alternatives for ice management that would minimize the probability of bridge damage and flooding during breakup. The flow can be regulated early in the winter to promote the growth of a stable ice cover, minimizing the total ice production in the reach. In the weeks prior to breakup, sustained releases and above-freezing air temperatures cause melting, weakening and gradual breakup of the ice, greatly reducing the flooding potential. Also, it is possible to produce a controlled ice breakup prior to an imminint natural event at lower stage and discharge than now occurs during major events. All of these ice control alternatives have associated power production costs.

RECENT SLUMP-EARTHFLOW IN THE BOUQUET RIVER VALLEY NEAR WHALLONSBURG, ESSEX COUNTY, NEW YORK

Franzi, David A., Donald J. Bogucki, and Eileen B. Allen, Center for Earth and Environmental Science, State University of New York, Plattsburg, New York, 12901

The Bouquet River Valley between the villages of Whallonsburg and Bouquet has a history of landslide activity. The most recent occurrence followed a light rainstorm on 28 July, 1987 when a 0.9 ha slump-earthflow developed in Pleistocene lacustrine sediment.

The crown of the slump is 115 m in length and 16 m above stream level with 7.5 m maximum vertical displacement along the headscarp. A 0.2 ha compression toe bulge, composed of highly plastic clay and alluvial sediment, was raised to a maximum height of 7 m above stream level. The bulge temporarily blocked the stream channel causing a 3 m deep back-water. Erosion of the clay dam initiated small-scale post-slide movements in the toe area.

The slump exposed 0.6 m of outwash over a thick sequence of glacio-lacustrine silt and clay at the headscarp. The lake sediment consists of rhythmically laminated clay and clayey silt. The clays are characterized by high natural water content with low bulk density and shear strength. The upper 2.5 m lacustrine sequence has higher silt to clay ratios and shows evidence of desiccation-consolidation and weathering. Bedrock occurs at depths ranging from 10 m beneath the toe to

24 m beneath the crown as determined from seismic refraction techniques.

Reconstructions, based upon slide-deposit morphometry, suggest that most of the movement occurred as a single mass characterized by head-scarp slumping with thrusting and plastic flow of clay at the toe. Secondary movements related to loss of confining stress were restricted to the headscarp area. Although the movement may have been rainstorm induced, the actual cause is probably related to long-term cutbank erosion at the slope base and pore pressure conditions at the clay-bedrock contact.

THE PALEOENVIRONMENTAL AND STRATIGRAPHIC SIGNIFICANCE OF CHERTIFIED OOIDS IN THE CLARENDON SPRINGS DOLOMITE (UPPER CAMBRIAN), MILTON, VERMONT

Parker, Ronald L., Vermont Department of Health, 60 Main Street, Burlington, VT 05401 and Eve Whitten, Environmental Studies Program, University of Vermont, Burlington, VT 05405

Recently discovered ooid grainstones in the Clarendon Springs dolostone, Milton, Vermont, furnish detailed information about paleoenvironments, current energy, geochemistry and bathymetric configurations of the platform margin of Laurentia during the Upper Cambrian.

The ooids occur as dense decameter scale accumulations surrounded by sucrosic dolomite. Ooids compose 100 percent of allochemical constituents, are well founded, moderately well sorted, ellipsoidal and in grain-to-grain contact. Ooid grains are remarkably large (1.0 - 2.5 mm) and exhibit virtually no deformational overprinting. Intergranular porosity is occluded by authigenic megaquartz and dolomite cement. Preferential weathering removal of cement permits the otherwise indistinguishable ooid grains to be seen.

Bioclasts, peloids, ooid fragments and rare quartz sand form ooid nuclei. Ooid cortices are thick and contain perfectly preserved microlaminations. Original aragonite crystal fabrics and early submarine isopachous cement are preserved by chert replacement. Chertification was clearly an early diagenetic phenomenon, predating fabric destroying dolomitization. Idiotopic dolomite is often observed to replace chertified ooids, especially near contacts with dolomite. The presence of relict ooid "ghosts" within surrounding dolomite suggests that progressive replacement of ooids is a significant process.

Textural and sedimentologic similarities with modern and Pleistocene oolites indicate similar formational processes. Like modern ooids, these formed in very shallow, current agitated normal marine waters that existed adjacent to a deep ocean basin. Tidally influenced currents drove cool, deep, CO_2 saturated water onto the shallow platform. Turbulent mixing with warm water expelled CO_2, resulting in $CaCO_3$ supersaturation and precipitation of aragonite on nuclei. Grain motion, burial, exhumation, growth, abrasion, etc., characterized each ooid grain. The ooids formed cross-bedded shoals in less than 20 feet of water. As with modern oolite shoals, these accumulations influenced the local hydrodynamic regime, creating protected leeward environments where finer grained sediments were deposited.

This interpretation provides independent confirmation of the positioning and configuration of the shelf edge (previously interpreted from polymictic debris flow conglomerates) and the existence of shelf marginal sand shoals. This interpretation also suggests that the shelf margin and the nearby shale basin were characterized by separate energy and depositional regimes. Therefore, the contact relation between the Clarendon Springs (shelf) and the Skeels Corners slate (basin) must be unconformable or tectonic in nature.

GEOLOGY OF THE WESTERN VERMONT MINERAL BELT

Washington, Paul A., Environmental Compliance Services, West Springfield, MA 01089 and Department of Geology and Geophysics, University of Connecticut, Storrs, CT 06268

The western Vermont mineral belt consists of a series of more than nine hydrothermal ore bodies aligned in a belt extending from Ferrisburg to Searsburg. These ore bodies are associated with a string of post-tectonic (?Late Cretaceous) plutons, mostly non-emergent; three of these bodies (North Ferrisburg, Barber Hill, and Shelburne Point) do not have significant associated ore bodies, Within the mineral belt, there is a sequence of areally-ordered variations in ore content. The northern end is dominated by base-metal sulphides; the most notable of these deposits are the Brandon Cooper-Lead-Zinc and Cuttingsville Pyrrhotite deposits. The southern end is dominated by precious metals and rare earths; these deposits include the Plymouth gold deposit, the Jamaica Uranium deposit, and the Searsburg Ridge Thorium deposit.

