THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

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Nothing unlucky about 13! This is our biggest spring meeting yet with 6 New England colleges represented. Twenty-three student papers will cover the topics of tectonics, petrology, stratigraphy and sedimentation. Come join us at:

VGS' THIRTEENTH ANNUAL

Presentation of Student Papers

Saturday, APRIL 26, 1986 8:00 A.M.

Angell Lecture Center

University of Vermont Burlington

EXECUTIVE COMMITTEE meets at noon. Come with your lunch.

DIRECTIONS: Park in the lot located between the Fleming Museum and Ira Allen Chapel on the UVM campus (enter from Colchester Avenue one block west of the Medical Center Hospital). Walk south around the Votey Engineering Building to Angell Lecture Center - the cantilevered building.

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PRESIDENT'S LETTER

On behalf of the Executive Committee, I would like to take this opportunity to thank all of our members who contributed to the great turnout at our Winter Meeting at Norwich University. Despite the significant time overrun (of which I take the blame), the meeting went very well. I think that the general interest and the wide variety of topics that were discussed kept everyone glued to their seats right up to the end.

Before we know it, we are now gearing up for the Spring Meeting to be held at University of Vermont on April 26. As most of you are probably aware, this forum will provide the opportunity for the students from various institutions throughout New England to present their latest research findings. I would encourage you all to attend and lend support to their efforts.

Likewise, the Executive Committee will be meeting during the lunch hour to discuss VGS business. I need not say that your input would always be welcomed and appreciated. If you cannot attend, feel free to drop a line with your suggestions.

Steve Goldberg

VGS BUSINESS & NEWS

WINTER MEETING REPORT

The 1986 Winter meeting attracted the largest audience ever for a Vermont Geological Society meeting. Among the 70 persons attending were students, academics, consultants and government workers, all interested in water quality in Vermont. Steve Goldberg is to be commended for arranging a varied and interesting symposium in somewhat less time than past presidents usually have had for the Winter Meeting.

Jonathan Lash, Commissioner, Department of Water Resources and Environmental Engineering, set the stage, putting into perspective the problems met in controlling water quality, and presenting a detailed history of water quality legislation in Vermont. His admitted lawyer's viewpoint was most refreshing in contrast with the more exacting details with which the hydrogeologist must view the problems. If it is at all possible, we shall present Mr. Lash's historical perspective of water quality legislation in Vermont in a future GMG for those who missed it.

Thanks to Norwich University's Dave Westerman and Fred Larsen for providing coffee and donuts, even if they were consumed in record time when a flood of people appeared!

[VGS Business & News continues on page 20.]

COFFEE AND DONUTS 7:45

MORNING SESSION: Barry Doolan, Convener

Tectonics and Petrology

1. John Hill: Transitional greenschist-amphibolite facies metamorphism in the Barnard Volcanics 8:00
2. Anette Filosof: The geochemistry of Precambrian dikes near Ripton, Vermont and implications for the tectonic evolution of Vermont 8:20
3. Robert Masinter: Petrology of Hazens Notch and Pinney Hollow greenstones 8:40
4. Hugh Rose: Paleozoic stratigraphy, structure, and metamorphism of metavolcanics and metasedimentary rocks of the Jeffersonville area, Northern Vermont . . 9:00
5. Mimi Boxwell: Metamorphic history of the Standing Pond Volcanic Member of the Waits River Formation, Southeastern, Vermont 9:20
6. Bruce Genereaux: Structure and deformation of the Cambrian schists of the Hoosac Formation, Middlebury College Snow Bowl, Hancock, Vermont . . . 9:40

BREAK 10:00

7. Thornton Tyson: The metamorphic history of the Middlebury College Snow Bowl 10:10
8. Elizabeth Spahr: Deformational fabrics in the Hoosac and Pinney Hollow formations, central Vt. . . . 10:30
9. Margaret Coleman: Kinematic interpretation of Pinney Hollow shear zone, central Vermont 10:50
10. Edward Hawkins: Tectonic slices of the Stamford-Heartwellville-Readsboro area, Southern Vermont . . . 11:10
11. Jill Schneiderman: Breccia inclusions at Little Ascutney Mountain, Vermont--A Geologic Skylight . . . 11:30
12. Beckie Fuller: Geochemistry of the Kjosen Formation, Arctic Norway 11:50

LUNCH (Executive Committee meets) 12:10

AFTERNOON SESSION: Peter Goreau, Convener

13. Nathan Burt: Structural constraints on Champlain thrust sheet deformation, Snake Mountain, Vermont . . 1:00

Stratigraphy and Sedimentation

14. Hugh Klein: Stratigraphic analysis of the Cambrian sequence in Sucker Brook, Middlebury, Vermont 1:20
15. Closey Dickey: Depositional environment of the Monkton Formation, Snake Mountain, central Vermont . . 1:40
16. David MacLean: Storm controlled deposits of the Glens Falls Formation, Champlain Valley, VT and NY . . 2:00
17. Ron Parker: Paleoenvironmental synthesis of the Deschambault Limestone (Lower Trenton) of South-eastern Quebec: A storm dominated ramp 2:20
18. Alisa Borre: Internal sources of phosphorus in Shelburne Pond, Vermont 2:40

BREAK 3:00

19. William Stockwell: The Beekmantown Group in the Champlain Valley: An historical perspective 3:10
20. Lansing Teal: Growth patterns and fluorescent banding in <u>Montastrea annularis</u> from Jamaica, W.I. . . 3:30
21. Alexander Walker: Sedimentology of the Rio Bueno, Jamaica, West Indies 3:50
22. Ivar Montbatten: Reef and sediment distribution on the north coast of Jamaica 4:10
23. Michael Wood: The comparison of Middle Ordovician reefs on Isle La Motte with Pleistocene reefs of northern Jamaica 4:30

AWARD OF PRIZES AND TROPHY: Steve Goldberg 5:15

ABSTRACTS

INTERNAL SOURCES OF PHOSPHORUS IN SHELBURNE POND, VERMONT

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Shelburne Pond, a University of Vermont Natural Area located in Northwestern Vermont, is a shallow, eutrophic lake suffering from nuisance algal blooms and abundant rooted macrophyte growth. External flux of nutrients to the pond is limited during summer months by the uptake in surrounding bogs and reduced stream flow, suggesting that potential internal sources exist. The purpose of this study is to determine whether internal sources of phosphorus (P) are significant during low water, high demand periods. Two possible sources were evaluated: (1) recycling of P in the water column, and (2) release of P already incorporated into the sediments.

Water column, sediment trap, and sediment core samples were analyzed for various forms of extractable, particulate associated phosphorus including: inorganic P (HCl-P and NaOH-P); organic P; and total P. The flux of seston and corresponding P fractions to the sediments was measured in a sediment trapping program. Additional water column data include: pH, temperature and secchi disc readings. Total phosphorus concentrations in the sediment cores were less than that of the sediment traps while the contemporary seston in the water column exhibited the widest range of values and also the largest concentrations of P based on dry sediment weight.

At the end of July, particulate concentrations in the surface water reached a maximum of 56.4mg/L while secchi disc transparency dropped as low as 0.5m and pH values ranged from 9.2 - 9.4, indicating that an major algal bloom was taking place. In mid-August the bloom died with a concommitant decrease in pH to summertime lows of 7.3 - 7.5. Oxygen depletion caused by consumption associated with algal decomposition resulted in a major fish kill. After a two week lag time, the settling out of particulate material was recorded in the lower sediment trap when average sediment flux rates reached a maximum.

Sedimentation rates ranging from 8.8 - 28.6 mg/m^2-day as determined by trap studies indicate that resuspension is a dominating factor in particulate distribution within the water column. Biologically available P (e.g. NaOH-P) associated with particulates ranges from 0.45 - 1.51 ug/mg implying that resuspension is involved in the internal cycling of phosphorus. In addition, elevated pH values observed in the pond fall well within the range needed to enhance P exchange.

METAMORPHIC HISTORY OF THE STANDING POND VOLCANIC MEMBER OF THE WAITS RIVER FORMATION, SOUTHEASTERN VERMONT

Boxwell, Mimi A., Department of Earth Sciences, James Hall, University of New Hampshire, Durham, N.H. 03824

Three metamorphic events (M1,2,3) are identified in mafic schists of the Standing Pond Volcanics (SPV) in the Claremont, Bellows Falls and Saxtons River quadrangles in southeastern Vermont. Contrary to the isograd pattern on the Centennial Geologic Map of Vermont (Doll and others, 1961) the dominant metamorphism, M2, gradually increases from east to west as indicated by a gradual increase in Na(M4) and Al(VI) + Fe3+ + 2*Ti + Cr in amphibole composition. In the east, M2 greenschist facies metamorphism is identified by the assemblage chl + epi + alb + amp of composition Actinolite to Magnesio-hb using the terminology of Leake (1978) and is intercalated with chl and biot grade pelitic rocks. To the west, intercalated with biot and gar grade pelitic rocks, epi-amp facies assemblages contain amp (classified as Tschermakitic hb to Alumino-Tschermakite) + chl + epi + alb +/or olig. The olig isograd is well constrained within the epi-amp facies zone indicating that M2 was a medium P facies series event as amp composition changes from act to hb at lower grade than plagioclase changes from alb to olig. M2 amp grains are commonly aligned parallel to F2 fold axes suggesting that M2 occurred contemporaneously with F2 (which produced the dominant schistosity in the rocks).

M1 is identified by amp cores of different optical orientation than M2 amp rims. Inclusion trails within M1 amp cores are inconsistent with the F2 schistosity suggesting that M1 outlasted an F1 folding event. M3 is characterized by local replacement of M2 amp by chl, biot, felsic minerals and carbonate and by chl and biot pseudomorphs of gar. M3 appears to post-date all deformation as evidenced by alignment of biot and chl grains parallel to relict amp cleavage planes.

The metamorphic sequence observed is similar to that described by Rosenfeld (1968) for the SPV in the study area, and the M2 event may be correlative to the second prograde event of the Jamaica, VT area reported by Karabinos (1984). Also, the olig isograd reported here may be a continuation of the olig isograd observed in Cambro-Ordovician rocks west of the Chester and Athens domes mapped by Laird and Albee (1981).

act=actinolite; alb=albite; amp;amphibole; biot=biotite; chl=chlorite; epi=epidote; epi-amp=epidote amphibolite; gar=garnet; hb=hornblende; olig=oligoclase; P=pressure

STRUCTURAL CONSTRAINTS ON CHAMPLAIN THRUST SHEET DEFORMATION, SNAKE MOUNTAIN, VERMONT

Burt, Nathan C., Department of Geology,
Middlebury College, Middlebury, VT 05753

Structural elements of the Cambrian Monkton Formation in the upper plate of the Champlain Thrust at Snake Mountain were analyzed to constrain thrust sheet geometry. The Monkton quartzites, dolomitic sandstones and shales are thrust over mid-Ordovician Bridport Dolostone in the field area. The Champlain Thrust, which transports Middlebury Synclinorium shelf deposits westward, is part of a belt of thrusting extending the north-south length of Vermont and known as Logan's Line. The thrust plane at Snake Mountain strikes N30E and dips 6E according to three-point analysis.

Structural features suggestive of east-west shortening are north-trending, west-verging, asymmetric open folds. West limbs of folds are near vertical and form ridges on the eastern dip slope of Snake Mountain. The western cliffs bounding north Snake Mountain expose vertical beds of the west-verging folds as well. Prominent jointing patterns in the lower Monkton Quartzite are consistent with east-west principal stress directions. Crenulation folding and intraformational thrusting associated with flexural slip are small-scale manifestations of the shortening event.

North-trending high-angle normal faults cross-cut older compressional features at central Snake Mountain. Vertical displacements are generally less than 2 m, but may be as great as 20 m.

Anomalous structures include an isoclinal north-verging fold in a dolomitic sandstones layer near good exposure of the dominant west-verging folding. There is also a small thrusting feature showing north over south displacement on the order of centimeters in a thin competent quartzite band within a shaly sandstone.

KINEMATIC INTERPRETATION OF PINNEY HOLLOW SHEAR ZONE, CENTRAL VERMONT

Coleman, Margaret E., Department of Geology,
Middlebury College, Middlebury, Vt., 05753

Mylonitic rocks of the Pinney Hollow and Hazens Notch slice have been examined from five outcrops along a 10-mile stretch of the Mad River on the east side of the Green Mountain Anticlinorium in west-central Vermont. These mylonites occur within what is interpreted to be the root zone for the westerly transported slices of the Taconic Allocthon.

In this region the Pinney Hollow and Hazens Notch formations occur as semi-pelitic greenschists. They are well foliated and highly recrystallized mylonites with compositional layering parallel to the dominant schistosity. Stretching lineations, mineral lineations and hinge lines of reclined folds plunge 65 east, down the dip of the prominent foliation.

Synkinematic asymmetric albite porphyroblasts, pressure shadows, and shear bands in micaceous layers are used to deduce the sense of shear in the mylonite zone. Eighty percent of the kinematic indicators require the upper plate to have been displaced to the east relative to the lower plate. Evidence of flattening within outcrops and thin sections cut perpendicular to the prominent mineral lineation reveals a significant pure shear component of strain within the fault zone.

The growth of stilpnomelane and albite is synchronous with and post-dates the growth of biotite and chlorite in the shear zone. Peak metamorphic conditions at the time of thrusting are estimated to have been in the middle to upper pressure-temperature field of the greenschist facies. Late metamorphic displacement and associated strain within the shear zone is believed to have occurred some time after the Late Ordovician peak of regional metamorphism.

DEPOSITIONAL ENVIRONMENT OF THE MONKTON FORMATION, SNAKE MOUNTAIN, CENTRAL VERMONT

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Stratigraphic relations in the Lower Cambrian Monkton Quartzite of Snake Mountain were analyzed to determine the depositional environment of the red and white sandstones, sandy dolostones and mudstones. Three measured sections were subdivided into four lithofacies, which have been interpreted as various sub-environments within a marine tidal environment.

Lithofacies A is a white, coarse-grained, well-sorted, supermature quartz arenite. The large sets of cross-stratification associated with this lithofacies suggest that it was deposited in a subtidal environment.

Lithofacies B is characterized by sandy dolomite beds with occasional interbeds of white quartz arenite. This unit's algal laminations and dessicated surfaces indicate that it was deposited in a low to middle tidal flat environment during periods of low terrigenous sediment supply.

Lithofacies C is dominated by red feldspathic sandstone and thin interbeds of white quartz arenite. Sedimentary structures include small-scale cross-lamination, channel scours, flaser bedding, tidal bedding, mudcracks and ripple marks. The composition and sedimentary features associated with lithofacies C indicate that it was deposited in a low to middle tidal environment during periods of high terrigenous sedimentation.

Lithofacies D is composed of cyclic alternations between coarse-grained immature sandstone and mudstone beds. The immaturity of the sandstone and its gradational association with wavy horizontally bedded mudstone suggest that this lithofacies was deposited in a fluvial environment above the tidal range.

Thin sections showed bimodality as a characteristic of some of the sandstones. Point counts determined that the sandstones were 80-90% quartz and 10-20% feldspar with minor amounts of accessory minerals.

THE GEOCHEMISTRY OF PRECAMBRIAN DIKES NEAR RIPTON, VERMONT AND IMPLICATIONS FOR THE TECTONIC EVOLUTION OF VERMONT

Filosof, Anette, Department of Geology,
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Greenstone samples from 3 parallel dikes cutting the Precambrian Mt. Holly Complex near Ripton, Vermont (referred to as I, II, III from south to north) were analyzed geochemically to determine their original tectonic environment. The samples are all characterized by low-grade greenschist facies metamorphic assemblages of albite -epidote -chlorite -biotite with Fe-Ti oxides, apatite, sphene and occasional quartz, calcite, actinolite, and rutile, An electron microprobe and XRF machine were used to obtain major and trace elements, respectively.

The dikes have distinctive occurrences in the field. Dike I is a massive greenstone with biotite porphyroblasts; Dike II is a fine-grained biotite-rich rock with clear intrusive contacts with the country rock; Dike III contains large feldspar phenocrysts.

The geochemistry of the 3 dikes was examined. These rocks are characterized by very high TiO2 and P2O5 contents. The geochemical trends of the 3 dikes considered collectively seem to describe the Ripton greenstones as a transitional continental basalt enriched in TiO2, P2O5 and alkalis. Major element discriminant diagrams indicate the greenstones are continental basalts but fail to classify them as either tholeiitic or alkalic basalts. Trace element discriminant diagrams indicate that these are clearly within plate basalts that are transitional (Y/Nb >>2) and have retained some characteristics of alkali basalts.