VGS BUSINESS & NEWS

NEW MEMBERS

The following new members have been accepted by the Executive Committee:

Barry Conolly	Westford, VT
Peter Fisk	London, England
Jake McDermott	Newfane, VT
Barbara Rhoade	Windsor, VT
Elyse Rudner	Bristol, VT
Nate Stearns	Providence, RI
John White	Cornish, NH
Vermont Historical Society Library	Montpelier, VT

EXECUTIVE COMMITTEE AGENDA FOR 2/20/88

- Secretary's Report
- Treasurer's Report
- Old Business:
  - Report by By-Laws Committee
  - Status of Vermont Geology vol.5
  - GSA Meeting, Portland, ME., March 10-12
- New Business:
  - Spring Meeting of Student Papers
  - Summer Field Trip
  - Geological Education Committee

Vermont Geological Society - Treasurer's Report

January 1, 1988

Balance as of 1/1/87		$2786.76
Income		
Interest	173.84	
Dues	1318.50	
Publication Sales	343.16	
Gift for Grant-in-Aid of Research	1500.00	
	3335.50	+3335.50
		$6122.26
Expenses		
Postage	334.94	
Printing/Copying	524.54	
Office Supplies	63.77	
Grants-in-Aid of Research	3000.00	
Meeting Expenses	39.84	
Speaker Honorarium	50.00	
Doll Student Prizes	50.00	
P.O. Box Rent	22.00	
Service Charges	55.05	
Check Charges	2.00	
Reimbursement for Overpayment	7.50	
	4149.64	-4149.64
		$1972.62

Respectfully submitted,

David S. Westerman

David S. Westerman
Treasurer

CALL FOR STUDENT PAPERS

The 15th annual presentation of student research papers will be held APRIL 30, 1988 at University of Vermont. Undergraduate and graduate students from any college or university who are engaged in research of Vermont or Vermont-related geology are invited to submit an abstract of no more than 300 words no later than APRIL 12, 1988. Talks are allotted 15 minutes with an additional 5 minutes for questions. The Society awards a cash prize to each of the best undergraduate and graduate papers and the name of the undergraduate winner (or winners in case of tie) will be inscribed on the Charles G. Doll Award plaque, which will reside at the student's department until the next spring.

GRANT-IN-AID FOR RESEARCH

Our anonymous "angel" has agreed to contribute funds again for a grant-in-aid. Announcements will be mailed out soon with a deadline date of APRIL 15, 1988 for submission of applications. Any student who has not had access to the proposal requirements by March 1 should contact Dave Westerman at Norwich University (802)-485-2337 for a copy of the announcement.

EDITOR'S REPORT

All the manuscripts for Guidebook 2, the 5th volume of Vermont Geology, are in and the copy should be ready to go to the printer's by the end of February so that we will have copies to sell at GSA in Portland, Maine. There are five excellent field trip guides included in this volume: Stratigraphy and Structure of the Camels Hump Group along the Lamoille River Transect, Northern Vermont by Barry Doolan, The Beekmantown Group in the central Champlain Valley by Paul Washington and Steven Chisick, Taconic Geology near Fair Haven, Vermont by Brewster Baldwin and Andrew Raiford, Pleistocene Glaciation at Lake Willoughby by Ballard Ebbett and Structural Character of the "Pre-Silurian" and "Silurian" Rocks and the Nature of the Boundary Between them in Central Vermont by David Westerman. Price and information for ordering this volume will be published in the Spring GMG.

EXHIBIT BOOTH AT GSA, PORTLAND, MAINE

The Society is going to run an exhibit booth at the Northeastern Section meeting of the Geological Society of America in Portland, Maine on March 10-12. We will be sharing cost and space with the Vermont Geological Survey. Sharon O'Loughlin and Jeanne Detenbeck will share the time "peopling" the booth but will accept help from any members attending who would like to help out and promote the Society and the Survey. Two years ago when the Society shared an exhibit booth with the Maine Society at the GSA meeting in The Concord, we at least broke even financially, and this year with a new volume of Vermont Geology to sell, we hope to do even better!

BYLAW REVISIONS

It has become apparent that there are inconsistencies in the bylaws that have developed over the years when they have been amended, and some of the articles have also been unworkable in recent times. Articles under consideration for change include those concerning the time of the annual meeting, quorum for the annual meeting, composition of the Executive Committee, Committee on Nominations reporting process. Shelley Snyder with the help of Dave Westerman and Jeanne Detenbeck are going to review the bylaws and make suggestions for changes. If any members have suggestions concerning these or any other changes, please contact Shelley. We will provide a copy of the Bylaws to anyone who needs one.

COMMITTEE ON NOMINATIONS

Shelley Snyder was appointed Chairperson to select nominees for the fall meeting election. She needs to appoint members of the committee and would like to have some volunteers. If you have suggestions for nominees, please contact Shelley (802)+658-0575.

MEET THE NEW OFFICERS

Alan Liptak, the Secretary, lives in Moretown, Vermont with his wife and two sons, ages 2 1/2 and 1 year. He works for the State of Vermont Solid Waste Management Division as a geological engineer. Alan received a Masters in Geology from the University of Montana in 1984 and a Bachelors in Geology from SUNY Potsdam in 1982. His hobbies include cross-country skiing, hiking, camping and homebrewing.

Ray Coish, a 2-year director, was born in Newfoundland, Canada and received a BSc from Memorial University of Newfoundland in 1973 and a PhD from University of Western Ontario in 1977. He held post-Doc appointments at the University of Tennessee and MIT. He has been an Associate Professor of Geology at Middlebury College since 1979 with field interests in igneous petrology and geochemistry. His current research interests are the relationship between mafic rocks and tectonics, and geochemistry of ophiolites and greenstones in the Appalachians. He is married to Barbara Merz and they have two children, Alice 4 1/2 and Joseph 4 months. His interests outside geology are cross-country skiing, skating, jogging (rarely), baseball (watching) and child care.