Geochemical and structural comparisons of the Ripton greenstones with other Vermont greenstone and with other Appalachian greenstones imply that the Ripton greenstones were emplaced during the late Precambrian rifting event that produced the proto-Atlantic Ocean. It is proposed on geochemical and structural bases that the intrusion of the Ripton greenstones are related to the incipient Hadrynian St. Lawrence paleo-rift system to the northwest.

GEOCHEMISTRY OF THE KJOSEN FORMATION, ARCTIC NORWAY

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The Lyngen Nappe is one of seven nappes in Arctic Norway. Of oceanic origin, the Lyngen Nappe contains four formations, including the Lyngen Gabbro and the Kjosen Formation (a chlorite mica schist with felsic and mafic intrusions). The Kjosen Formation lies in structural contact below the Lyngen Gabbro. The Kjosen Formation has previously been mapped as a tectonic wedge of the Lyngen Gabbro. The data from this study supports a new theory (Furnes and others, 1979; Minsaas and Sturt, 1981) of the Kjosen Formation as the sheeted dike complex of a dismembered ophiolite.

Numerous other dismembered ophiolites have been mapped in Norway. Sturt and others (1984) classified Norwegian ophiolites into two groups, one with Finnmarkian and Scandian deformation, the other only Scandian deformation. The Lyngen ophiolite (the Kjosen Formation plus the Lyngen Gabbro) shows evidence of Finnmarkian and Scandian deformation.

Major and trace element data from 15 dikes of the Kjosen Formation show these intrusions are similar in composition to ocean- floor basalts and low-K tholeiitic basalts. On tectonic variation diagrams (e.g., Ti-Zr-Y, FeO-MgO-Al2O3, TiO2-MnO-P2O5), the dikes plot in similar fields as the Lykling and Leka ophiolites of southern and west-central Norway. This suggests that the Kjosen Formation has a similar origin as these ophiolites: that of a back-arc basin.

STRUCTURE AND DEFORMATION OF CAMBRIAN SCHISTS OF THE HOOSAC FORMATION, MIDDLEBURY COLLEGE SNOW BOWL, HANCOCK VERMONT.

Genereaux, Bruce M., Department of Geology,
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Middle to lower cambrian schists of the allochthonous Hoosac Formation, located four and one half miles east of Ripton, were studied to analyize their structure and deformational history. Three lithologies are mapped: 1) A dark green amphibole - epidote - albite - greenstone. 2) A green to dark green chlorite - muscovite - actionolite - albite - epidote - schist. 3) A silvery white quartz - muscovite - albite - metagreywacke. Field observations, as well as petrographic studies show compositional, gradational and faulted contacts between the above units. Three planar fabrics are recognized. S1, an early flattening foliation composed of chlorite, muscovite and albite. This fabric is folded to form an S2 crenulation cleavage. Associated map scale tight to isoclinal folds (F2), variably inclined to reclined in geometry are truncated by a thrust fault. Kinematic indicators along this fault indicate an upper plate to-the-east sense of shear. The fault is folded by asymmetric, west-verging buckle folds. Associated with these west-verging folds is a crenulation cleavage (S3). A late stage of amphibole growth occurs synchronous to post thrusting and suggests an increase in temperature during the last generation of folding. The correlation of these data with present models for the tectonic history of the Green Mountains is the final objective of this paper.

TECTONIC SLICES OF THE STAMFORD-HEARTWELLVILLE-READSBORO AREA SOUTHERN VERMONT

Hawkins, Edward F., Department of Geology and Geography, Boston College, Chestnut Hill, Massachusetts 02169

The Stamford-Heartwellville-Readsboro area in southern Vermont is comprised of four tectonic packages of rocks (slices). These slices from upper to lower are (1) the Hoosac Mountain (Vermont) slice (HMS), (2) the Heartwellville slice (HVS), (3) the Readsboro slice (RS), and (4) the Stamford thrust block (STB). HMS is separated from HVS and STB by the Hoosac Summit thrust (HST). HVS is separated from RS and STB by the Heartwellville thrust (HVT). HMS is comprised of dominantly metagraywackes, metashales, and metavolcanics, and is inferred to be a more distal (easterly) rift clastic sedimentary facies. HVS is comprised of dominantly marble bearing metashales and is inferred to be a more proximal rift clastic sedimentary facies. Both RS (east) and STB (west) contain middle Proterozoic basement rocks with an unconformable, rift clastic cover.

Three folding events and two garnet grade metamorphic events separated by a pervasive chlorite retrogression were recognized within HMS and HVT. Two folding events and two biotite grade metamorphic events wwere recognized within STB. Two episodes of folding and one garnet metamorphism was detected in RS.

TRANSITIONAL GREENSCHIST-AMPHIBOLITE FACIES METAMORPHISM IN THE BARNARD VOLCANICS

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Interbedded hornblende-chlorite amphibolite, muscovite-biotite schist, and quartz-rich gneiss in the Barnard volcanic member of the Mississquoi Formation were closely examined for petrographic indicators of temperature, pressure, and metamorphic grade.

Most samples show an initial foliation event accompanied by chlorite-zone greenschist facies metamorphism followed by a more intense deformation and overgrowth by epidote-amphibolite facies assemblages. The common succession of assemblages is chlorite +epidote +albite +quartz +K-mica +calcite +Fe oxide going to almandine +oligoclase +quartz +muscovite +calcite or hornblende +almandine +oligoclase +andesine +quartz +biotite +calcite. Late retrogradation from biotite zone to chlorite and muscovite zone greenschist facies is common with overgrowths of chlorite, calcite, and sericite.

The composition of 75 representative plagioclase grains from six polished mounts suggest transitional greenschist-amphibolite facies metamorphism. Biotite-garnet pairs in samples where albite (An 0-5) is the dominant feldspar give an average temperature of 378 C. However, in samples whose plagioclase compositions are An 20-45 (oligoclase-andesine), the average calculated temperatures range from 455 to 470 C.

Analyses of 50 amphiboles from four samples indicate a narrow range of calcic hornblende composition. Using methods after Laird (1984), amphiboles from the Barnard plot between the garnet and oligoclase isograds in the low to medium pressure zone. Oxide counts were recalculated for all-FeO and intermediate FeO/Fe2O3 values, and pressure determinations from formula proportion variation plots of Na(M4) against Al6+Fe3+2Ti+Cr were found to be sensitive to the partitioning of Fe on the M2 site and Na on the M4 site.

In summary, samples from the Barnard were metamorphosed at temperatures ranging from ~370 to 470 C under low to medium pressure conditions.

STRATIGRAPHIC ANALYSIS OF THE CAMBRIAN SEQUENCE IN SUCKER BROOK, MIDDLEBURY, VERMONT

Klein, Hugh E., Department of Geology,
Middlebury College, Middlebury, VT 05753

The Green Mountain Front forms a boundary between the Middlebury Synclinorium to the west and the Green Mountain Anticlinorium to the east. As currently mapped, an eastward traverse originating from the western shore of Lake Dunmore encounters Dunham Dolomite, Cheshire Quartzite, Forestdale Marble, Moosamaloo Phyllite, the Pinnacle Formation, and the Mount Holly Complex.

This study examines contacts of the Forestdale Marble, the Cheshire Quartzite, and the Dunham Dolomite at Lana Falls. The Forestdale/Cheshire contact of Osberg (1952) was mapped and examined in thin section. Sedimentary features, lithology, and structural relations all suggest that the contact is instead between Cheshire Quartzite and Dunham Dolomite. Faulting is suspected along the Green Mountain Front, but does not appear along this newly identified Cheshire/Dunham contact. However, the Cheshire/Dunham contact due west of the Middlebury Airport is faulted.

STORM CONTROLLED DEPOSITS OF THE GLENS FALLS FORMATION, CHAMPLAIN VALLEY, VERMONT AND NEW YORK

David A. MacLean, Department of Geology, University of
Vermont, Burlington, Vt. 05405

Storms were the major mechanism controlling sedimentation of the Glens Falls Formation (Middle Ordovician Trenton Group) in Vermont and New York. The Glens Falls Formation, composed dominantly of alternating limestone beds and thinner, shale interbeds, records deposition on a shallowly sloping ramp. Three storm processes dominated ramp sedimentation: 1.) powerful storm waves scoured shallow areas above storm wave base, 2.) unusually large storm surge ebb currents transported sediments into environments below storm wave base and 3.) storms triggered turbidity currents which moved downslope into deeper ramp environments.

Since these storm effects decrease towards deeper water, the resulting deposits can be classified on the basis of proximality. Four types of storm deposits are recognized in the Glens Falls Limestone. Ranging from most proximal to most distal these include: 1.) Amalgamated, channelized grainstones, packstones, laminated mudstones and occasional bryozoan bafflestones, 2.) proximal graded couplets containing whole fossil grainstones overlain by laminated and reworked fine grainstone, 3.) distal graded couplets containing basal abraded, sorted grainstone overlain by lime mud, and 4.) laminated mudstones.

Amalgamated beds represent multiple storm events occasionally punctuated by biostromal development. Couplets represent single storm events with lags representing the storm peaks and the overlying unit representing deposition during the waning of storm energy. Proximal couplets record a period of extensive storm winnowing followed by fine sand deposition from suspension. Distal couplets record a period of current transport and abrasion with the overlying muds representing sediment winnowed from more proximal environments. Laminated mudstones represent storm generated turbidity deposits emplaced below storm wave base.

Differentiating proximal and distal storm deposits facilitates basin analysis by providing a rough estimation of bathymetric position. Distal storm deposits are localized in the northern end of the basin suggesting that a south to north gradient developed during the Middle Ordovician. Deep water deposits in the northern part of the Champlain Valley may represent deposition on a down thrown fault block similar to those proven active during Trenton Group deposition in Central New York and Quebec.

PETROLOGY OF HAZENS NOTCH AND PINNEY HOLLOW GREENSTONES

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Whole rock major and trace element analyses have been completed on greenstone members of the Hazens Notch and Pinney Hollow formations. Greenschist facies metamorphism has replaced the original texture of the rocks. Thin section study shows a chlorite -epidote -albite primary mineral assemblage with minor actinolite, associated biotite, magnetite, and sphene. Quartz and calcite are present mainly in shear-related veins and patches. Greenschist facies minerals aligned with the dominant schistosity of the rocks are overgrown by post-kinematic epidote and Fe-Ti oxides. These phase relations suggest at least two metamorphic recrystallization episodes have occurred.

TiO2, P2O5, Zr, Y, and Nb are considered immobile during metamorphism and are used as petrologic discriminants. FeO, MgO, Al2O3, and MnO are moderately mobile and noted as such when used as discriminants. Major element geochemistry indicates all the greenstones are metabasalts. Y/Nb variations further classify these rocks as transitional to tholeiitic. On the basis of immobile trace element abundances, two types of greenstones are recognized. Hazens

Notch (HN) types generally contain more Ti, Y, and Zr than Pinney Hollow (PH) types. Furthermore, HN types appear to have been derived from a more differentiated magma than PH types.

Ti-Zr-Y, TiO2-MnO-P2O5, and FeO-MgO-Al2O3 ternary diagrams are utilized as discriminants of tectonic environment, and consistently indicate HN types to be within-plate tholeiitic basalts. PH types plot in the fields for ocean island and MORB tholeiites. The greenstones are believed to be volcanics associated with different stages of EoCambrian continental rifting.

REEF AND SEDIMENT DISTRIBUTION ON THE NORTH COAST OF JAMAICA

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The purpose of the study was to measure the distribution of reef and sediment cover of the fringing reef along the north coast of Jamaica.

Jamaica offers a wide variety of fringing reef environments that are influenced by a number of natural processes, such as river input, wave and current energy. Three sites, each approximately half a mile long, were chosen along the coast. Sites were chosen to represent the morphological variety existing, and extremes in the physical conditions influencing them.

The sites were mapped with the use of aerial photographs. They were then areally subdivided into the back reef lagoon, the reef crest, buttress zone, sand channels of the deep fore reef. In addition some of these areas were further sub-divided. The percentage cover was calculated by weighing cutouts of each zone.

It was found in the three sites, that the area of sand in the fore reef slope ranged between 21% to 41%, and that the thallassia beds in the back reef lagoon occupied 67% to 83% of the area. These variations are not suprising since each area has it's own unique characteristics which are responsible for the variety.

PALEOENVIRONMENTAL SYNTHESIS OF THE DESCHAMBAULT LIMESTONE (LOWER TRENTON) OF SOUTHEASTERN QUEBEC: A STORM DOMINATED RAMP

Parker, Ronald L., University of Vermont, Burlington, Vermont

The Deschambault limestone of Southeastern Quebec records the facies evolution of the storm dominated carbonate ramp of Early Trentonian Eastern North America.

Four lithofacies are defined 1.) Shallow subtidal mobile skeletal sands - Comprised of coarse biointrasparite and biosparite grainstones with abundant graded beds, intraclast horizons, preserved megaripple trains and horizontal, tabular and trough cross-laminations. Skeletal grains are broken and abraded. Conspicuously lacking are whole fossils, fine muds and a bioturbating infauna. Sediment was deposited as a highly mobile accumulation of skeletal debris near fair weather wave base. 2.) Shallow subtidal stabilized sands - This lithofacies is comprised of fine biosparite and muddy biosparite grainstones and lesser packstones characterized by comminuted skeletal grains micritized rinds and some lime mud. Infaunal reworking is ubiquitous and primary laminations are rare. Localized hard-grounds, chert nodules and slumpfold horizons indicate early dia-genetic alteration of sediments. This facies was deposited in lower energy subtidal depositional environments fringing mobile sands. Storms introduced sediments that were later reworked during long periods of stasis. 3.) Bryozoan bafflestones - This facies is characterized by interlaminated biosparmicrite packstones and bryozoan dominated calcareous shales. Beds are laterally continuous and are arranged in repetitive decimeter scale cycles. Packstones contain whole fossils, are extensively bioturbated and locally contain current features. Shales are matted with articulated arborescent bryozoans in life positions; now crushed by compaction. The sediments accumulated as the result of the baffling and substrate stabilizing capabilities of bryozoan communities. Storms introduced skeletal debris which was then populated by well-developed infaunal and epifaunal communities. This lithofacies was deposited in slightly deeper subtidal environments. 4. Deeper subtidal - This facies is characterized by interlaminated nodular biomicrite wackestones and non-fissile calcareous shales. Pinch and swell bedding, extensive bioturbation and occasional lenses of coarser grainstone and packstone "starved ripples" are typical. Nodularity is controlled by an interplay of original layering, infaunal reworking, early marine cementation and differential compaction. This lithofacies was developed in deeper water subtidal environments where ambient mud deposition was interrupted by upper-ramp sediment influx during storms.

The four recognized lithofacies suggest deposition on a shallow water,normal marine carbonate ramp characterized by high biologic productivity and rapid sediment generation. Facies disributions were primarily influenced by episodic high energy storm events overprinting long periods of normal weather sediment reworking. Syn-depositional fault block motion may also have been of consequence as a facies control.

PALEOZOIC STRATIGRAPHY, STRUCTURE, AND METAMORPHISM OF META-VOLCANICS AND METASEDIMENTARY ROCKS OF THE JEFFERSONVILLE AREA, NORTHERN VERMONT

Rose, Hugh S., Department of Geology, University of Vermont

The study area is situated along the western flank of the Green Mountain Anticlinorium (GMA), in the north central part of the Jeffersonville 7 1/2 minute quadrangle. Four distinct tectono-stratigraphic sequences are separated within the study area by mapping at a scale of 1:5000. They include: (1 undif-ferentiated carbonaceous, rusty muscovite-albite schists (Ha-zens Notch Formation); 2a) silvery-green, quartz-muscovite-chlorite+magnetite schist; 2b)chlorite-rich, silvery-green quartz-muscovite+magnetite schist (Underhill Formation); 3) a stratified pile of volcanic flows, ash falls and related sediments, characterized by a chlorite-biotite-albite-epidote-amphibole-sphene + carbonate assemblage; 4) well stratified clean white marbles, grading into dirty marbles and dolomites, which grade into a sequence of interbedded quartzites and black phyllites,(Ottauquechee Formation). Unit 1 is confined to the eastern part of the study area; units 2 and 3 to the central part and unit 4 to the western area. West dipping fault contacts are noted along the east contact of unit 4 and within the unit 2-3 stratigraphy.

The entire field area has undergone 3 periods of deformation and metamorphism. The first event (F1) (presumed early Taconian) produced tight east-west isoclinal folds. The second event (F2) (presumed later Taconian) produced north-south structures, east facing folds and steep reverse faults. The F2 event reached biotite grade. F3 correlates with the formation of the GMA and is associated with shallow plunging, open, north-south structures and a distinctive axial planar slip cleavage. F3 metamorphism was of chlorite grade and retrograded most of the field area.