Eric Lapp, Chairperson of the Public Issues Committee, is currently a hydrogeologist with the Ground Water Management Section of the Vermont Agency of Natural Resources. He grew up in the small town of Chester, Vermont, home of the "dome" and a variety of interesting minerals. His B.A. degree is in Geology-Environmental Science (Colby College, 1982) and his M.S. is in Geology (UVM, 1986, Bedrock Geology of the Mt. Grant - South Lincoln Area). Eric now wrestles with Act 250 reviews and town water resource issues instead of kyanite pseudomorphs and polymetamorphosed faults. He resides in Essex and enjoys X-country skiing, basketball, tennis and photography.

Sharon O'Loughlin, Chairperson of the Geological Education Committee, was brought up and educated in the town of Westford, Massachusetts. Her B.S. in Geology was earned at UMass Amherst where she took courses in many of the natural and physical sciences. She came to University of Vermont in the fall of 1983 where she received an M.S. in Structural Geology in 1986. Her thesis was the interpretation of structural and metamorphic sequences in the rocks of the lower Camels Hump Group around Mt. Abraham and Lincoln Gap in Lincoln, Vermont. Since July 1986, Sharon has been working for the Vermont State Geologist in Waterbury, VT as a Geologist/ Information Specialist where she is involved in geologic education and in answering requests from various individuals for geologic information. She currently resides in Essex, VT.

PUBLIC ISSUES COMMITTEE REPORT

Vermont Geological Society

P. O. Box 304 • Montpelier, VT. • 05602

January 19, 1988

Senator Edgar May
Chairman, Senate Committee on Appropriations
State House
Montpelier, Vermont 05602

Re: Bill S.206

Dear Senator May and Committee Members,

The Vermont Geological Society wishes to express its strong support for Senate Bill Number S.206 which will transfer the responsibility for sales of geological publications and other geological products (topographic maps, rock kits) to the State Geologist's Office from the State Library. This bill also will establish an account which will be used specifically for publication of geological information.

Currently, the receipts from the sale of geological publications go into the State Library account and thus are not available to the State Geologist. Bill S.206 is extremely important since the information that is being gathered through the State Geologist's programs of geological mapping and field investigations should be made available to the user through a program of regular publications. Such an account will enable the State Geologist to carry out this important function by assuring a continued source of funding to perpetuate the publication and dissemination of geological information.

Engineers, geologists, hydrogeologists in the public and private sectors depend on the information gathered and distributed by the State Geologist's Office to help investigate and evaluate land areas for a variety of purposes. These include the proper siting of ground water supplies and waste disposal facilities, mineral resource explorations, the safe and proper routing of highways, general construction purposes, erosion control related to construction, timber cutting and agricultural practices. Geological information is also fundamental to all environmental protection programs.

The Vermont Geological Society is devoted to the advancement and promotion of Vermont geology and the establishment of high standards among geologists through education, research, and the dissemination of geological information. It is an actively growing organization of over 140 individual and corporate members. The Society would be happy to provide additional testimony to your committee.

Respectfully,

Jeffrey L. Pelton

Jeffrey L. Pelton, President
Vermont Geological Society

UPDATE: Employment data wanted

As chairman of the Public Issues Committee, I have asked Brett Cox and Jack Drake to serve with me. From you, "the public", I need to know what issues, especially geologic ones, are on your mind. I am interested in putting together a short article on employment and the earth sciences in Vermont for the Summer GMG. Please send any information, observations or opinions to me at the address listed below.

Recent highlights from state government include continued work on environmental protection rules and minor reorganization and renaming, including the addition of Patrick Parenteau as new Commissioner of the Department of Environmental Conservation (formerly DWREE), with Jonathan Lash now Secretary of the Agency of Natural Resources (formerly AEC). This year's legislative session is predicted to be a short "housekeeping" one, however, Senate Bill 206 is quite pertinent to geologic work in this state and the final draft of a VGS letter in support of the bill is reprinted above.

In addition to increasing public awareness and concern for such environmentally related issues as landfills, gravel pits, contamination and land use, much discussion in recent months has focused on growth and Vermont's future. Recommendations listed in the recent Governor's Commission report include additional groundwater protection and inclusion of significant earth resource areas in regional plans. Another suggestion to further explore the use of a geographic information system (GIS) to aid resource planning was recently followed up with demonstrations of the USGS' system held at UVM and in Montpelier. Increased use of this valuable technology may highlight the critical need for more of the basic geologic information (detailed mapping) as input layers.

Eric Lapp
11 Greenfield Rd.
Bld. 1, Apt. 3
Essex Jct., VT 05452
tel. 878-0146

ANNUAL MEETING MINUTES - OCTOBER 24, 1987

The annual banquet and meeting were held at the New England Culinary Institute's dining room on upper Main Street, Montpelier.

Following a stimulating after-dinner talk by Jonathan Lash, Secretary of the Vermont Agency of Natural Resources, President Shelley Snyder opened the 14th annual meeting of the Vermont Geological Society at 8:40 PM. Items on the agenda included accepting the Secretary's report of the Fall meeting as reprinted in the Green Mountain Geologist and Dave Westerman's Treasurer's report as follows: VGS had a net worth of $2009.91 as of 6PM 10-24-87. Dave also reported that 38 members were behind in payment of dues for 1987 and that 9 members were two years in arrears. The good new was that the Society's bank account has been transferred to the Northfield

Savings Bank resulting in a reduction of charges, a higher rate of interest and free money orders. New membership applications were received from: Peter Fisk, London, England; Barbara Rhoade, Windsor, VT.; Elyse Rudner, Bristol, VT.; and John White, Cornish, NH.