Trace element geochemistry of unit 3 meta-volcanic rocks, shows that they were erupted as within plate basalts (Pierce and Cann, 1973). The unit 3 greenstones have similar chemistry to the metavolcanic rocks of the Tibbit Hill (TH) collected in this study and previously reported by Coish and others. The data suggests that the unit 3 rocks were emplaced during early stages of the rifting of the ProtoAtlantic continental margin. Lithic characteristics of the surrounding sedimentary rocks support this hypothesis. Petrological differences in the horizons of unit 3 are due in part to differences in response to metamorphism as well as variation in basalt chemistry.

The rocks of unit 4 lithically correlate to the Ottauquechee Formation. Unit 4 rocks, previously mapped as coring the "Cambridge Syncline" (Christman, 1959), appear to have a more complicated structural history. Unit 4 is interpreted to represent the lower plate of a west-verging(?) thrust fault of F1 age that decorated the contact with unit 3 greenstones. Refolding of the fault contact occurred during F2 time, rotating earlier formed planar surfaces into upward or steep east facing structures.

BRECCIA INCLUSIONS AT LITTLE ASCUTNEY MOUNTAIN, VERMONT - A GEOLOGIC SKYLIGHT

Schneiderman, Jill S., Harvard University,
Department of Geological Sciences, 24 Oxford Street, Cambridge, Massachusetts 02138

The Ascutney Mountain Intrusive Complex is one of three complexes in Vermont that belong to the White Mountain Magma Series. Occurring in southeastern Vermont, the complex intrudes Precambrian core rocks and mantling strata of the Chester Dome; it is adjacent to the Monroe line, a major boundary between two Acadian metamorphic terranes. The complex consists of Cretaceous (120 million years) gabbro-diorite, syenite and granite stocks and a prominent crescent-shaped syenite ring dike.

At least fourteen breccia masses occur as inclusions in the syenite ring dike. The breccia masses are comprised of a diverse array of angular rock fragments in a cataclastic matrix. Rock types represented as fragments in the breccias are: garnet cordierite schists (±corundum), garnet biotite schists, quartz cordierite gneisses, garnetiferous quartzites, schistose quartzites with graded bedding, biotite chlorite quartzites, amphibolites, calc-silicates and chert. Comminuted bits of the above-mentioned rock types constitute the cataclastic matrix.

The breccia masses are crush breccias and formed by breaking and consolidation of country rock in a ring fracture prior to emplacement of the ring dike. Bits of the breccia were then picked up by the intruding magma. Shallow emplacement depth estimates, constrained by the presence of annite in the syenite and andalusite in the contact aureole to be greater than 5.8km and less than 14.5km, are consistent with this model.

While some rock fragments in the breccia correlate with units immediately surrounding Ascutney, others, particularly the fragments displaying graded bedding, bear striking resemblance to units of the Devonian Littleton Formation observed in the metamorphic terrane east of the Connecticut River. As with fossiliferous Devonian limestone fragments found in the St. Helen's Island breccia of Mont Royal, Canada, the graded bed fragments in the Little Ascutney breccia may be remnants of rock units once pressent stratigraphically above the currently exposed terrane.

DEFORMATIONAL FABRICS IN THE HOOSAC AND PINNEY HOLLOW FORMATIONS, CENTRAL VERMONT

Spahr, Elizabeth D., Department of Geology, Middlebury College, Middlebury, VT 05753

Six outcrops in the Cambrian Hoosac and Pinney Hollow Formations, east of the Green Mountain anticlinorium, were examined to determine their structural style and metamorphic history. Three outcrops studied are in the upper structural section of the Hoosac, while three others exist in the lower portion of the Pinney Hollow. Structural analysis of planar, linear, and folded fabrics show evidence for at least three episodes of deformation. Where visible, the F1 folds are isoclinal folds. F2 folds are isoclinal and commonly reclined. F3 folds occur as asymmetric west-verging crenulations. Throughout the field area F2 folds are sheared, exhibiting features of flattening and rotation. At high strain gradients, axial planar F2 fabric is aligned with the L2 lineations.

The Hoosac formation is characterized by the assemblage: chlorite, muscovite, quartz, epidote, biotite, albite, and actinolite. In the Hoosac (Worth Mountain), the characteristic post-F3 mineral growth is chlorite, epidote, and muscovite. At a very high structural level in the Hoosac, late actinolite, muscovite, and biotite over-grow the S3 foliation. Thus a late high-grade event is recorded very near the Hoosac-Underhill contact.

Greenschist and lower amphibolite grade rocks near the base of the Pinney Hollow are characterized by the assemblage: chlorite, muscovite, quartz, albite, and actinolite. Actinolite and muscovite post-date the most recent deformation, indicating a late, higher grade metamorphic event. At Texas Falls (up section), porphyroblasts of albite show concentric zoning, which suggests a continued period of growth. The Pinney Hollow at higher levels does not reveal a similar grade of metamorphism (Coleman, 1986).

Current tectonic models (Stanley and Ratcliffe, 1985), suggest that formations east of the Green Mountain anticlinorium are individual thrust sheets. Petrologic and structural data show evidence of three periods of fabric development. The first and second events most likely developed in the Ordovician, and were accompanied by two pulses of greenschist metamorphism. The third folding event reflects the Acadian orogeny, and was marked by a continued upper greenschist and lower amphibolite grade metamorphism.

THE BEEKMANTOWN GROUP IN THE CHAMPLAIN VALLEY: AN HISTORICAL PERSPECTIVE

Stockwell, William E., Castleton State College, Castleton, Vermont 05735

The internal stratigraphy of the Beekmantown Group (originally called the Calciferous) has been a matter of much discussion for over a century. Augustus Wing worked out the first internal stratigraphy in the 1860s. Basing their work to a great extent on Wing's unpublished notes, Brainerd and Seely provided the first formal description of the stratigraphy in 1890. In 1899 Clark and Schuchert applied the present name based on the exposures at Beekmantown, New York. Since then, the limits of the group have been variously defined and the divisions have acquired numerous names. Recently, a debate has arisen over the proper placement of the included formation boundaries. The points of disagreement over the years have centered around the points where Brainerd and Seely differed with Wing. The general trend is toward confirmation of Wing's original work.

GROWTH PATTERNS AND FLUORESCENT BANDING IN MONTASTREA ANNULARIS, FROM JAMAICA, WEST INDIES

Teal, Lansing H., Department of Geology, Middlebury College, Middlebury, Vt. 05753

Eleven samples of the hermatypic coral *Montastrea annularis* were collected from the north coast of Jamaica. Collection sites, from modern and ancient reefs, ranged from high to low terrigeneous influx from rivers along a thirty mile stretch of fringing reef. Samples were analyzed for annual density banding and the occurrance of fluorescent bands within the coral skeleton.

X-radiography of cut coral sections show growth records of skeletal density which fluctuate seasonally. The rate of annual growth was made by direct measurement from X-radiograph positives of each slab. Analysis has shown that the modern corals have been accreting 4-13 mm yr^{-1}, an 8.45 mm yr^{-1} average. Fossil growth rates for the Falmouth fm., approximately 120,000 y.b.p., show 6-10 mm yr^{-1} variability, an 8.12 mm yr^{-1} average. Coral growth rates provide a record of recent and fossil reef accretion rates, and paleoclimatic variations, including runoff and storm activity.

Pulsed U.V laser induced fluorescent spectra and profiles were made across the slabs. Spectra, made throughout visible wavelengths, show a distinct aragonite peak at 500 nm. Intensity profiles show a reproducible series of light and dark bands. Black light and visual correlation of the fluorescent bands confirmed the laser profiles. Isdale (1985) suggests that similar bands from Great Barrier Reef corals only occur in close proximity to river mouths. They are caused by terrigenous fulvic acids incorporated into the skeleton and are a measure of local river runoff. This study is an attempt to extend these techniques to corals of the Caribbean. However, the patterns occuring in Jamaican corals are apparently unrelated to proximity of local river mouths.

THE METAMORPHIC HISTORY OF THE MIDDLEBURY COLLEGE SNOW BOWL

Tyson, Thornton M., Department of Geology,
Middlebury College, Middlebury, VT 05753

Rocks of the Hoosac Formation, on the east flank of the Green Mountain Anticlinorium, record an episodic history of deformation and metamorphism. The purpose of this study is fourfold: 1) to determine the mineral assemblages of the three observed lithologies; 2) to determine the timing of the metamorphic events relative to the deformational events; 3) to place constraints on the temperatures and pressures of the metamorphic events; and 4) to determine if these results are consistent with the tectonic model of western New England proposed by Stanley and Ratcliffe (1984).

Three lithologies are recognized in the field area: a silver to white qtz-musc-alb schist; a dark green qtz-musc-epi-alb schist; and an act-hbl-alb greeenstone. The greenstone unit locally contains glomeroblasts of epidote (up to 10 cm in length) and may be massive to well-foliated.

The first episode of mineral growth is of greenschist grade and is characterized by the assemblage chl-ms-alb±bt±act in rocks of variable bulk composition. The growth of these minerals is synchronous with the development of early isoclinal folds (F1) and associated with the flattening foliations (S1), but predates the development of reclined F2 folds and crenulations. The axial surface traces of these folds are truncated by a thrust fault which is itself folded by asymmetric west-verging F3 folds. The second episode of metamorphism (M2) is of upper greenschist-lower amphibolite grade, and it is characterized by the growth of blue-green amphibole, albite and calcite in rocks of mafic composition. The growth of these minerals post-dates the development of shear zone fabrics along the thrust fault and appears to outlast F3 folds and associated crenulation fabrics.

The results of this study appear to correlate well with Stanley and Ratcliffe's tectonic model of an accretionary prism.

SEDIMENTOLOGY OF THE RIO BUENO, JAMAICA, W.I.

Walker, Alexander M., Department of Geology,
Middlebury College, Middlebury, VT 05753

The Rio Bueno is approximately 10 miles long and drains a basin of approximately 800 square miles. It is believed to be a continuation of the Cave River, which descends into a cave 20 miles further inland. The drainage basin shows well developed karst topography.

Thirteen sediment samples were collected from headwaters to mouth, and suspended sediments were filtered from 3 sites. Measured suspended sediment loads were .01 grams/liter at the headwaters, .2 g/l at the dam (3 miles upstream from the mouth), and .1 g/l at the mouth. X-ray diffraction of sediments revealed calcite, kaolinite type clays, iron oxides and possibly aragonite. X-ray diffraction of suspended sediments showed almost totally calcite. However, diffraction patterns of filtered sediment from the headwaters revealed nothing, possible due to the low amount of sediment.

Photographs of suspended sediments taken through a scanning electron microscope and magnified up to 5000x showed coccolith fossils and rhombohedral grains of calcite up to 5-10 microns in length in a field of much smaller (<1 micron) grains. Energy Dispersive Spectra identified the elements occurring in the field of view as Ca, Si, Al, and Fe.

THE COMPARISON OF MIDDLE ORDOVICIAN REEFS ON ISLE LA MOTTE WITH PLEISTOCENE REEFS OF NORTHERN JAMAICA

Wood, Michael R., Department of Geology,
Middlebury College, Middlebury, VT 05753

Exposed reef outcrops exist on both Isle La Motte, Vermont and Rio Bueno harbor in Jamaica, W.I. The ancient Middle Ordovician reefs of Vermont and modern Pleistocene reefs of northern Jamaica were both mapped using plane tabling techniques. The maps of these outcrops provided a more detailed analysis of the vertical and lateral relationships of organic assemblages and sediment distribution in order to determine any similarities in reef growth patterns and environments of deposition.

The reefs of Isle La Motte were beleived to be deposited by a westward encroaching sea on a flat shelf in the shallow water of the sublittoral zone. This zone is analogous to the upper fore reef section, including the buttress zone, of modern reefs. The lateral and vertical relationships on Isle La Motte indicate periods of heavy sediment influx into the environment, temporarily cutting off reef growth.

At its seaward edge the uplifted terrace of West Rio Bueno represents the reef crest and regresses into the back reef lagoonal zone in a landward direction. The lateral relationships of this terrace have been obscurred by case hardening of the upper layers but the vertical relationships do show that the ratio of sand to coral increases a great deal in a landward direction from the edge of the terrace.

The two reefs have similar diagenetic histories which included dolomitization following subaerial exposure and rapid lithification. Both of the reefs also underwent similar stages of development in which a certain species started growth and was colonized by a variety of encrusting organisms. As the reefs grew outward and upward their diversity increased until subsequently the organism best suited to live at a certain depth took over and dominated the zone. Since Middle Ordovician time many different reef dwelling organisms have evolved and made the modern reef community much more complex than its ancient counterpart.

[**VGS BUSINESS & NEWS** continued from page 2.]

BOOTH AT NE-GSA: A REPORT

Our first attempt to seek general public recognition in the geological community was really quite successful. We sold $102.50 worth of publications, more than recovering the cost for the booth at NE-GSA (the fee of $103.50 being shared equally with The Geological Society of Maine) and the brochures distributed. At least 100 brochures were distributed (I haven't counted the remainder exactly, but we will continue to use them during the year) and a mailing list of 64 persons interested in future publications was collected.

If we did nothing but let people know that there are active geological **SOCIETIES** in the small states of Vermont and Maine, it was worth the effort. Geologists all too readily finish the "S" after a state name as "Survey": witness both my GSA member badge and exhibitor badge which read **SURVEY** boldly.

Special thanks to Gretchen Eastler, daughter of one of the Maine Society members, and Barbara Formichella, geology secretary at UVM, who spelled the Maine Society president, Steve Pollock, and me at the booth so that we could attend an interesting symposium one afternoon.

Exhibition at future NE-GSA meetings will need serious consideration. In the immediate future we will be provided a space at the Burlington Gem and Mineral Club's August 2-3 Show in South Burlington. See the last page of this GMG for details.

Jeanne Detenbeck

NEW MEMBERS

Welcome to these new members of our Society accepted by the Executive Committee in meetings since last Fall:

Mary Lou Curran	Groton, MA
David Franzi	Plattsburgh, NY
Laura Gross	Brattleboro, VT
Brian Heckenberger	Montpelier, VT
Eric Lapp	Colchester, VT
Susan Oppenlander	Colchester, VT
Margaret Ottum	Johnson, VT
Rod Pingree	Waterbury, VT
Andy Raiford	Castleton, VT
Stephen York	Mendham, NJ
Middlebury College Library	

EXECUTIVE COMMITTEE MINUTES

February 15, 1986 at Norwich University
Present: Steve Goldberg, Dave Westerman, Shelley Snyder, Jeanne Detenbeck, Carolyn Merry, Char Mehrtens, Craig Heindel
Secretary's report from previous meeting read and approved.
Treasurer's report presented by Dave Westerman and accepted.
1)current status: started the year with $528; taken in (dues and sales) $1365; expenses $336; balance $1029.

2)expect income from sales at GSA booth and yearly dues

3)Publication sales: vols. 3 & 4 are selling and can consider printing additional copies. 22 remaining copies of v. 4. 100 copies will cost $300. Good supply of vols. 1 & 2.

OLD BUSINESS

1)Jeanne D. reported Me. Geol. Soc. interested in NEGSA booth. Nature of the advertising discussed. It was moved and approved to spend up to $100, if necessary, for the booth display.

2)Jeanne D. suggested publishing an information brochure, listing the available VGS publications. How many for GSA? It was moved and approved to spend up to $32 for 500 copies. Also suggested and approved to print 200 membership forms.

3)Dave W. had applications for new members and recommended dropping 4 names from lack of dues payment (3 years in arrears). All were approved.

NEW BUSINESS

1)Craig H. wanted to know if VGS wished to take a stand on any of the current legislation in Montpelier. Steve and John Malter endorsed the concept of the Society responding to legislation. Bills which may be of interest include: H.453-contaminated soil bill; H.81-moving the Geological Survey into a permanent branch of AEC; H.459-sludge and septic management. It was moved and approved that we support all of these bills. It was also suggested that VGS members write to their legislators to support H.81. It was also →

MINERAL OF THE QUARTER

ANDALUSITE, var. CHIASTOLITE

Formula: $Al_2(SiO_5)O$ with some iron or manganese

Crystal System: Orthorhombic
Specific Gravity: 3.1 - 3.2
Cleavage: Good prismatic
Hardness: 6 1/2 - 7 1/2
Luster: Vitreous
Streak: White

This mineral was named for Andalusia, Spain, where it was first identified. It is a contact metamorphic mineral often found associated with garnet, tourmaline, sillimanite and kyanite. It is commonly found in dull, rough, prismatic crystals with nearly square cross section. The chiastolite form has carbonaceous impurities included into the crystal which have oriented themselves in the growing crystal so that a black Maltese cross or flower forms at right angles to the prism.