President Snyder reported having received word from three teachers requesting assistance in teaching geology. Jeffrey Pelton reported that he had a list of 13 teachers who would like help from a geologist in setting up a field trip.

President Snyder opened the floor for the nomination of officers for 1988. Absentee ballots were received from four members all of whom voted for the nominees and on motion by John Malter that the Secretary cast 1 ballot for the list of candidates, the following officers and directors were elected: President, Jeffrey Pelton; Vice President, John Malter; Secretary, Alan Liptak; Treasurer, David Westerman; Board of Directors, 2-year term, Ray Coish; and Permanent Committee chairpersons: Geological Education, Sharon O'Loughlin and Public Issues, Eric Lapp.

Immediately following the election, President Pelton took charge of the meeting and requested input from the members as to new directions and actions for the Society.

John Malter suggested that the Society take a role on the issues of Waste Management and growth control, but that no specific bills have yet been presented for public review. John also reported that the Agency of Natural Resources had appreciated the Society's input into the recently passed water quality legislation.

President Pelton requested that members contact the Executive Committee with any further suggestions.

Jim Ashley mentioned Senate Bill 18 which addresses the expansion of well driller licensing to include test well drillers.

Chuck Ratte' requested support for a bill (now S-206) which would establish an ongoing Geologic Publication account to support printing of geologic studies.

There being no other new business, the meeting was adjourned.

Respectfully submitted,
David Butterfield
Secretary

EXECUTIVE COMMITTEE MINUTES - November 11, 1987

The meeting was called to order at 7:00 p.m. at John Malter's house in Waterbury Center. Present were: Jeff Pelton, Shelley Snyder, Eric Lapp, Jeanne Detenbeck, Sharon O'Loughlin, Dave Westerman, John Malter, and Alan Liptak.

A discussion of length of term for the President of the Society began the meeting. It was suggested that the current term of one year was too short to follow through on initiatives. A two-year term would better allow a president to accomplish goals while in office. However, it was mentioned that Article 4 would require lengthening the Vice President's term to two years if the President's term were lengthened. A four-year service period would be required for an aspiring Society pres-

ident, as the vice president usually becomes president. This might deter applicants, inhibiting change, and vitality which may be the key feature of the present system.

Two changes to current by-laws were suggested: one would resolve a present conflict in permanent committee membership; the other would permit better attendance and more time at annual meetings.

The Treasurer's Report was presented. The bank account balance as of November 11, 1987, was $1861.30. Also, the Society was holding $181.25 in Petty Cash, and a $20 check. Total assets were $2,062.55, not including "on shelf" publications. The report was accepted unchanged.

The VGS Grant-in-Aid for research check was submitted to the University of Vermont and returned. The University refused to accept the check as the student would receive money directly. The Treasurer will resubmit the check to the University for distribution.

Minutes of the Executive Committee Meeting of August 30, 1987, were read. The only change made concerned the NEIGC Meeting list. The list grows each year and is not deleted annually. The next NEIGC Meeting will be October 14-16, 1988 in Keene, New Hampshire. The secretary's report was accepted.

A report of the Annual Meeting at the Culinary Institute in Montpelier was not available.

Old Business: A formal note of appreciation should be sent to Jonathan Lash for speaking at the annual meeting. Shelley Snyder agreed to write this note.

New Business: The winter meeting date and format was discussed. Two dates were suggested -- February 13 and 20, 1988. The latter date would aviod the mid-winter break at local universities and would allow a better turn out. The date of the winter meeting was set at February 20, 1988. Norwich University was suggested as the location of the meeting. Dave Westerman accepted the opportunity on behalf of Norwich University. The topic of the Annual Meeting was discussed at length. There was much enthusiasm for a central theme of comparison of Scottish Geology with Vermont Geology. Several knowledgeable speakers were suggested including Rolfe Stanley, Dave Westerman, Jack Drake, Char Mehrtens and Bud Ebbett. Other possible speakers with other Vermont Geological topics included N. Ratcliffe, and James Thompson; Barry Doolan; Allen Hunt; Fred Larsen; also from State Government: Winslow Ladue; David Butterfield; William Ahearn and Cedric Sanborn. Other potential speakers include Craig Heindel; Chris Stone; Susan Oppenlander; Steve Revelle; Mike Wurth; Andy Reiffert and Doug Klemme.

A suggestion was made to expand the focus of the winter meeting as well as other meetings, to include areas of Vermont-related geology, notable New York, southern Quebec, and New Hampshire.

The length of the winter meeting talks will be 15 to 20 minutes. Abstracts should be submitted to Jeanne Detenbeck before January 30, 1988, with a confirmation date of January 15, 1988. Jeff Pelton agreed to send letters of invitation to potential speakers and Dave Westerman agreed to supply coffee for the meeting.

The 1988 VGS calendar was discussed. It was suggested that the February 3, 1988 Executive Committee meeting be cancelled. The next Executive Committee meeting will be March 17, 1988.

Regarding the spring General Meeting, two dates were proposed: April 30 and May 7, 1988. April 30 was selected as the date of the spring meeting.

Summer field trip topics were discussed and included an Adirondack field trip to examine glacial features, led by David Franzi.

The Annual Meeting date was selected to be October 8, 1988.

Shelley Snyder was selected as Chairperson of the Committee on Nominations. She will select two other members to serve on the Committee.

Miscellaneous: The Public Issues Chairman will draft a letter supporting a Bill in the Legislature authorizing a State Geological Publication Fund (copy attached). [Editor's Note: See the report of the Public Issues Chairman for this letter.] pg. 12

Annual dues notices will be sent in November with stamped, self addressed envelopes.

Permission was requested to spend $300-500 to print Volume 5 of Vermont Geology (Field Trip Guide). The cover should wrap around the pages for durability, it was noted.

The question of VGS operating a booth at the 1988 GSA meeting to be held in Portland, Maine on March 10-12, 1988 was discussed. It was noted that the last booth provided the Society with good exposure and the Society broke even financially.