The Vermont occurrence, as might be expected, is near the White Mountain batholith, just south of Bloomfield. To reach the road cut where the light gray phyllite is exposed in which pink or darker chiastolite occurs, take Route 2 to its junction with 102 five miles east of Lunenburg. Take 102 north to .6 miles south of Bloomfield, just opposite a small cemetery. Some of the chaistolite has been altered to sericite and is white. Small garnet crystals are also found at this location.

Submitted by
Ethel Schuele

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suggested that the Public Issues Comm. be notified of these bills and possibly meet at the next Exec. Comm. meeting.

2)Steve reported that P. Washington offered to lead a field trip to the Beekmantown Dol. in the Whitehall area with Steve Chisisk.

3)It was decided to hold the spring meeting at UVM. Jack Drake and Barry Doolan are asked to be in charge.

March 26, 1986 at John Malter's in Montpelier

Present:Steve Goldberg,Dave Westerman,John Malter,Jeanne Detenbeck.

Treasurer's report: $1218 plus $200 in publication sales. Dave presented 4 membership applications - all approved. Suggested coding mailing labels of those still owing dues before sending letters.

OLD BUSINESS

1)Legislation: H.81 the Geological Survey bill died. VGS needs to find sponsors in the legislature. We shold ask Chuck to address the Exec. Comm. about the need for this bill if he isinterested. H.459 is passing with maybe $17.5K. H.453 probably being voted on tomorrow - Craig Heindel has testified.

2)NEGSA booth was successful. $102.50 in publications sold, brochures distributed and 64 names on mailing list for future.

3)Spring meeting- Steve G. to find judges and judging forms. Exec. Comm. to meet at lunch time.

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MEETINGS

APR 26 **VGS SPRING MEETING**
See page 3.

JUL 12 **VGS SUMMER FIELD TRIP**
"Beekmantown Stratigraphy in the Central Champlain Valley" led by Paul Washington and Steven Chisick.

AUG 2-3 **7th Annual Champlain Valley Gem And Mineral Show**
10-6 on Saturday and 10-5 on Sunday.
At South Burlington High School and Community Library, Dorset Street north of Kennedy Drive (near Exit 13E of interstate I-89).

Special guest speaker: Dr. Woodrow (Woody) Thompson, Director of Bureau of Surficial and Bedrock Geology of the Maine Geological Survey.

Exhibits of New England minerals, worldwide specimens of gold, opals of the world , and more. Demonstrations of gemstone cutting, soapstone carving, and scrimshaw cutting. Color films on the rock cycle, earthquakes, and the Grand Canyon in the Mesozoic and Cenozoic. A working goldsmith will repair jewelry on the spot. Dealers will offer minerals, fossils, carvings, jewelry, gemstones, and supplies for rockhounds and lapidaries. Fish pond for children. Modest admission fee.

We hope Chuck Ratté will open the Show by speaking at 10:00 A.M. Saturday. The Vermont Geological Society will have an exhibit and be able to sell its publications also at the Show.

Here is a continuation of the list of SEPM (Society of Economic Paleontologists and Mineralogists) projects for 1986. Information about these can be obtained from: Joni C. Merkel, SEPM, P.O. Box 4756, Tulsa, OK 74159-0756 [(918)+743-2498].

MAY 30 SEPM Short Course "Glacial Sedimentary Environments", Champaign, Illinois.

JUN 14-15 SEPM Short Course "Structures and Sequences in Clastic Rocks", Atlanta, Georgia.

JUN 14-15 SEPM Short Course "Modern and Ancient Deep Sea Fan Sedimentation", Atlanta, Georgia.

JUN 14 SEPM Short Course "Paleoclimatology and Economic Geology", Atlanta, Georgia.

JUN 15 SEPM Core Workshop "Modern and Ancient Shelf Clastics", Atlanta, Georgia.

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4)Paul Washington will lead a field trip in early summer.

NEW BUSINESS

1)Steve G. will start appointing the nominations committee.

2)Fall field trip- need to know date of NEIGC. Dave W. suggested field trip using his new geophysical instruments in field trials.

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

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

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

FIRST CLASS

SHELB[illegible]

Charles A. Ratté
4 Chestnut Hill
Montpelier, VT 05602

Red numbers next to your name? The treasurer's records indicate you owe dues for those years. Please let him hear from you soon.

THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

SUMMER 1986 VOLUME 13 NUMBER 2

Vermont Geological Society Grant-in-Aid of Research

Description: The Vermont Geological Society announces a privately-funded, grant-in-aid of research in the amount of $1500 to an undergraduate or graduate student working on a project in Vermont geology which integrates chemistry or hydrology with bedrock aquifer studies. The purpose of this award is to stimulate thought about the problems involved in this interdisciplinary topic. The format of the research is not restricted and may include field studies, literature research, laboratory experimentation or analysis, mathematical modeling of existing data such as that from well logs or other approaches. The schedule of payment will be determined by the grant committee.

Proposal: The successful applicant's proposal will include the following sections:

-Nature, aim and significance of the project
-Approach and procedure to be used
-Availability of required facilities and equipment
-Personal qualifications (include relevant course background and other experiences)
-Project timetable (work to be done no later than summer 1987)

[Continued on Page 2.]

CONTENTS **PAGE**

WHO ARE THE DELINQUENT 40? [See page 4.]

PRESIDENT'S LETTER

Our President, Steve Goldberg, has taken a job in the New York area. He felt that he couldn't be effective doing the job as President of the Vermont Geological Society being so far from Vermont. Therefore, I've assumed his role as President until the new slate of officers are elected this fall.

The summer field trip was held on July 12th in the Middlebury area. Paul Washington and Steven Chisick led the group to study the Beekmantown Group in Central Champlain Valley. Although I was not there, I'm sure all involved had a very enlightening trip.

Our Fall Field Trip and Annual Meeting will be held on Saturday, October 11th. Dave Westerman from Norwich University will be our guide for the field trip to be held in central Vermont. He'll also be demonstrating the new geophysical instruments they've acquired at Norwich.

This issue of GMG announces the "Vermont Geological Society Grant-in-Aid of Research".

The new slate of officers for VGS is also described in this issue. If you can't make the Fall Meeting, make sure that you send in your vote.

I hope to see you all at our Fall Meeting.

Carolyn J. Merry
Carolyn J. Merry
Acting President

VGS BUSINESS & NEWS

GRANT-IN-AID OF RESEARCH [Continued from Page 1.]

Terminal Reports: The recipient will be expected to submit both written and oral reports to the Vermont Geological Society upon completion of the research.

Applications: Completed applications will include a proposal as described above and two letters of reference from faculty associated with the project. These materials should be received by September 30, 1986 at the following address:

Grant Committee
Vermont Geological Society
P.O. Box 304
Montpelier, Vermont 05602

Announcement of the award will be made at the VGS Annual Meeting on October 11, 1986 and also by mail immediately thereafter.

Additional information may be obtained at the above address.

COMMITTEE ON NOMINATIONS

The Committee on Nominations, Roger Thompson, Chairman, and John Malter, has submitted the following slate of candidates to be elected at the Fall 1986 annual meeting:

President	Shelley Snyder
Vice President	Jeffrey Pelton
Secretary	David Butterfield
Treasurer	David Westerman
Board of Directors:	
2-year term	Donald Wernecke
1-year term	Stanley Corneille

NEW MEMBERS

Welcome to these new members of our Society accepted by the Executive Committee recently:

Mimi Boxwell	Durham, NH
James Butler	Chapel Hill, NC
Jill Schneiderman	Cambridge, MA
John Strunk	Bristol, VT
University of Rochester Library	

EDITOR'S REPORT

Sales of <u>Vermont Geology</u>, especially Volume 4, the guidebook, are going well. Plans are going ahead for Volume 5, the second guidebook, and although printing cannot proceed until we have enough funds in the treasury (a policy voted at the Fall Annual Members Meeting), the following is a tentative list of the field trip guides it will contain:

1. Charles Ratté: Mechanics of emplacement of the multiple intrusions at Ascutney Mt. and Little Ascutney Mt., Windsor, Vermont.
2. Brewster Baldwin and Andrew Raiford: Deep water sediments and folding in the Taconic Klippe, Fair Haven, Vermont, area.
3. Frederick Larsen: Glacial History in central Vermont - Barre and Randolph 15' quadrangles.
4. Ballard Ebbett and Sandria Ebbett: Glacial landforms in the vicinity of Lake Willoughby, Vt.
5. Barry Doolan: Stratigraphy and structure of the Camels Hump Group in north-central Vermont.
6. Frederick Larsen: Glacial history of the Hartford - Hartland - Lebanon area, Vermont - New Hampshire.
7. Paul Washington and Steven Chisick: Beekmantown stratigraphy in the central Champlain Valley, the Summer 1986 field trip.

TREASURER'S REPORT - THE 40 DELINQUENTS!

The treasurer is disappointed, to say the least, that 40 members have not yet paid their dues for 1986. Some of these are loyal members who have paid promptly in the past. Red stars marked their mailing addresses on the Spring GMG, but even the response to this was unrewarded. Did these members not receive their dues announcements? Why have they failed to respond to the treasurer's notice? How can we attract their attention when 1987 dues are due? Please check your check stubs, and if you find no record of payment, please drop a check for dues ($10.00) in the mail to the treasurer. Help save him time and the extra expense of mailing second notices. Thanks.

There was $1167.54 in the checking account on April 26. Our publications are selling steadily but the treasury must have a substantial balance in order for us to continue adding to our publications list, while at the same time financing the news letter and other activities.

SPRING MEETING REPORT

The student papers presented to the Vermont Geological Society on April 26th were as usual outstanding. The topics ranged geographically from the Arctic Norway to balmy Jamaica with alot of Vermont geology. Topics ranged from unconsolidated sediments to deformational fabrics. It was a very exciting day. Student presenters came from University of Vermont, Middlebury, University of New Hampshire, Harvard University, and Castleton State College. The Vermont Geological Society would like to thank all the participating students for sharing their research.

In the interest of encouraging student research the Vermont Geological Society awards the Charles Doll award to the best graduate and undergraduate papers. This includes a circulating plaque engraved with the students' names and a $25 award. Papers are judged on five criteria. First is the introduction, how well the problem is stated. Second is how the solution of the problem is stated. How well visual aids are used and general quality of the presentation are judged are third and forth. How well the student responds to questions is the final criterion. Each criterion is judged on a scale of 1 (well below average) to 5 (well above average). The undergraduate and graduage student with the highest point score wins the award.

The undergraduate award was given to Hugh Rose (University of Vermont) for Paleozoic Stratigraphy, Structure, and Metamorphism of Metavolcanics and Metasedimentary Rocks of the Jeffersonville area, Northern Vermont. The graduate award was given to David MacLean (University of Vermont) for Storm Controlled Deposits of the Glens Falls Formation, Champlain Valley, Vermont and New York.

The judges this year were Louise Lindsay, Alan Liptak and Jeff Noyes. Thank you judges for your time and efforts. Judging these papers was a hard job. There were so many excellent papers.

Respectfully submitted,

Shelley F. Snyder

PUBLIC ISSUES COMMITTEE

In order to show support for legislative bills which protect Vermont's natural resources, Craig Heindel (the VGS representative to a state advisory panel on discharge policy), Chris White (chairman of VGS' Public Issues Committee) and Steve Goldberg drafted the following letter to the Senate Natural Resources Committee. Approval was given by the Executive Committee.

April 18,1986

Senator Arthur Gibb
Chairman, Senate Committee on
  Natural Resources and Energy
State House
Montpelier, VT 05602

Re: Bill H.453
    Bill H.459

Dear Senator Gibb and Committee Members:

The Vermont Geological Society would like to take this opportunity to offer our strong support for Bill H.453 (Contaminated Soils) and Bill H.459 (Sludge and Septage Management). Both bills are very important to the preservation of Vermont's generally uncontaminated soils, groundwaters, and surface waters.

The Contaminated Soils bill offers a careful, scientifically sound method of disposing of petroleum-contaminated soils in a closely managed setting. This use of the natural cleansing ability of soils and soil bacteria at specifically chosen sites is a wise use of our natural resources. The current alternative, shipping these soils out of state by truck, is exceedingly costly. To make this program work effectively, it is important that the Waste Management Office of the AEC have the additional staff and funding they have requested.

The Sludge and Septage Management bill is long overdue, and will hopefully lead to a level of management of these two waste products similar to that now being applied to other wastes in Vermont. Thoughtful use of our natural resources will allow the safe disposal of these products, while deriving as much beneficial use from them as possible. Again, adequate staffing and funding is essential, so that this program gets the attention it deserves in the Waste Management Office.

The Vermont Geological Society has approximately 130 members, all active geologists or people interested in the geology of Vermont. We would be glad to offer additional testimony on these two bills if you feel it would be appropriate.

MINERAL OF THE QUARTER

The Melendy Museum

Anyone interested in seeing excellent quality mineral, crystal or fossil specimens would enjoy visiting Earl and Marie Melendy's museum located on Museum Terrace in South Londonderry, Vermont. They have been upgrading their collection for more than 30 years and at this point the quality of their exhibited specimens is spectacular. A new interest is beginning to work its way into the museum now, also, as they are starting to collect bells as well. Earl and Marie are very knowledgeable about their specimens and are very friendly people, besides. They have been willing to identify mineral and fossil specimens for the public at the Vermont Gem and Mineral Shows in Bennington and Burlington for many years. Earl also is one of the founding members of the Brattleboro Mineralogical Society. He has been their newsletter editor since their group began. If you would like to visit their museum, call Earl and Marie at 802-824-5272 to be sure they will be at home. They are very active people and may be out at a Gem Show somewhere in the U.S. Earl has been a judge for exhibitors for years at Eastern Federation of Mineralogical Societies' shows.

Submitted by Ethel Schuele

RECENT PUBLICATION

'Way back in 1981 (Winter 1981 issue of the GMG, vol.7, no.4) Brewster Baldwin reported about the work of the COSUNA (Correlations of Stratigraphic Units of North America) Project and the assignment of Vermont rock sections for correlation. The Correlation Chart for New England (Catalog #695) is now available from AAPG. Cost for a single chart is $8.00 plus $1.50 postage for parcel post delivery. Send your prepaid order to: AAPG Bookstore, P.O. Box 979, Tulsa, OK 74101.

STUDENT ABSTRACT

The following student abstract was not available in time to be published in the Spring GMG. The paper was presented at the VGS Spring meeting at the University of Vermont.

GEOCHEMISTRY OF SIX SOUTH LINCOLN GREENSTONES

Gavigan, Thomas H., Department of Geology,
Middlebury College, Middlebury, VT 05753

Greenstones from six outcrops in the Underhill Formation near South Lincoln have been analysed for major and trace elements. None of the outcrops are mapped on the state geologic map.

A typical greenschist assemblage of albite-chlorite-actinolite is found in all the samples. Magnetite, quartz, epidote, biotite and calcite are common accessory minerals.

Major elements have been shown to be mobile under alteration and metamorphism. Trace elements, including Y, Nb, Ni,

Cr, Zr, along with relatively immoble major element oxides, TiO_2, and P_2O_5 are used to determine tectonic setting of emplacement of the greenstones. Major element geochemistry suggests that the South Lincoln greenstones are basalts (SiO_2 ave. = 47.7 wt.%) with high TiO_2 wt.% (ave. = 3.4%). A Y/Nb diagram shows the basalts to be transitional between alkalic and theoleiitic. When plotted on a Ti-Zr-Y diagram, the greenstones show a distinct within-plate basalt nature. An FeO-MgO-Al_2O_3 diagram further distinguishes the basalts as continental.

In conclusion, the South Lincoln greenstones are transitional between alkalic and tholeiitic basalts. Their continental association suggests that they were formed during the rifting of the continent prior to the opening of the proto-Atlantic Ocean. The overall geochemistry and stratigraphic relations suggests that these greenstones are type A (Coish and others, 1985) metabasalts similar to the Tibbit Hill and Huntington greenstones of the Pinnacle and Underhill formations respectively.

MEETINGS

OCT 11 — **VGS FALL FIELD TRIP AND ANNUAL MEETING.** Dave Westerman will lead the trip along the RMC in central Vermont and perhaps conduct field demonstrations of some geophysical instruments. Details will appear in the Fall <u>GMG</u>.

Through the generosity of a foundation grant, the Geology Department at the University of Vermont is sponsoring a Visiting Lecture Series this fall. Lectures will be held in Perkins Building, Room 200 at 4:00 P.M. For further information, contact Dr. Rolfe Stanley, Geology Department, University of Vermont, Burlington, VT 05405, (802)+656-3396.

SEPT 15 — Dr. Carl Reidel, Geology: An Interdisciplinary Perspective or What Good Are Geologists?

SEPT 22 — Dr. Richard April, Acid Rain: The Acidification of Freshwater Lakes and Streams.

OCT 6 — Dr. Gary Lash, Sedimentation Patterns at Convergent Margins: An Ancient Example from the Central Appalachian Mountains.

OCT 23-24 — Dr. Stephen Bachman, Sedimentation, Tectonics, and Basin Analysis (Short Course). Reservation suggested.

NOV 17 — Dr. Frank Spear, Metamorphic Evolution of Mountain Belts.

SEPM meetings. Information available from: Joni C. Merkel, SEPM, P.O. Box 4756, Tulsa, OK 74159-0756 [(918)+743-2498].

SEPT 14-18 — SEPM Short Course "Modern and Ancient Eolian Deposits", Alamosa, Colorado

SEPT 23-25 — SEPM Short Course "Platform Margin and Deep Water Carbonates", Raleigh, North Carolina

SEPT 24-25 — SEPM Short Course "Modern and Ancient Deep Sea Fan Sedimentation", Raleigh, North Carolina.

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

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

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

SHELBURNE AUG 14 PM 1986

FIRST CLASS

Charles A. Ratté
4 Chestnut Hill
Montpelier, VT 05602

THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

FALL 1986 VOLUME 13 NUMBER 3

FALL FIELD TRIP

Structural Character of "pre-Silurian" and "Silurian" Rocks and the Nature of the Boundary between them in Central Vermont

David Westerman, Leader

9:30 A.M. SATURDAY, OCTOBER 11, 1986

Meet in Montpelier High School parking lot.

BANQUET & ANNUAL MEETING

SOCIAL HOUR starts at 5 P.M in
Sambels' on the Common, Northfield, Vermont

[See Page 3 for details.]

CONTENTS **PAGE**

PRESIDENT'S LETTER

The fall field trip will be held on October 11th with *David Westerman from* Norwich University leading the trip in central Vermont. He'll be showing us the structural geology -- the RMC rocks -- for the time frame between the pre-Silurian and Silurian-Devonian era. The foliage should be quite colorful as Dave will be leading us into the back hills of Vermont. Details on times and places are available elsewhere in this issue. The field trip proves to be very interesting and I hope that all of you can make it.

Also, don't forget our Annual Meeting and Banquet that will be held in downtown Northfield shortly after the field trip.

Many thanks to Roger Thompson (Chairman) and John Malter for submitting the slate of officers for the coming year. We'll be voting on them at our Annual Meeting. I'm sure that the proposed officers will do an excellent job and provide good programs at our upcoming meetings.

I hope to see all of you at the field trip and/or the Annual Meeting.

Carolyn J. Merry
Acting President

VGS BUSINESS & NEWS

VGS GRANT-IN AID OF RESEARCH

As of September, no applications had been received, but note that the deadline is September 30. Look for the announcement of a winner at the annual meeting.

VGS AT GEM & MINERAL SHOW

VGS was generously alloted a table at the Burlington Gem and Mineral Show on August 2-3. Shelley Snyder and Jeanne Detenbeck each spent a day promoting the Society and answering questions. Display of our publications resulted in sales of $55. Many visitors picked up our brochure listing past publications and signed up to receive information on future publications. We also displayed the new Maine Geological Survey's bedrock map, of interest to those who heard Woody Thompson's talk about Maine geology, and sold copies for the Survey at the table.

FALL PROGRAM

FIELD TRIP

TOPIC: Structural Character of "pre-Silurian" and "Silurian" Rocks and the Nature of the Boundary between them in Central Vermont.

LEADER: David Westerman, Norwich University

DATE: SATURDAY, OCTOBER 11, 1986

TIME OF DEPARTURE: 9:30 A.M.

ASSEMBLY POINT: Montpelier High School parking lot. Exit 8 from I-89 into Montpelier merges with Memorial Drive. About 3/4 mile from the exit is the Stockyard Inn on the left on Bailey Ave. ext. Turn left. The H.S. is on the left on High School Drive. It will be possible to car pool from here.

FIRST STOP: About 2 miles west of Montpelier on Route 2 - look for the caravan.

LUNCH: Bag lunches will save time,but there will be a chance to buy food,if necessary.

PURPOSE: We will look for recognizable structures in rocks which have experienced both the Taconic and Acadian orogenies versus the ones which have experienced only the Acadian Orogeny and observe the nature of the boundary between them (the famed RMC - Richardson Memorial Contact).

Views of the Vermont countryside will be possible during a stop at Mooretown Gap.

BANQUET AND ANNUAL MEETING

5-6 PM: SOCIAL HOUR. There will be a cash bar at Sambels' on the Common in "downtown" Northfield.

6:00 PM: DINNER at Sambels. Advance reservations before the day of the field trip are not necessary unless you and/or your spouse or friend will be coming only to the banquet. In that case, please let Dave Westerman or Fred Larsen know by October 10 at 485-5011 (ask for Earth Science and leave a message).

Price of dinner will range from $10-13 depending on your choice of fish, chicken or prime rib.

ABOUT 7:30 PM: ANNUAL MEETING in the meeting room at Sambels.

MINERAL OF THE QUARTER

The Harvard Mineralogical Museum Visited

It seemed appropriate to write a short introduction to this interesting collection of minerals, gems and fossils for this Green Mountain Geologist as we had to return 16 specimens of tourmaline from Newry, Maine which we had borrowed for the Champlain Valley Gem and Mineral Show in August.

The hardest part of visiting this museum is finding a place to park - legally. The University Museum is on Oxford and Kirkland Streets in Cambridge, It can be reached easily enough from Boston by taking Broadway all the way to Cambridge. This takes you to Kirkland - after a left onto Kirkland, you can make a right onto Oxford Street. The entrance for the Mineralogical Museum is the same one that takes you to the famous glass flowers in the Botanical Museum. After going up two flights of stairs, pay your entrance fee and turn right to go into the area for minerals and gems.

As you enter the room you are struck by the large, beautiful specimens displayed around the edge of the room. The rooms are well lit, now, thanks to money raiséd by the Boston Mineral Club.

Many interesting specimens from world-wide locations are displayed as you move through the various families of minerals. All are marked with source and date of their collection. We found most interesting, the exhibits featuring special mineral locations in depth, such as Pala, California. These are located on both side of the central isle and along the edges of the room. The lower right hand corner also had the new acquisitions such as the Ellenwood, Tennesee calcite with included bright pyrite tetrahedrons.

There is a special New England room just beyond the main room, to your right. It was interesting to walk to this room, where each state has its own area, and see the wealth of materials found in such a small area of the United States. The Vermont Asbestos Mine minerals were well represented, thanks to the generosity of Clement Mason, former mine supervisor. We found the Newry, Maine tourmaline specimens and Rhode Island scepter amethest crystals the most fascinating, here.

There were also exhibits of meteorites and tektites in the hall beyond the New England room. This is only fitting as these are extra-terrestial minerals.

Cut gemstones were well displayed in the main room, as well as minerals. One of the most interesting to us was an iceland spar gemstone cut so that the birefringence broke the light entering the crystal into the colors of the rainbow. One case of gem quality Newry, Maine pink and green tourmaline carved birds was very striking as the two color areas had been used to best advantage in parrots, roosters and other fowl. A beautiful inlaid plaque, made with many varied gemstones, very artfully represented an iris in bloom. There was also a huge inlain malachite tray which made good use of the tapestry-like patterns in this African mineral.

[Continued on Page 13.]

STATE GEOLOGIST'S REPORT

OFFICE MOVES TO NEW LOCATION

On July 19th the entire Agency of Environmental Conservation completed its move from Montpelier to Waterbury. Space within the state hospital complex has been completely remodeled and renovated. The state geologist's offices are first class. We're located on the 3rd floor of the Center Building at **103 South Main Street.** Our new phone number is: (802) 244-5164.

BEDROCK AND SURFICIAL GEOLOGICAL MAPPING PROGRAM

Summary of the June 25, 1986 Meeting of the
Vermont State Bedrock and Surficial Geology Mapping
Advisory Committee and Interested Parties

In attendance were: Charlotte Mehrtens, Barry Doolan, Norm Hatch, Nick Ratcliffe, Rolfe Stanley, Peter Thompson, Thelma Thompson, Chris Hepburn, Paul Karabinos, Wally Bothner, Chuck Ratté and Larry Becker

Chuck Ratté opened the meeting with a presentation of the history, current status and intent of the Vermont Bedrock and Surficial Geology Mapping program. He indicated the program is an official state program with current funding sources including the State, U.S.G.S., and the Green Mountain National Forest. Long term goals are to produce new state geologic and surficial geology maps with interim large scale products at the completion of individual projects. Emphasis will be on greater detail and attention to the 3rd (depth) dimension with a constant realization that geological information must be readily available for the "applied" fields of geology.

The program organization was presented and is as follows:
Director -- Charles A. Ratté, State Geologist
Co-Director -- (surficial Program) Larry Becker
Advisory Committee -- see list at end of this report
Regional Mapping Coordinators and Compilers for the Bedrock Program -- See map at end of this report
Mapping and Geotechnical Personnel

New mapping and project proposals will be reviewed by the Advisory Committee and the coordinator of the region in which the project area is located. Accepted proposals will be financed as long as money is available. Outside funding is encouraged. Products will be published by the state as "Special Bulletins" as publication funds become available. Authors may prefer other publication sources. All state publications will be reviewed by a special review committee composed of professional geologists not directly associated with the mapping program. Final compilation of the state map, however, will be the responsibility of the regional coordinators and compilers.

It should be noted that the program is "product oriented". Incremental preliminary maps and progress reports will be required from field mappers as they progress toward a completed project. The author's request for confidentiality will be honored until the information is released in formal publication.

The program looks to continued and improved communications and cooperation while at the same time maintaining complete respect for individuality of ideas, interpretations, etc.

It is expected that State funding will improve over the next few years and that our committment to the U.S. Geological Survey COGEOMAP program and the National Geological mapping effort will strengthen.

We have a strong start in the bedrock program and will work toward an equally strong surficial mapping program.

Other comments and concerns voiced by those in attendance at the meeting:

•How to handle boundary zones between mapping projects. The greatest efforts toward cooperation are required in the boundary areas. Cooperative mapping by the principals involved are strongly encouraged. Early efforts at communication are vital. Dual forays into opposite territories should be most productive. A certain amount of duplication of coverage should not be considered a "wasted effort" but rather as a healthy exchange of ideas. Much can be accomplished by joint, informal, working field trips. Nick Ratcliffe offered to initiate such a field trip (July 31-August 2) in southern Vermont.

•It was expressed that the program should encourage and respect a broad range of views assured by the make up of the Advisory Board and the reviewers of publications. Everyone agreed, and the director promised to make every effort to assure that everyone's professional views would be honored and everyone would be encouraged to "present their views" in the individual project publications. However, everyone also agreed that ultimate decisions regarding the choices that must be made in compiling the final state map will be made by the regional coordinators and compilers.

•The director was encouraged to contact U.S.G.S. Topographic Division to clarify mapping format and production schedules.

•A greater effort should be made to involve the staff at Middlebury College in the program.

•An effort should be made to coordinate the work of U.S.G.S. (Joe Arth, Bob Ayuso) on the granites of northeastern Vermont with the bedrock mapping program.

•The compilation of the state map should not wait for one final effort but rather should develop gradually by compiling the projects that are completed every two or three years. Such a periodic assessment will aid in directing the program to areas where greater efforts should be concentrated to solve problems, etc.

•It was requested that the "Special Bulletin" be published and packaged in a way that is more amenable to established file sizes, i.e., folded to 8-1/2 x 11 or legal size.

•It was revealed that certain geophysical information had been and/or would soon be available to field mappers:

•Columbia Gas Transmission Company has allowed the people at U.V.M. and the State Geologist to see their seismic data.

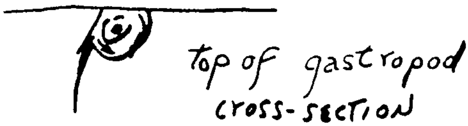
•The U.S.G.S. CUSMAP programs (Lewiston, Glens Falls) have excellent compilation of gravity and magnetics.

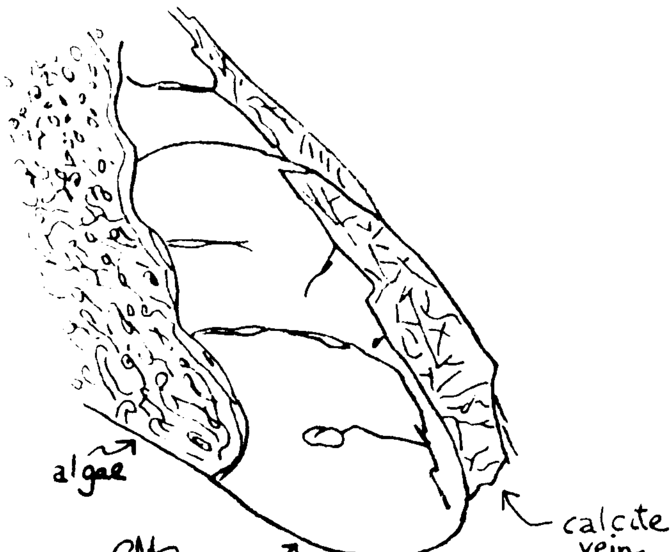
•Complete SLAR coverage for Vermont is available through U.S.G.S. Eros Data Center.

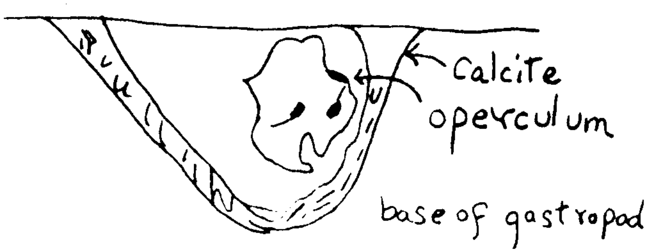
[Continued on Page 9.]

Gastropod Fossil Sketches

by Ethel Schuele







A GASTROPOD AND PROBABLE ALGAL DEPOSITS FROM THE SHAW MOUNTAIN FORMATION, VERMONT

Charles G. Doll
Emeritus Professor of Geology
University of Vermont

ABSTRACT

A gastropod that failed to "come out of hiding" with its Mid-Paleozoic class-mates is added to the list of fossils recently reported on from the Shaw Mountain Formation, Seaver Branch locality (Doll, 1984). Newly discovered probable algal fossils are also added to this list of fossils.

INTRODUCTION

The Shaw Mountain Formation consists essentially of a quartz conglomerate basal to tuffs and a series of quartzites which, in turn, are overlain by relatively thin beds and lenses of gray to white fossiliferous limestone interbedded with greenstone locally and light gray to brown weathered tuff (Currier and Jahns, 1941; Doll, 1951). The gastropod has been exposed on the sawed surface of a lenticular concretion composed of limestone layered externally by thin, fine-grained, semi-lustrous, micaceous phyllitic tuff. The fossil is bordered on its left by thin calcite veinings and limestone of a coarser texture than elsewhere on the specimen, and on its right by a vein of white calcite tapering spireward of the fossil (Fig. 2), (possibly recrystallized shell substance, considering its location, limited extent lengthwise and curving crosswise at the base of the fossil, thinning toward the posterior end, and the break in the vein at the suture).

The coarser textured biostromal limestone contains a few black globular constituents and/or tubular filaments, more conveniently visible with a hand lens. In the plane of the sawed surface these structures display gray, glassy interiors encircled by thin black rims (walls), (Fig. 2). The appearance, structure and size of these features are strikingly similar to late Devonian algae described by Veevers (1969, Pl. 32, Fig. 1; Pl. 36, Fig. 1). These forms could be representative of isolated oölites or more probably algal deposits (Fig. 1). The irregular-shaped components in the groundmass of the sawed surface are undetermined and might be fragments of associated tuff and probable algae. The coeval presence of algae with an appreciable concentration of a variety of invertebrates at this locality is additionally suggestive of an organic reef. Wray (1967) has found *Girvanella* widely distributed in blue-green algae in carbonate sediments associated with an abundance of invertebrates forming organic reefs.

Only mention is possible of the scattering of disunited probable gastropod parts which might be interpreted as belonging to the gastropod here under discussion, in the remaining and obscure area of the sawed surface opposite the coarse textured portion already described.

THE GASTROPOD

The mud-filled gastropod is a high-spired type with the whorls defined by helicoid sutures which become less prominent in the narrowing shell form toward the apex of the spire (Fig. 2). Only the form of the gastropod is present, the original shell material having suffered solution, reportedly a common occurrence among Paleozoic gastropods. The body whorl is centered by a circular cross-section of a probable columella (Fig. 2). Looking down at the apex area of the oriented specimen, close inspection discloses a small (3mm) circular feature, the diameter of which accords with that of the uppermost whorl of the spire. The circular feature is thus shown to be a part of the fossil (Fig. 3). With attention now directed to the opposite end of the fossil, to the aperture, a structure rarely preserved with Paleozoic gastropods is observed, which stands out in the aperture as a gray disc. This structure is intepreted as the operculum (Fig. 4). A perforated knob at the center of the operculum is surrounded by a surface with biscuit-shaped units (best seen at left of knob in Figure 4) which appear to be of structural importance and ornamental as well (Goldring, 1950, p. 152; Shrock and Twenhofel, 1953, p. 415-416; Moore, 1958, p. 598).