Discussion ensued on whether the Society should provide reprints of historical maps for sale.

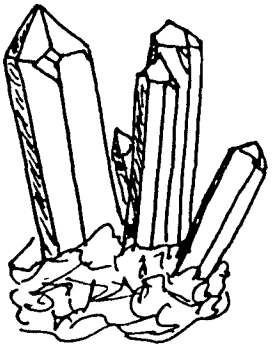
The meeting adjourned at 10:30 p.m.

Respectfully submitted,

Alan R. Liptak

MINERAL OF THE QUARTER

ROCK CRYSTAL AND SMOKEY QUARTZ



Composition: Almost 100% silicon dioxide. Some traces of iron, magnesium, aluminum, calcium, lithium, sodium. potassium and titanium may occur in clear colorless quartz.
Crystal System: Hexagonal. Twinning is common. Crystals commonly prismatic, terminated by pyramidal faces, usually unequally developed.
Specific Gravity: 2.65
Luster: Glassy
Fracture: Concoidal - no cleavage
Hardness: 7
Strong piezoelectric properties

Quartz is one of the commonest minerals in the earth's crust. It is a major constituent of sedimentary, igneous and metamorphic rocks. Colorless rock crystal is a late forming mineral in sedimentary rocks where it fills seams and cavities formed by secondary action. A typical Vermont occurrence of this type of quartz is in the black calcareous shale rock used as road fill where Route 2 crosses from Grand Isle to North Hero. Quartz is found here as stubby clear crystals in crevices with white calcite.

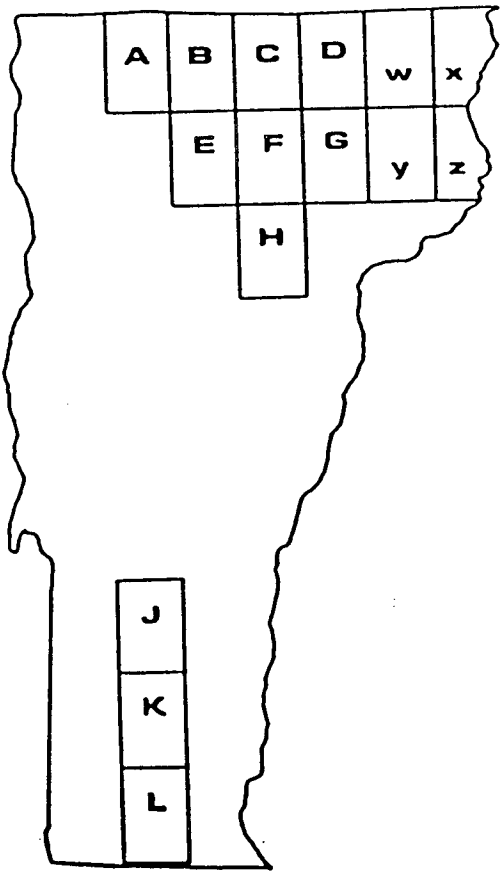
Crystalline quartz is also found in metal ore veins. An example of this occurrence is found in Devil's Den on Mt. Tabor in Rutland County. The local schist rock has pockets of clear quartz and smokey quartz crystals as well as pyrite (FeS_2) and illmenite ($FeTiO_3$). Smokey quartz ranges in color from pale brown to almost opaque black. This color is probably developed when rock crystal is radioactively "burned" by radioactive minerals in its vicinity. Most smokey quartz has uneven color distribution. The impurities which produced the color centers when the material was irradiated were not evenly distributed. To reach this location, take the Mt. Tabor Road from Danby. Park at the Devil's Den picnic area and walk north along the road to the rock outcrops on the east side of the road. Good sized clear and smokey quartz crystals have been found at this location.

Vermont History. The publication of the Vermont Historical Society in the October 1956 issue contains an interesting anecdote about quartz mining in the Plymouth, Vermont area. In 1835, the area had an iron mining and smelting industry which died when the ore pinched out. In 1858, Wm. Hankinson, newly returned from the California gold fields, found a gold vein near Plymouth. This, too, proved not rich enough to provide a livelihood for local residents. Some years later two men began mining quartz in the area. Residents of the area were impressed by the large ore samples they saw. No stock was sold until the owners announced that things were going so well they needed to build a larger plant. The impressed locals bought numerous shares of stock, sure they would make their fortunes. Unfortunately, almost overnight all operations stopped and the two entrepreneurs disappeared without a trace.

STATE GEOLOGIST'S REPORT

The following is a summary of the "new" metric topographic quadrangle maps to date. They are not found on the USGS Index to Topographic Maps of New Hampshire and Vermont of February 1, 1986. They are 7.5 minute quadrangles with metric contours (6 meter interval), 1:24,000. All are 1986 provisional maps with the exception of Jacksonville, VT which is 1987 provisional.