SIGNIFICANCE

The fossil is the first gastropod to be reported from the Shaw Mountain Formation. The first fossils discovered in the Shaw Mountain Formation were crinoid stems (Currier and Jahns, 1941), which, some years later, were augmented to include an impressive variety of classes and genera, and additional recently discovered probable algal deposits (this paper), permitting greater accuracy in the determination of the age of the formation (Doll, 1984; Boucot and Drapeau, 1968).

The amount of interesting detail provided by the gastropod, some rare, as, for example, the probable operculum, which, incidentally, is in place, prompts an attempt to determine its affiliation that may lead to a reasonable judgment of its age. The specimen appears to answer to the description of a *Loxonema* type gastropod of the Devonian of New York; in any case, since the gastropod's association with fossils that have already established the age of the Shaw Mountain Formation is known, it can not be other than Silurian-Devonian in age (Doll, 1984; Murray, 1985, p. 108-109, Pl. 6.6.42; Goldring, 1950, p. 159; Knight, 1930, Suppl., p. 9; Clarke, 1904, p. 332-333).

The Devonian strata in New York State carry an abundance of gastropods in the Middle (Hamilton) and Upper (Naples) groups (Goldring, 1950). *Loxonema noe* Clarke is abundantly distributed among the Naples fauna in the "soft shales and lime concretions" (Clarke, 1904, p. 333). Distortion of the gastropod is minimal.

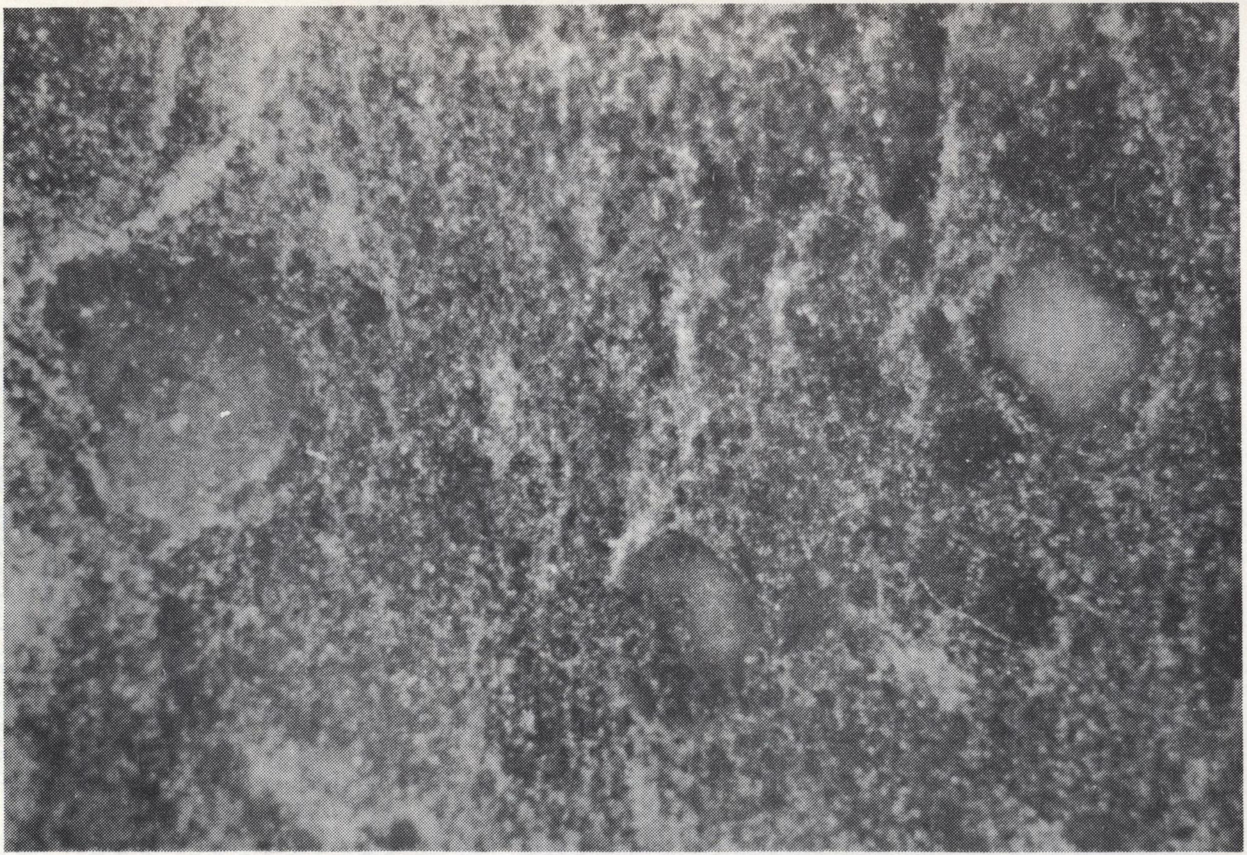


Figure 1. Enlarged portion of the area on the left of the gastropod to better show the algal features described in the text. X16.

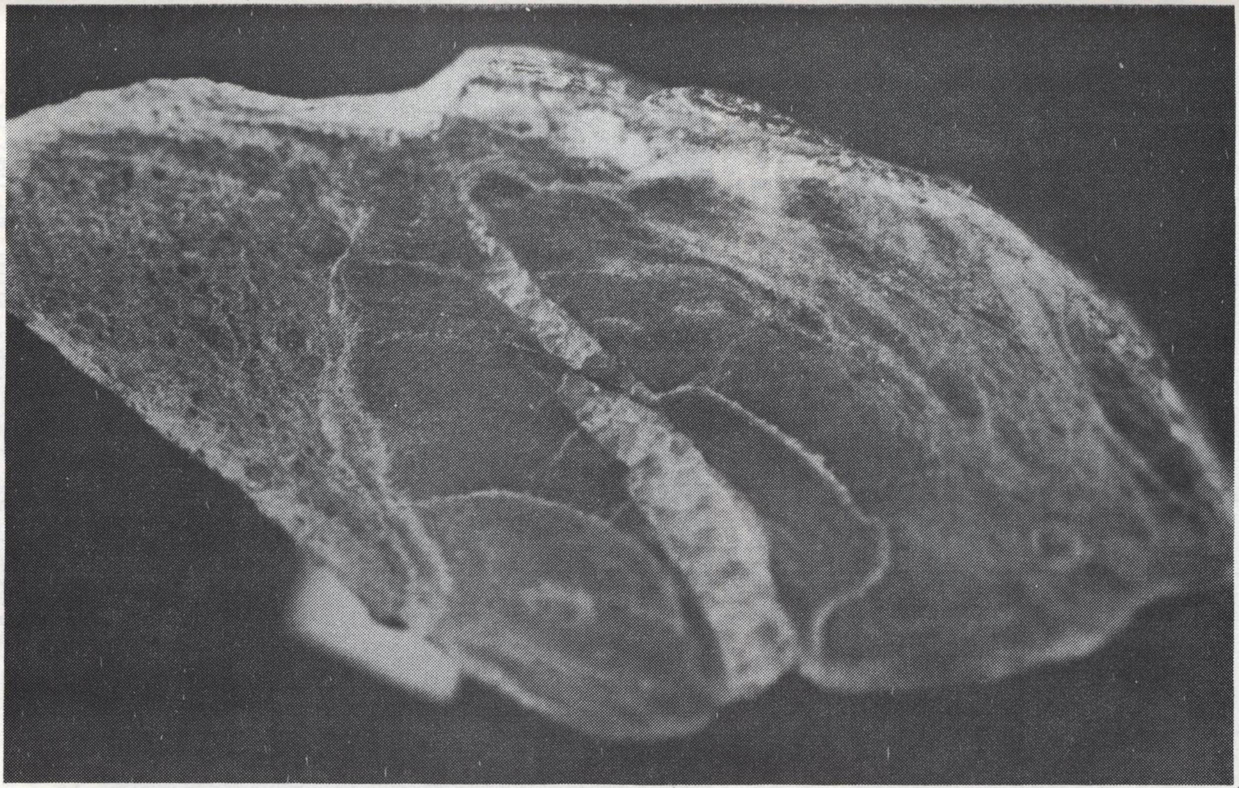


Figure 2. High-spired gastropod of *Loxonema* type illustrated on sawed surface of lenticular concretion. Visible on left of gastropod are the globular bodies and/or tubular filaments described in the Introduction of the text. X2.

Figure 3. Circular feature marking top of spire of gastropod (arrow). X2.

Figure 4. Shows perforated protuberance (knob) at center of probable operculum (arrow) and a part of its surface pattern. X3.

FURTHER CONSIDERATIONS

On the basis of present knowledge of the paleontology and distribution of the Silurian-Devonian formations in western New Hampshire and eastern Vermont, the writer envisions an environment conducive to forming biohermal structures of regional proportions.

Collectively, the Silurian-Devonian fossil localities in New Hampshire, beginning with the well-known Littleton area, trend south-southwest to cross the Vermont border, while the collective trend of the Silurian-Devonian fossil localities, starting with those in the Eastern Townships in Quebec, is south-southeast in Vermont, both trends fringing an extensive lobate area which noses at the long-studied Bernardston, Massachusetts, locality. This regional view of the known Silurian-Devonian fossil localities, along with additions in the future, has developed into an areal pattern of a probable organic reef complex within strandlines wedging southward, comparable in magnitude to the great barrier reefs now in existence.

ACKNOWLEDGMENTS

The writer appreciates the critical reading of the manuscript by his colleagues, Prof. Allen S. Hunt and Prof. Barry L. Doolan. The ideas expressed in this paper are wholly the writer's. The writer is also thankful for the enlargement of the algal deposits (Fig. 1), courtesy of Prof. John C. Drake.

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State Geologist's Report
[Continued from Page 6.]

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HIGH-LEVEL RADIOACTIVE WASTE PROGRAM

The DOE grant to monitor the federal high-level radioactive waste program terminated on September 30, 1986. The DOE has indefinitely suspended the search for a second repository in crystalline rocks.

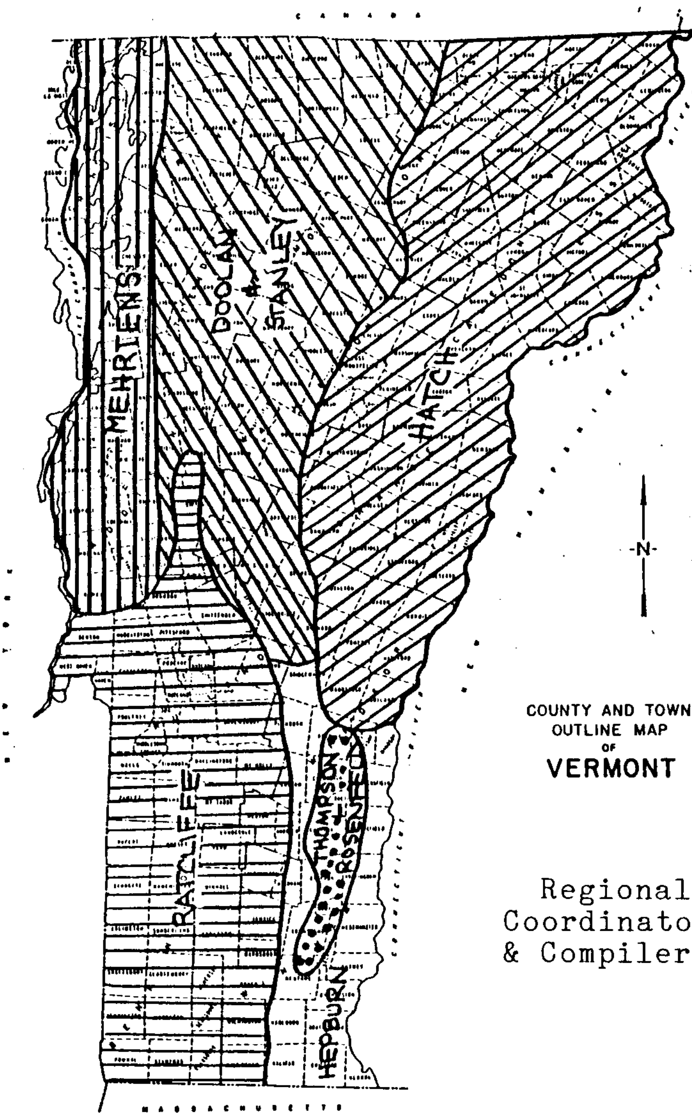
PERSONNEL CHANGES

First of all we should congratulate Diane and Frank Vanecek for their superb production. Jennifer arrived August 3, 1986 weighing in at 7 lbs. 11 oz. Diane will be on maternity leave until January. In the meantime Sharon O'Laughlin, a recent Master's Degree recipient from the Geology Department at U.V.M. is doing a fine job as our information officer.

Larry Becker who has been our high-level radioactive waste program coordinator leaves that frying pan to jump into the firing line of the low-level radioactive waste program. Larry will be devoting most of his time to this program but will also keep his hand in geology by working closely with the organization efforts and coordination of the surficial geology mapping program.

Keri West will be moving on to new adventures as a student at Woodbury College. We've enjoyed having Keri with us if only for a brief time as the administrative assistant in the high-level waste program. We wish you the best in your new experience.

Al McBean has completed his project of cataloging Vermont's metallic and industrial mineral occurrences. These have been entered into the U.S. Geological Survey Mineral Resources Data System (MRDS). Al has recently taken the position of chief Geologist with the Agency of Transportation.



Regional Coordinators & Compilers

ABSENTEE BALLOT
(Vote for one for each office.)

President	Shelley Snyder	☐
Vice President	Jeffrey Pelton	☐
Secretary	David Butterfield	☐
Treasurer	David Westerman	☐
Board of Directors:		
2-year term	Donald Wernecke	☐
1-year term	Stanley Corneille	☐

If you will not be attending the VGS Annual Meeting on Saturday, October 11, 1986 at 7:30 PM in Sambels' on the Common, Northfield, Vermont, 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:

Charlotte Mehrtens, Secretary
Vermont Geological Society
Box 304
Montpelier, VT 05602

It must be received before **OCTOBER 10.**

Harvard Mineralogical Museum
[Continued from Page 4.]

To reach the fossil exhibits, you leave the Mineral Museum and cross the hall, passing the glass flower exhibit. That is, if you can. We couldn't! It would be a shame to be so close to this unique work of a father and son and not see it. This collection of over 800 plants, all of them botanically correct, was made by Leopold and Rudolph Blaschka in Dresden, Germany between 1887 and 1936 to serve as an aid to botany students at Harvard. They are well worth spending some time to visit.

The fossil exhibit is well done. Many really striking specimens and dioramas are in this rather compact area. It is obvious they are keeping their displays up-to-date as there is an exhibit showing how X-ray examination of a trilobite specimen makes visible parts like legs and internal organs of the animal which would not be visible to the naked eye.

This museum is well worth a visit. If you want to go, contact me about a metered parking area we found after having to park illegally the first day we spent at the museum.

Submitted by
Ethel Schuele

MEETINGS

OCT 11 **VGS FALL FIELD TRIP AND ANNUAL MEETING.**
See page 3 for details.

OCT 17-19 78th Annual New England Intercollegiate Geological Confererence. The NEIGC will be held at Bates College this year. Registration is $15 and the guidebook $10.
Contact: Don Newberg, Dept. of Geology, Bates College, Lewiston, ME 04240, (213)786-6155.

Reminder of the Fall Visiting Lecture Series at UVM.
Seminars begin at 4 PM in Room 200, Perkins Building.

OCT 6 Dr. Gary Lash, "Sedimentation Patterns at Convergent Margins: An Ancient Example from the Central Appalachian Mountains".

OCT 23-24 Dr. Stephen Bachman, "Sedimentation, Tectonics and Basin Analysis" (Short Course).

NOV 17 Dr. Frank Spear, "Metamorphic Evolution of Mountain Belts".

Continuing the list of SEPM meetings. Information from: Joni C. Merkel, SEPM, P.O. Box 4756, Tulsa, OK 74159-0756 [(918)+743-2498].

OCT 20-21 SEPM Short Course "Recognition of Fluvial Deposition Systems and their resource potential", Baton Rouge, Louisiana.

NOV 1 SEPM Short Course "Exploration Concepts in Carbonate Rocks", Houston, Texas.

NOV 6-7 SEPM Short Course "Modern and Ancient Deep Sea Fan Sedimentation", Houston, Texas.

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

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

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

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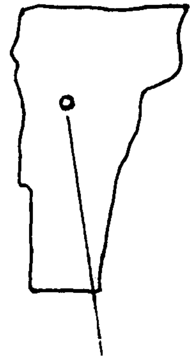
FIRST CLASS

Charles A. Ratté
4 Chestnut Hill
Montpelier, VT 05602

THE **GREEN MOUNTAIN GEOLOGIST**



QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

WINTER 1986 VOLUME 12 NUMBER 4

DON'T MISS THE 9TH ANNUAL WINTER MEETING FEATURING:

A SYMPOSIUM:

Current Research on Ground and Surface Water Quality in Vermont

THE KEYNOTE SPEAKER:

JONATHAN LASH

Commissioner, Department of Water Resources
and Environmental Engineering

"WATER QUALITY LEGISLATION IN VERMONT"

Saturday, February 15, 1986 8:45 A.M. PROMPTLY
Cabot Science Annex
Norwich University
Northfield, Vermont

[See page 3 for directions to Cabot Science Annex.]

CONTENTS PAGE

PRESIDENT'S LETTER

On behalf of the Executive Committee I would like to take this opportunity to welcome all members (old and new) to what we hope to be an exciting year for VGS.

The winter meeting scheduled for February 15 at Norwich University is shaping up with a good agenda. It seems appropriate at this time to focus the winter meeting on a topic that affects all of us - a clean and healthy environment. As in 1985, the Legislature is very busy grappling with bills and "counter" bills relating to groundwater and surface water protection. How do we maintain a clean environment while at the same time provide for a healthy economic climate in Vermont? The subject, of course, is a complex one, made up of many issues. I'm sure that we are all aware of the current debates involving ski area development and the purity of mountain streams. What streams and aquifers will we allow to be affected by development pressures, realizing that development is an essential fact of life? How do we minimize the impacts of growth? Is any pollution too much pollution? What about hazardous and toxic waste disposal? How do we deal with the chemical products of modern society without ruining the environment for generations to come? Being acutely aware of the problems that we face, we should be in a unique position since we have the opportunity to learn from the mistakes of others. Our speakers will talk about some of the legislative and technical issues that should be of interest to all of us.

On a different and lighter note, the Executive Committee will be meeting on the same day. The agenda for future events is wide open. The Committee would encourage your attendance and would welcome suggestions for future meetings and field trips.

We are always looking to increase our membershiip and I hope that each of you will try to recruit new members for our growing Society. The greater our membership, the wider and more diverse will be the spectrum of issues that we can learn about.

In the meantime, I will look forward to seeing you (and meeting many of you for the first time) at Norwich University. Enjoy the snows!

Steve Goldberg

WINTER MEETING PROGRAM

February 15, 1986

Cabot Science Annex
Norwich University Northfield, Vermont

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

MORNING SESSION: Room 45
Opening remarks: Steven Goldberg, Convener 8:45

KEYNOTE SPEAKER: Jonathan Lash
"Water Quality Legislation in Vermont"

1. Bruce Douglas: A study of the impact of high densities of on-site domestic sewage disposal systems on nitrate concentrations in groundwater. 9:25
2. John Amadon: Remediating LUST in Vermont 9:45
3. William Ahearn: Solid waste management in Vermont 10:05
4. Jeffrey Nelson: Application of groundwater modeling to a Vermont hydrogeologic setting 10:25

COFFEE BREAK.................................. 10:45

5. Lawrence Becker: Status of the U.S. Department of Energy's high level nuclear waste disposal proposal.......................... 11:00
6. Winslow Ladue, Katherine Leonard and Dave Manning: Radon update 11:20
7. Paul Washington: Bedrock structures vs. groundwater plumbing in the Cambro-Ordovician strata of Addison County.................... 11:40
8. Jack Drake: Sediments as sources and sinks of nutrients............................ 12:00

EXECUTIVE COMMITTEE MEETING...................... 12:45
Bring a brown bag lunch and join the committee for a discussion of the following business:
1. Current water quality legislation,
2. Planning VGS' 1986 calendar,
3. Booth display at NE GSA.

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

SOLID WASTE MANAGEMENT IN VERMONT

Ahearn, William, Solid Waste Management Chief,
Department of Water Resources, AEC, Montpelier, VT 05602

Solid waste in Vermont continues to mount up. Our disposal technology consists of two distinct options. The land filling of waste which is the most common option, concentrates waste in one area, dedicating the land use and in many instances, groundwater use within the zone of influence of the disposal facility. The other principle disposal technology is land application of waste. The beneficial use of waste is accomplished by this technology. Materials reuse and recycling for beneficial use requires that we view waste as factors of production for another process.

The land application of waste water sludges is an excellent example of reuse of waste materials. The perception that the public maintains significantly affects the success of this practice. The interactions between waste, soils and soil fauna impact on the benefits that this technology produces. These same factors impact the degree of comtaminant intrusion into groundwater. The responsibility for our ground and surface water resources has been assigned to the Agency of Environmental Conservation. The development of regulations and guidelines has been consistent with the evolution of knowledge in the field. The emergent technologies in waste management are predicated on the scientific strides being made in groundwater flow modeling and containment flow modeling. Groundwater chemistry of the multitude of organic compounds is rapidly becoming an essential element of our waste management strategies. The great desire of Vermonters to maintain or improve water quality is a well-known tenet with which we all live. This is in conflict with some of the practices that our society currently embraces.

The resolution of this conflict is anticipated to occur through the interaction of societal components within the regulation process. There are many special interest groups that are active in advocating their positions. The public needs careful administration of the programs that balance these conflicting desires. The solid waste management section is currently preparing to revise the state solid waste management plan. This document will serve as a framework for evaluating the needs and benefits in managing Vermont waste streams.

REMEDIATING LUST IN VERMONT

Amadon, John, Soil Scientist, Waste Management Division,
Agency of Environmental Conservation, Montpelier, VT05602

The UST legislation (Underground Storage Tank) promulgated in 1985 will become effective in 1986. There has been a flurry of activity over the last year by many tank owners to replace tanks prior to implementation of the regs. Many leakers (LUST) have been found. The degree of petroleum product contamination varies from site to site. The types and extent of ongoing remediation measures also varies. The paper will

discuss types and degree of contamination as well as the measures being used for remediation. Types of contamination include vapor phase, free product saturating soils or floating on water tables, and soluble components, in groundwaters. Remediation measures include the 'Yank-a-Tank' protocol, 'muck and truck cleanup', and insitu remediations such as soil venting, water table depression with product recovery, treating soluble components in groundwaters, and enhancing naturally occurring biodegradation.

STATUS OF THE U.S. DEPARTMENT OF ENERGY'S HIGH LEVEL NUCLEAR WASTE DISPOSAL PROPOSALS

Becker, Larry, Office of the Vermont State Geologist,
Agency of Environmental Conservation,
Montpelier, VT 05602

The U.S. Department of Energy is proposing to site a second repository for high-level nuclear waste disposal east of the Mississippi River. Twelve sites have been chosen for further study in New Hampshire, Maine, Minnesota, Wisconsin, Virginia, North Carolina and Georgia. The first repository will be constructed in a western state with a 1998 opening date. A date in mid-February is set to choose three sites in the west that will receive detailed site characterization studies.

For the next five years the sites in the east will undergo Area Characterization Studies before Congress decides if a second repository is needed. Studies in the east may include geologic mapping, geophysical work and drilling of boreholes for coring and hydrologic testing. Keeping track of the Department of Energy's activities is part of the Vermont State Geologist's responsibilities through the Vermont High Level Radioactive Waste Monitoring Program.

The seventy-eight square mile site chosen in South Central New Hampshire is in the Cardigan Pluton, twenty miles from the Vermont border, in the vicinity of the intersection of Sullivan, Merrimack, Hillsborough and Cheshire counties. Preliminary work indicates that the proposed potentially acceptable site is primarily underlain by Kinsman Quartz Monzonite, Vermont's geologic concerns focus on the unknown nature of groundwater flow at repository depths and the need to investigate the possibility of the Connecticut River being a discharge zone for deep ground waters from this New Hampshire site.

A STUDY OF THE IMPACT OF HIGH DENSITIES OF ON-SITE DOMESTIC SEWAGE DISPOSAL SYSTEMS ON NITRATE CONCENTRATIONS IN GROUNDWATER

Douglas, Bruce, Hydrogeologist,
Department of Water Resources, Montpelier, VT 05602

The cumulative impact of high densities of existing single-household on-site sewage disposal (OSSD) systems on nitrate+nitrite-N concentrations in groundwater is being investigated. High densities are considered to be residential developments with greater than one OSSD system per two acres. The investigation consists of a literature review and field study. Existing analytical models to predict the impact of various densities of OSSD systems are being evaluated. These methods are primarily based on estimating dilution of nitrate in groundwater. Nitrate+nitrite-N concentrations in groundwater are being monitored at six high density residential developments with OSSD systems in Vermont. These developments were selected based on their lot sizes, number of single-family dwellings, general hydrogeological environments, previous and adjacent land uses, age of the developments and other criteria. At each of two residential developments, five monitoring wells have been installed. The geologic environment at these sites can be generally described as coarse textured stratified drift overlying lacustrine silt and clay. Four residential developments with glacial till soils over bedrock aquifers are also being monitored. Water quality samples are collected at eight to twelve domestic water supply bedrock wells at the till sites. The monitoring network is being sampled monthly. Sampling began in November, 1985 and will continue through November 1986. Samples are being analyzed for total nitrate+nitrite-N, total ammonia-N, total chloride, total dissolved solids and conductivity. This is an interim report focusing on site selection, site hydrogeology and the results of the first three months of groundwater quality monitoring.

SEDIMENTS AS SOURCES AND SINKS OF NUTRIENTS

Drake, John C., Department of Geology,
University of Vermont, Burlington, VT 05405

Although the release of phosphorus from profundal sediments has long been accepted, phosphorus regeneration from sediments under aerobic conditions has more recently been recognized as a potentially significant nutrient source. Whole lake mass balance studies, limnocorral investigations and laboratory measurements of P release from intact sediment cores all confirm the release of P from aerobic sediments. Factors affecting the release of phosphorus include current velocity, pH, sediment phosphorus concentrations, temperature, and redox potential. The basis for these controls are discussed with specific application to St. Albans Bay, Vt. and Esthwaite Water., England. A review of analogous investigations provides a basis for comparative evaluations. In addition to serving as a source of phosphorus, sediments also act as a sink, ameliorating the effects of both point and non-point inputs. This is clearly demonstrated by sediment-phosphorus relationships in the Stevens Brook - Jewett Brook wetlands.

RADON UPDATE

Ladue, Winslow, Katherine Leonard and Dave Manning,
Vermont Department of Health, P.O. Box 70,
Burlington, VT 05402

The Vermont Department of Health has completed a radon sampling effort on public community water supplies supplied by groundwater sources. Results of 379 water supplies range from 0 to 14,000 pCi/l, with a median value of about 600 pCi/l and a mean of about 925 pCi/l. Analysis of the data is underway and will include an evaluation of radon levels and source type and geologic setting.

APPLICATION OF GROUNDWATER MODELING
TO A VERMONT HYDROGEOLOGIC SETTING

Nelson, Jeffrey A., Wagner, Heindel and Noyes, Inc.,
P.O. Box 1629, Burlington, VT 05402-1629

A variety of techniques are available to numerically model the flow of groundwater and the movement of contaminants in confined and unconfined aquifers. Among these are finite element and finite difference methods for flow simulation, and method of characteristics, random walk, and finite element for solute transport modeling. These techniques have been incorporated into a number of computer codes which allow the simulation of a variety of aquifer configuration and stresses. These include simulations of steady-state and transient conditions, pumping and injection conditions, irregular boundaries, and rainfall recharge.

Among the various computer codes available is the USGS method of characteristics program. This program was written in 1978 by Bredehoeft and Konikow, and can be applied to confined and unconfined aquifers to solve for 2-dimensional groundwater flow and solute transport. The program was used in a hydrogeologic evaluation of a proposed 20,000 gpd subsurface wastewater disposal site in northern Vermont.

The purpose of the evaluation was to determine the hydraulic response of the groundwater system, and the potential for off-site migration of contaminants resulting from the disposal system.

Field collection on the site consisted of a series of test pits and borings, which indicated a sequence of deltaic sands underlain by a continuous clay layer. Water level measurements in the borings indicated that two separate aquifers merged beneath the proposed disposal system: a relatively large regional groundwater system, and localized hillside aquifer. An intensively monitored, 5-day controlled loading test was used to calibrate the model. After calibration, the model limits were extended so that the boundary effects would not influence the predicted response of the full scale disposal system. A full-scale transient simulation of the effect of the proposed loading on the existing groundwater conditions was conducted for a total period of 1 year, using 1 month time steps. The model predicted an induced groundwater mound approximately 4 feet in height beneath the disposal fields. Additionally, the contaminant transport simulation indicated that, although there would be off-site migration of contaminants, there would be no threat to nearby water supplies located upslope, but within the same aquifer. The model provided a more realistic view of the groundwater/effluent than traditional methods of analysis such as plan view flow nets.

BEDROCK STRUCTURE VS. GROUNDWATER PLUMBING
IN THE CAMBRO-ORDOVICIAN STRATA OF ADDISON COUNTY

Washington, Paul, BOX 75, East Middlebury, VT 05740

Most (approximately 85 percent) private water wells in Addison County west of the Green Mountain front derive their water from bedrock aquifers. These aquifers are generally confined by virtually impermeable country rock, so the only exploitable water supplies are found when one of these aquifers is encountered.

A lack of permeable strata as well as a lack of correlation between water availability and penetrated strata suggests that these are not stratigraphically controlled. Recent detailed mapping in this area has revealed a system of previously unrecognized thrust faults. Initial comparison of well depths with the surface structural data shows a very strong correlation between location of exploitable water supplies and expected location of the faults within this thrust system. In addition, almost all bedrock springs occur along the surface traces of these thrust faults. The combination of the through-cutting fractures that comprise the faults and the dense fracture arrays adjacent to the fault planes are thus the primary conduits for groundwater movement in this area.

Since the thrust faults are imbricates splaying off of master detachment surfaces, these conduits connect at depth to form large plumbing system(s). The subsurface connection between the various elements of this plumbing sustem has serious implications for the areal effects of contaminents. This, in turn, has major implications for the effects of such contamination on both domestic and commercial (mainly farm) activity in the Champlain Valley.

THE BOLTON KNOBS

Charles G. Doll

Fascinating in the field of glacial geology is the study of profiles which are an important part of the description of a glacial feature. In the Winooski River valley one mile east of the village of Bolton, where the valley broadens, a whole mountain side of glacially eroded bedrock features, known in the science of glacial geology as roches moutonnées (sheep rocks), may be viewed from U.S. Route 2 (overlooking a colony of mobile homes) and even appreciably recognized on the fly from paralleling Interstate 89, each glaciated unit is so well fashioned.

The eye clearly sees the long profile of each well-formed feature, the extended smooth stoss side overridden by the continental ice sheet and the short, blocky, steep lee side from which the overriding glacial ice plucked chunks of bedrock along fractures to be deposited elsewhere as glacial erratics along its course, the gently sloping stoss side indicating the direction of movement of the continental ice mass from left to right or northwest to southeast.

Expanding the view, the roches moutonnées appear to be formed on a common base, the mountain side which itself describes a corresponding longitudinal profile of a huge roches moutonnée, in a way analogous to a portly dam with her progeny clinging to her side (Fig. 1).

Figure 1. The Bolton Knobs, viewed from U.S. Route 2.

Many geological phenomena seem to center around Lake Dunmore.
- H. M. Seely (1910, p. 305) -

FOSSIL CERVALCES BONES FROM LAKE DUNMORE, VERMONT

Charles G. Doll
Emeritus Professor of Geology
University of Vermont

ABSTRACT

Three ancient moose antler bones, of which two fit together, were found in kame terrace deposits at the outer part of the Branbury State Park bathing beach in Lake Dunmore. Radiocarbon dating gives an age of $25{,}460^{+1870}_{-1520}$ C-14 years B.P.

INTRODUCTION

The specimens were submitted by R.H. Fifield, Department of Forests and Parks, Pittsfield, Vermont, finder unknown. It was pointed out from the shore by Mr. Fifield that the find was made in the vicinity of the beach raft. Subsequent attempts to locate additional specimens were made without success. The beach is on a kame terrace which is reported to surround the lake (Connally, 1970: Connally and Calkin, 1972). The bones were not necessarily *in situ* when discovered, as the copious meltwater from the adjacent slope could have transported them into the depression of the lake during the building of the kame terrace; near-by Falls of Lana most certainly had the capacity which they continue to demonstrate, though in reduced post-glacial volume.