Quadrangle Name	quadrant of	previously mapped 15 minute map
Bakersfield, VT	SE	Enosburg Falls, VT
Irasburg, VT	SE	Irasburg, VT
Johnson, VT	NW	Hyde Park, VT
Morrisville, VT	SE	Hyde Park, VT
Sterling Mountain, VT	SW	Hyde Park, VT
Westmore, VT	SE	Memphremagog, VT
Enosburg Falls, VT	NE	Enosburg Falls, VT
Newport, VT	NW	Memphremagog, VT
Richford, VT	NW	Jay Peak, VT
Sheldon Springs, VT	NW	Enosburg Falls, VT
West Charleston, VT	NE	Memphremagog, VT
Cold Hollow Mtns., VT	SW	Jay Peak, VT
Eden, VT	NE	Hyde Park, VT
Fairfield, VT	SW	Enosburg Falls, VT
Hazens Notch, VT	SE	Jay Peak, VT
Jamaica, VT	SE	Londonderry, VT
Londonderry, VT	NE	Londonderry, VT
Orleans, VT	SW	Memphremagog, VT
Peru, VT	NW	Londonderry, VT
Stratton Mtn., VT	SW	Londonderry, VT
Jay Peak, VT	NE	Jay Peak, VT
Mount Snow, VT	NW	Wilmington, VT
Newport Center, VT	NE	Irasburg, VT
North Troy, VT	NW	Irasburg, VT
Readsboro, VT	SW	Wilmington, VT
Albany, VT	NW	Hardwick, VT
Cabot, VT	NE	Plainfield, VT
Caspian Lake, VT	SE	Hardwick, VT
Craftsbury, VT	NE	Hardwick, VT
Crystal Lake, VT	NW	Lyndonville, VT
Lowell, VT	SW	Irasburg, VT
Lyndonville, VT	SE	Lyndonville, VT
Marshfield, VT	SE	Plainfield, VT
Plainfield, VT	SW	Plainfield, VT
Stannard, VT	SW	Lyndonville, VT
Sutton, VT	NE	Lyndonville, VT
Wolcott, VT	SW	Hardwick, VT
Woodbury, VT	NW	Plainfield, VT
Danby, VT	SW	Wallingford, VT
Mount Holly, VT	NE	Wallingford, VT
Wallingford, VT	NW	Wallingford, VT
West Dover, VT	NE	Wilmington, VT
Weston, VT	SE	Wallingford, VT
Jacksonville, VT	SE	Wilmington, VT



NEW TOPOGRAPHIC MAPPING

IN VERMONT

15 minute quadrangles
with new 7½ minute maps

A Enosburg Falls
B Jay Peak
C Irasburg
D Memphramagog
E Hyde Park
F Hardwick
G Lyndonville
H Plainfield
J Wallingford
K Londonderry
L Wilmington

15 minute quadrangles
7½ minute maps to come

w Island Pond
x Averill
y Burke
z Guildhall

The following publications are the result of some of the studies being conducted in the U.S.G.S./State Geologist Cooperative Landslide Project Report:

Baskerville, C.A. and Ohlmacher, G.C., 1987, Some slope movement problems in Windsor County, Vermont, 1984: U.S. Geological Survey Open File Report 87-349.

Lee, Fitzhugh T., 1988, Slope movements in the Cheshire Quartzite, Southwestern Vermont: U.S. Geological Survey Open File Report 88-20.

These Open File Reports may be ordered from the U.S. Geological Survey, Open-File Report Section, DFC Box 25425, Denver, CO 80225.

Also available are these Vermont publications which may be ordered from the Vermont Geological Survey, 103 So. Main Street, Center Building, Waterbury, VT 05676. Orders must be accompanied by full payment of $3.00 per bulletin + 4% sales tax.

DelloRusso, Vincent and Stanley, R.S., 1986, Bedrock Geology of the Northern Part of the Lincoln Massif, Central Vermont: Special Bulletin No. 8, Vermont Geological Survey, Agency of Natural Resources, Waterbury, VT.

Mehrtens, C.J. and Dorsey, R.J., 1987, Stratigraphy and Bedrock Geology of the Northwestern Portion of the St. Albans Quadrangle and the Adjacent Highgate Center Quadrangle, Vermont: Vermont Geological Survey Special Bulletin No. 9, Vermont Geological Survey, Agency of Natural Resources, Waterbury, VT.

ARTHUR KEITH'S GEOLOGIC WORK IN VERMONT: AVAILABLITY OF HIS FIELD WORK

Paul Washington

Arthur Keith (1864-1944) spent many years working on the geology of Vermont and had a major impact on geologic thinking in the western part of the state. Most of his findings, however, were published only in summary (Keith, 1928, 1932, 1933a) or abstract (Keith, 1912, 1913, 1914, 1917, 1922, 1933b) form. Only his paper on the Burlington area (Keith, 1923) presents a reasonably detailed view of his work there. The rest of his work remains locked away in his field notes.

From an historical perspective, Keith was a highly respected and experienced field geologist when he started his field work in Vermont. One of the original geologists of the Appalachian division of the U.S.G.S., he did much of the basic mapping of the Blue Ridge of Tennessee, North Carolina, and Georgia and participated in studies of much of the central and southern Appalachians. In the reorganization of the survey around 1907, he was made chief of the Section of Areal and Structural Geology. Part of this job entailed reviewing folios prior to approval for publication. It happened that the Fort Ticonderoga (Vt.-N.Y.) and Taconic (Vt.-Mass.-N.Y.) folios were among those he reviewed early on. In his attempt to verify and correct these folios, he began his work in Vermont.

He started with a detailed study of the structure in and adjacent to the north end of the Taconics (U.S.G.S. Ann. Rpts. 30 [1909],p. 200; 31 [1910]. p. 219) supplemented by field conferences with T.N. Dale and L.M. Prindle (see U.S.G.S. Ann. Rpt. 32 [1911], p. 276-277) who were working on the Fort Ticonderoga and Taconic folios, respectively (this was also the period Dale conducted his detailed studies at Hyde Manor [Dale, 1912, 1913, 1929]). Keith continued his work on the Taconics and related problems in western and southern Vermont (U.S.G.S. Ann. Rpts. 33 [1912], p. 283; 34 [1913]. p. 347; 35 [1914], p. 370-371; 36 [1915], p. 509-510; 37 [1916], p. 444-445; 38 [1917], 443-444), with a minor diversion into glacial shorelines, until World War I caused the work here to be suspended (U.S.G.S. Ann. Rpt. 38 [1919], p. 567). Ostensibly, all of this work was aimed at "solving certain intricate problems there before the western Vermont folios can be published" (U.S.G.S. Ann. Rpt. 37 [1916], p. 445). Incidentally, these folios were never published; Prindle's work on the Vt.-Mass.-N.Y. border area was published independently (Prindle and Knopf, 1932) and the Fort Ticonderoga work (including the Brandon and Castleton quadrangles and the eastern portions of the Ticonderoga and Whitehall quadrangles) was partially incorporated into various papers by Dale, Keith, Ulrich, and others, but never released in map form by the survey (the originals [Dale, unpubl.] still exist).

After the war, records of Keith's work become difficult to find, Although he initially claimed to be preparing a "report on the structure of the Taconic range, Vt." (U.S.G.S.

Ann. Rpt. [1920], p. 84) he obviously turned his attention northward since his work on the Burlington area is the next thing to appear. Unfortunately, the Taconic paper was never published. He obviously continued working in Vermont around his other duties since his publications on the area continued and we have dates from his field notes into late 1934 (Ticonderoga Quad. notes). During his work in Vermont he covered the western part thoroughly and reconnaissanced much of the rest of the state. By the mid-1930's, he had begun to turn his attention toward Quebec (Keith 1936, 1938), using his experience in Vermont as a base. During the '20s and '30s he also began synthesizing his work in the Appalachians and establishing his own tectonic views (see Keith, 1928). The last word we have of his work, other than the memorials following his death (Stose, 1944; Swinnerton, 1944; Visher, 1944; Larsen, 1945), is Cady's (1945, p. 519) acknowledgment that he "examined" Keith's "numerous maps and field notes in advance of publication". Unfortunately, publication never followed although some of his maps were definitely prepared for submission.

Since Keith's death, his work has been mostly forgotten, mainly because it was inaccessible and was superceded by Cady's (1945) and Zen's (1961) work. In the course of my own work on the Middlebury area, I discovered that his field notes still exist in the Field Records Division of the U.S.G.S. Library in Denver. After reviewing the notes and maps, I find that he differed substantially with Cady's and Zen's work. Although I do not always agree with his conclusions, I often find them more tenable than those of later workers. Whatever you feel about his conclusions, however, his notes are extremely detailed and contain many valuable observations. In addition, they provide a much more detailed view of the basis for his conclusions and allow us to more carefully assess his contributions.

ARTHUR KEITH'S NOTES AND MAPS

available at: U.S. Geological Survey Library
Field Records Office
Box 25046, Mail Stop 914
Denver Federal Center
Denver, Colorado 80225
(303) 236-1005

Brandon, Vermont Quadrangle Maps: geology by Arthur Keith; USGS Field Records, Envelope 5369.

contents: 15' base maps with detailed notes;
Enlargements at 1:14000 with detailed notes;
A few notebook pages detailing the Taconic boundary in southwestern Brandon and adjacent Sudbury.

dates: none.

Burlington, Vermont, Quadrangle Maps; Notes by Arthur Keith:
USGS Field Records, Envelope 5370.

contents: 15' base maps with detailed notes;
Enlargements at 1:14000 with detailed notes.

dates: none

Middlebury, Vermont, Quadrangle Maps; Notes by Arthur Keith:
USGS Field Records, Envelope 5371.

contents: 15' base map with detailed notes;
Enlargements at 1:14000 with detailed notes.

dates: none.

Rutland, Vermont, Quadrangle Maps; Notes by Arthur Keith:
USGS Field Records, Envelope 5347.

contents: 15' base map with detailed notes;
Enlargements at 1:14000 with detailed notes.

dates: none.

Ft. Ann, N.Y.-Vt.; Enosburg Falls, VT., Willsboro, N.Y.-Vt.;
Port Henry, N.Y.-Vt.; Hyde Park, Vt.; Rochester, Vt.;
Montpelier, Vt.; Camels Hump, Vt.; Lincoln Mtn., Vt.;
Mt. Mansfield, Vt.; quadrangle maps with notes by Arthur
Keith:
USGS Field Records, Envelope 5385.

contents: 15' base maps with notes (detailed notes on portions of Port Henry, Enosburg Falls, and Ft. Ann quads.; others are reconnaissance);
Enlargements at 1:14000 of NE 1/4 of Ft. Ann quad. with detailed notes.

dates: none

Quadrangle maps: Randolph, Vt.; Barre, Vt.; Woodbury, Vt.;
Saxon's River, Vt.; Ludlow, Vt.; Woodstock, Vt.;
Brattleboro, Vt.; Keene, N.H.; Hanover, N.H.-Vt.;
Milford, N.H.; Peterboro, N.H. Notes by Arthur Keith:
USGS Field Records, Envelope 5386.

contents: 15' base maps with notes (reconnaissance).

dates: none

Berlin-Greylock (Mass.-N.Y.); Hoosick-Bennington (N.Y. & Vt.)
quadrangle maps. Notes by Arthur Keith:
USGS Field Records, Envelope 5388.

contents: 15' base maps of Bennington quad. with geologic contacts and a few notes.
15' base map of Hoosick quad. with geologic contacts and many notes.
15' base map of Greylock quad. with geologic contacts and many notes. Enlargements at 1:14000 of Hoosick, Greylock and Berlin quads. with detailed notes (need magnifying glass for some portions).

dates: none

Whitehall, Vt. and N.Y., quad maps. Notes by Arthur Keith: USGS Field Records, Envelope 5392.

contents: 15' base map with geologic contacts and notes; Enlargements at 1:14000 of most of east half with detailed notes.

dates: none.

Ticonderoga, Vt.-N.Y., quad. maps. Notes by Arthur Keith: USGS Field Records, Envelope 5393.

contents: 15' base map (east half only) with geologic contacts and notes.
Enlargements at 1:14000 of east half with detailed notes.

dates: 1934.

Castleton, Vt.-N.Y., quad. maps. Geology by Arthur Keith (Marked A.C. Swinnerton):
USGS Field Records, Envelope 5394.

contents: Enlargements at 1:14000 with detailed notes (appear to be transcribed versions of those in 5395).

dates: none.

Castleton, Vt.-N.Y., quad maps. Geology by Arthur Keith: USGS Field Records, Envelope 5395.

contents: 15' base map with geologic contacts and notes.
Additional NW 1/4 of 15' map.
Enlargements at 1:14000 with detailed notes.
Some loose notebook pages.

dates: on maps - 1914; on notebook pages - 1915.

Also available are manuscript copies (both rough and "final" drafts) of geologic maps of the Burlington, Middlebury (including Snake Mountain in the Port Henry Quad.), Brandon and Castleton 15' Quadrangles, all at 1:62500. For each quadrangle there is a colored and uncolored version (the two versions do not quite agree in many of the more complex areas). These are all stored together in a single roll; no bibliographic citation is yet available.

REFERENCES CITED

Cady, W.M., 1945, Stratigraphy and structure of west-central Vermont: Geological Society of America Bulletin, v. 56, p. 515-587.

Dale, T.N., unpublished, Fort Ticonderoga folio: bedrock geology of the Brandon, Vt. and Castleton, Vt., 15' quadrangles and the Paleozoic rocks of the Ticonderoga, Vt.-N.Y., and Whitehall, Vt.-N.Y. quadrangles.

——, 1912, The Ordovician outlier at Hyde Manor in Sudbury, Vt.: American Journal of Science, 4th ser., v. 33, p. 97-102.

——, 1913, The Ordovician outlier at Hyde Manor in Sudbury, Vt. (Second paper): Ibid., 4th ser., v. 36, p. 395-398.
——, 1929, The Ordovician outlier at Hyde Manor in Sudbury, Vt. (third paper): Ibid., 5th ser., v. 17, p. 521-524.
Keith, Arthur, 1912, New evidence on the Taconic question: Geological Society of America Bulletin, v. 23, p. 720-721.
——, 1913, Further discoveries in the Taconic Mountains: Ibid., v. 24, p.680.
——, 1914, A Pre-Cambrian unconformity in Vermont: Ibid., v. 25, p. 39-40.
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RECENT PUBLICATIONS

The Maine Geological Survey has two new publications available. The Second Edition of the Ground Water Handbook for the State of Maine by W.B. Caswell costs $5.00 plus $.25 sales tax, and reprints of the November/December issue of Rocks & Minerals magazine which features Maine minerals and mineral localities costs $4.00 plus $.20 sales tax. Checks payable to "Treasurer, State of Maine" should be sent to: Maine Geological Survey, Department of Conservation, State House Station 22, Augusta, Maine 04333.

The New York State Museum is offering the first in a Software Series, Electronic Bedrock Map of New York State by James R. Albanese. It is a graphic and text data base designed for the Apple II family of computers which uses color display and joy stick to teach important facts about New York State's geology and map skills. Condensed from the New York State Geological Survey's Bedrock Map, it provides location name, county, composition, chronological age and geological age of bedrock deposits and physiographic province for 259 data points. The cost is $15 postpaid, payable to "New York State Museum Sales". Send orders to: New York State Museum, Publication Sales, 3140 CEC, Albany, NY 12230.

MEETINGS

FEB 13 — **WELL DRILLERS' WORKSHOP**
Topics at this year's meeting will include screened wells and pump yields from bedrock wells. The meeting will be held at Vermont Technical College in Randolph, VT and will start with coffee and donuts at 9:00 A.M, the sessions running from 9:30 A.M. to about 4:30 P.M. For further information call Jim Ashley at (802)+244-5638.

FEB 20 — **VGS WINTER MEETING**
Details on Page 3 of this issue.

APR 30 — **VGS SPRING MEETING**
Presentation of student papers at University of Vermont. Details in Spring GMG.

OCT 8 — **VGS FALL MEETING**
Details of annual meeting to appear in the Fall GMG.

UNIVERSITY OF VERMONT GEOLOGY DEPARTMENT
SPRING 1988 VISITING LECTURE SERIES

Lectures will be held in Perkins Building, Room 200 at 3:45 PM. For further information, contact Dr. Rolfe Stanley, Geology Department , University of Vermont, Burlington, VT 05405, (802)+656-3396.

FEB 22 — Prof. Neil Lundberg, Princeton University
Structural Features in Modern Subduction Zones: Implications for Mountain Belts.

FEB 29 — Prof. Michael Williams, University of Massachusetts
The Proterozic Ortega Terrane: Heterogeneous Deformation and Homogeneous Metamorphism.

MAR 24-25 — Prof. Richard Parizek, Pennsylvania State University
SHORT COURSE - Principles of Hydrogeology as Revealed in Case Studies.
Please call the number above to reserve your place at this event.

APR 4 — Prof. James Head, Brown University
Plate Tectonics on Venus?

APR 18 — Prof. James Kramer, McMaster University
Chemical Characterization of Organic-Rich Lakes

APR 22 — Prof. Gary Ernst, University of California, L.A.
Metamorphic and Crustal Evolution of the Western United States.

MIDDLEBURY COLLEGE GEOLOGY DEPARTMENT
SPRING 1988 SEMINAR SPEAKERS

All seminars will be held in Science Center Room 420 at 4:00 PM. For further information contact the Geology Department (802)+388-3711.

FEB 18 — Dr. Paul Karabinos, Williams College
Tectonic significance of basement/cover relationships in the Green Mountain Massif.

MAR 2 — Dr. Kevin Furlong, Pennsylvania State University
Earthquakes and the Evolution of the San Andreas Fault.

MAR 10 — Dr. Mike Williams, University of Massachusetts, Amherst
Proterozoic geology of New Mexico and Arizona: a cross-section of an orogeny.

MAR 17 — Dr. Jim Reynolds, Norwich University
The Rise of the Central Andes: Constraining the onset of uplift in Argentina using magnetostratigraphy.

MAR 24 — Dr. Shiela Seaman, Colgate University
Magma evolution and caldera volcanism in the Gila Wilderness, southwestern New Mexico.

APR 7 — Dr. Dave Westerman, Norwich University
Constraints on the Tectonic History of Central Vermont as imposed by the geology along the Richardson Memorial Contact.

APR 12 — Dr. Roger Alexander, AAPG Distinguished Speaker, Chevron
World Petroleum needs for geology, geophysics and interdisciplinary analysis: today and tomorrow.

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