Previous known discoveries of Pleistocene land mammal bones from boggy areas in Vermont consist of the following with localities from these sources: Agassiz, 1850; Hitchcock, 1861; Perkins, 1910; Thompson, 1853. (Asterisks indicate specimens in the Department of Geology museum at the University of Vermont).

Mammoth tusk, Bellows Falls
Mammoth tusk, Brattleboro*
Elk hip bone and horns, Fletcher*
Elk antlers, Grand Isle*
Mammoth tusks (2) and tooth, Mount Holly
  (one tusk and plaster cast of tooth)*
Mastodon tusk, Richmond*
Caribou horn, Woodbury*

The Lake Dunmore discovery is an important addition to those listed above, as the specimens have had the advantage of radiocarbon dating. They are now a part of the collection in the geology museum mentioned above.

BONE DESCRIPTIONS

The bones appear to have been in the water a long time, as indicated by the reddish-brown to black color and some replacement (Fig. 1). Irregular fractures, some prominent, traverse the bones lengthwise, but do not show in cross section. The bones are massive and have added weight due to partial replacement.

TABLE 1

Measurement details of the specimens.

Specimen	Length cm	Width cm	Thickness cm	Weight gm
LD-1a	15.24	6.35 to 3.81	2.86 to 2.54	283.50
LD-1b	13.97*	7.30 to 6.35	3.17 to 2.86	368.55
LD-2	33.02	4.76 to 2.54	2.22 to 1.60	496.13

*Bone LD-1b has been shortened to 7 cm for an adequate radiocarbon testing sample.

RADIOCARBON DATING

Age determination was made by Krueger Enterprises, Inc., Geochron Laboratories Division, Cambridge, Massachusetts. Their report stated that collagen could not be recovered in an amount sufficient for dating, but that the bone apatite fraction was used in the analysis, which gave an age of $25{,}460\ ^{+1870}_{-1520}$ C-14 years B.P.

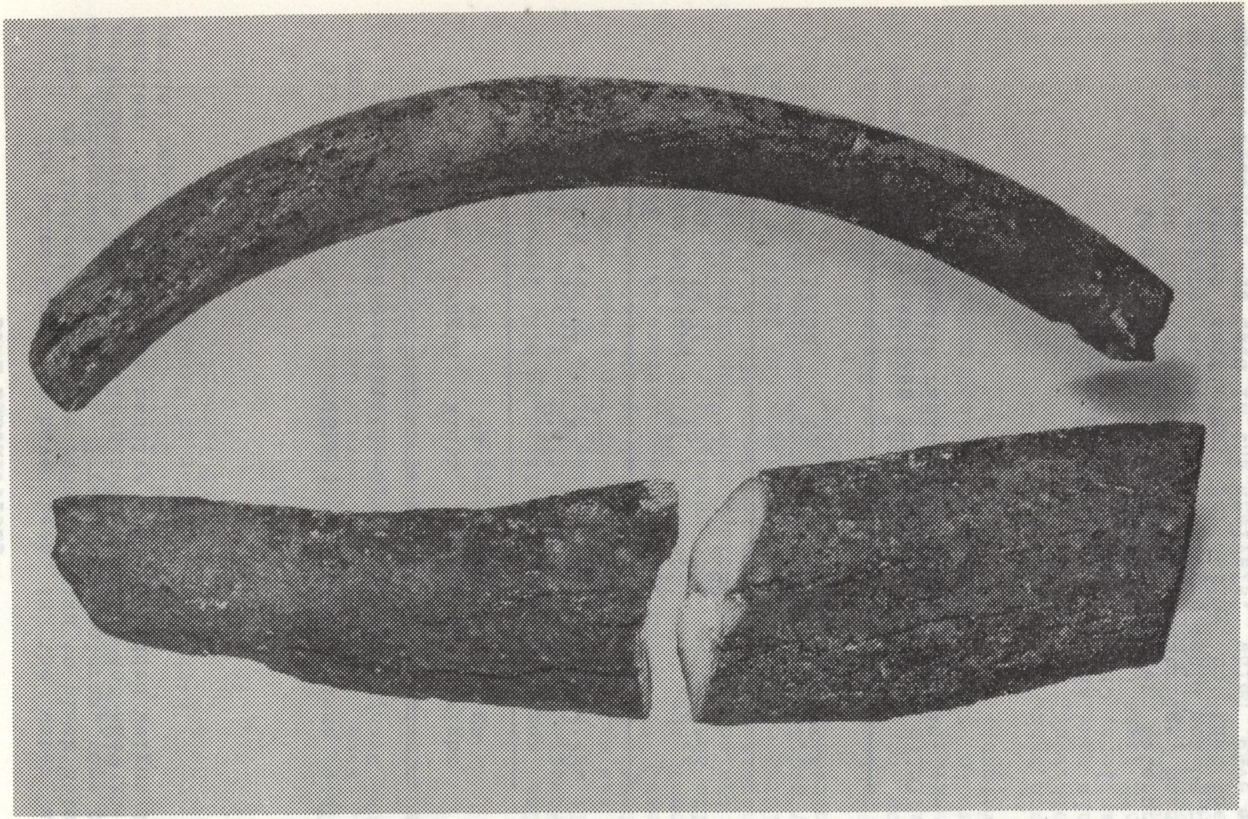


Figure 1. The bones showing massive interior structure.
Bones LD-1a, left; LD-1b, right; LD-2, rear.

Figure 2. Reconstruction of a stag-moose from a skeleton in Princeton University Museum (from Scott, 1937).

DISCUSSION

A comparison study of the full display of antlers in the Agassiz Museum at Harvard University was made in the company of Professor Bryan Patterson. After some thought on the possibilities between elk and moose antlers, it was decided that the specimens more nearly resembled those of the latter, very possibly a stag-moose (Fig. 2). Stag-moose (Cervalces) were native only to North America (Scott, 1937). They inhabited the subarctic forest-belt not far from the waning ice sheet (Flint, 1957). This was the likely scene in this part of the Champlain Valley as the glacial ice was slowly retreating northward, before the early lake stages in the basin.

ACKNOWLEDGMENTS

The writer is indebted to Professor Bryan Patterson for his valuable assistance in the determination of the probable possessor of the antler bones. Appreciation is extended to Professors Allen S. Hunt and Barry L. Doolan for critically reading the paper.

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VGS BUSINESS & NEWS

PUBLIC ISSUES COMMITTEE

The current legislative session in Montpelier is actively addressing a number of issues of potential interest to geologists. Here is a brief summary of the proposed legislation and rule changes, as of January 20:

S.38: Underground Storage Tanks (Delaney-Soule). Regulates underground storage tanks.

S.42: Pristine Streams Protection (Doyle-Spaulding). (Same as H.274) Authorizes state to identify 25 pristine streams; provides high level of protection for those streams.

S.95: Wetlands Protection (Delaney-Conrad-Little). Authorizes state to identify wetlands; provides high level of protection.

S.132: Hazardous Waste Clean-up Fund (Skinner). Establishes fund by $5 million bond.

S.148: Water Resources (Senate Committee on Natural Resources and Energy). Authorizes state to establish well standards, to issue general discharge permits.

S.227: Liability for Nuclear Waste Sites (Welsh). Establishes fund to compensate victims and state for damages.

H.81: Geological Survey (Faris). Establishes geological survey as division of AEC.

H.453: Contaminated Soils (Fortna and others). Establishes planning program for petroleum-contaminated soils.

H.459: Sludge and Septage Management (Fortna and others). Establishes management plan.

H.586: Non-point Discharges and Pristine Streams (Emmons). This is Agency of Environmental Conservation proposal: makes distinction between point and non-point discharges; establishes high level of protection for all streams above 1500 feet in elevation; sets up management programs for significant non-point discharges, including requirement for discharge permit; removes the appeal of discharge permits and certificates of compliance from the Act 250 process.

Proposed: Non-point Discharges and Pristine Streams (Water Resources Board).
1. A rule change, to allow non-point discharges into Class B and possibly Class A waters.
2. No major legislation is needed: just administer existing legislation as written, rather than as currently practiced. This would limit public participation and appeals to water quality issues.

Proposed: Rebuttable Presumption of Certificate of Compliance (Environmental Board). A 'rule' change to give certificate more weight in Act 250.

The VGS Executive Committee will be discussing an updated and expanded version of this list, hopefully at the February 15 meeting. If any VGS members have any comments on any of these bills, please make them known to any members of the VGS Executive Committee, or directly to the legislative committees discussing them. For information on legislative committees and hearings schedules, call the legislative council (828-2231).

Submitted by
Craig Heindel

VGS BOOTH AT NE-GSA

In a bold attempt to present the Society to a large audience of geologists, we will operate a booth at the Northeastern Section Geological Society of America meeting at Kiamesha Lake, New York during March 14-16. Actually, we will be using only half the booth, because we are sharing it and the cost with The Maine Geological Society. We will take this opportunity to sell volumes 1-4 of Vermont Geology, distribute membership information and display some publications of the Vermont Geological Survey. Jeanne Detenbeck has agreed to staff the booth for VGS (but I'll appreciate the chance to attend a talk or two if any members have time to help sit at the booth). Ideas for our booth display will be discussed at the Executive Committee meeting at the winter meeting, February 15 at Norwich University. A revised membership application and a VGS flyer (describing the purpose and activities of the Society and listing the contents of the 4 Vermont Geology volumes with an order blank) will be available also at the winter meeting for your inspection and suggestions.

Look for us at **BOOTH #2** under the sign "**VERMONT AND MAINE GEOLOGICAL SOCIETIES**", and wish us luck!

MEET THE OFFICERS

There are a number of new faces at the Executive Committee meetings since the last election and because the officers may not be known to all the groups that make up our Society, it is appropriate to introduce all the officers here.

The President, Steve Goldberg, a native Vermonter from Burlington, received his B.A. in biological sciences from the University of Vermont. In Scotland, he received his PhD in soil chemistry from Edinburgh University. Steve lives and works in Montpelier as a hydrologist and soil scientist in the Department of Water Resources where he deals with issues relating to ground and surface water protection.

Carolyn Merry, our Vice President, came to New England from Wattsburg, Pennsylvania with a B.S. in geology from Edinboro State College. She received her M.A. in geology from Dartmouth College and is working for her PhD in Engineering from University of Maryland at College Park, expecting to complete her degree this summer. Since 1973 she has been working at the U.S. Army Cold Regions Research and Engineering Laboratory in the field of remote sensing, analyzing satellite and aircraft scanner data using image classification techniques. She lives in Enfield Center, New Hampshire.

Charlotte Mehrtens, the Secretary, received her PhD from the University of Chicago in 1979 and has been teaching soft rock geology ever since, first for three years at St. Lawrence University and currently at the Department of Geology at the University of Vermont. Her field of research is stratigraphy and sedimentology of the Cambrian-Ordovician sequence of western Vermont and adjacent New York. She commutes to work from Jonesville and in her spare time coaches the UVM crew club.

Dave Westerman, the Society's treasurer, is an Associate Professor of Geology at Norwich University and spends part of each summer working as a field mapper for the Vermont Geological Survey. Dave is a general geologist with advanced training in the areas of petrology and tectonics. He lives with his wife, Elga Gemst, in the town of Moretown, and has two teenage children who live in the south. As a transplanted Mainiac, Dave thoroughly enjoys his adopted state where he feels very much at home.

Roger Thompson, a charter member of VGS, is serving on the Board of Directors as Past President. He is another native Vermonter, born in Woodstock, and has lived in Hartland since 1977. He received both his B.A. and M.S. in geology from the University of Vermont and has worked as the Regional Engineer in Springfield for the Agency of Environmental Conservation, Water Resources Department since 1979.

Shelley Snyder, who is serving her second year as a Director, is our third native Vermonter. She received her B.A. in geology from the University of Vermont and worked for a time at the Water Quality Laboratory of the School of Natural Resources at UVM. Taking time off for two active sons, Shelley has now returned to St. Michael's College for a Master's degree and a teaching certificate in order to teach math and science in the public schools. A resident of South Burlington, she serves on her community's Natural Resources Committee and is active in the PTO.

Steve Revell, starting a term on the Board of Directors, is another native of Pennsylvania, receiving a B.A. in geology from Franklin and Marshall College, Lancaster and an M.S. in geology from Southern Illinois University in Carbondale. Steve runs his own company, Lincoln Applied Geology, actively consulting on soil, water and rock related problems. His specific responsibilities include geotechnical planning, prediction of potential problems and correction of instantaneous or existing problems as they relate to the soil, water and rock environments. His professional interests and specialties include: hydrogeology, emphasis on groundwater development, containment hydrogeology and remedial action. Steve is active in the Association of Ground Water Scientists and Engineers , The American Institute of Professional Geologists and serves on the Governor's Special Task Force on On-Site Waste Disposal Technology. In Lincoln, where he lives, he is 1st Assistant Chief of the Lincoln Volunteer Fire Department and member of the Vermont State Firefighters Association.

Vermont Geological Society - Treasurer's Report for 1985

January 22, 1986

Balance as of 1/1/85			$ 684.95
Income			
	Dues	1153.00	
	Interest	30.87	
	Publication sales	727.50	
		1911.37	
			+ 1911.37
			$ 2596.32
Expenses			
	Postage	269.32	
	Printing/Xeroxing	1391.66	
	Office supplies	82.96	
	Meeting expenses	19.12	
	Student prizes	50.00	
	Post box rent	22.00	
	Service fees	21.50	
	Charles G. Doll Award	197.58	
	Engraving	13.87	
		2068.01	
			- 2068.01
	Balance as of 12/31/85		528.31

Respectfully submitted,

David S. Westerman

David S. Westerman
Treasurer

REMINDER - DUES ARE DUE!!!

Minutes of the Fall Membership Meeting
October 19, 1985
Holiday Inn, White River Junction

Roger Thompson called the meeting to order at 8:15. Jeanne Detenbeck read the minutes from the last meeting, which were approved as written.

Dave Westerman and Jeanne Detenbeck tallied the votes for the new officers of VGS and the following slate was elected:

Steve Goldberg - President
Carolyn Merry - Vice President
Dave Westerman - Treasurer
Char Mehrtens - Secretary
Stephen Revell - Board of Directors

Dave Westerman presented the Treasurer's Report, which stated that our current balance was $526, but with unpaid expenses related to the publication of Vermont Geology, Vol. 4 (Field Trip Guides), would drop to $263. This initiated a discussion of possible ways to generate more money. Our assets appear to be tied in stock of back issues of Vermont Geology vols. 1-3, so several suggestions included ways to sell these issues (special sale prices, increased advertising). After much discussion, it was moved and approved that VGS cease all new publications, with the exception of Green Mountain Geologist, until monies are recouped from the existing stock of publications, to be determined by the Executive Committee. Various members stressed that VGS needs to increase advertising, both to increase membership as well as sales of publications. Earth Science teachers and high school libraries were mentioned as an untapped pool of potential subscribers to GMG. The Treasurer's report was approved unanimously.

In New Business, the Executive Committee moved to confer lifetime honorary membership on Brew Baldwin in recognition of his contributions to Vermont geology. There was a motion from the floor to confer lifetime membership on Jeanne Detenbeck as well, in recognition for her efforts for VGS. This also passed unanimously.

Fred Larsen was thanked for leading the fall field trip. The meeting was adjourned at 10PM.

Respectfully submitted,
Char Mehrtens, Secretary

Minutes of the Executive Committee Meeting
December 18, 1985, Montpelier

The meeting was called to order at 7:15 by president-elect Steve Goldberg. Also present were Dave Westerman, Jeanne Detenbeck, John Malter, Shelley Snyder and Char Mehrtens. Minutes from the Fall membership meeting were approved and the committee quickly moved onto New Business with a discussion of the date and topic for the Winter VGS meeting. Considering the current legislative interest in water quality issues in the state, it was decided that the Winter meeting should be devoted to water quality: current areas of research, current methods of research, recent problems in Vermont.

The date chosen for the meeting was Saturday, February 15. Considering that we would like the location to be convenient to legislators in Montpelier, Norwich University was chosen as the site for the meeting. John Malter and Steve Goldberg agreed to formulate the program.

Continuing New Business, Dave Westerman presented the Treasurer's Report, and stated that VGS currently had a balance of $550. This balance does not include various invoices for publication and winter dues, which should improve the balance to approximately $725. The Treasurer's Report was approved.

The final item of New Business concerned our continued efforts to increase membership. It was suggested by Dave Westerman and Jeanne Detenbeck that VGS look into obtaining an exhibition booth at the Northeastern GSA meeting in March, 1986. The cost of renting a booth would be $90, and it is also possible that a booth could be split with either Northeastern Geology or Maine Geological Society. Dave Westerman will investigate if either of these organizations is interested in sharing a booth. The committee moved and approved to send Jeanne to the NEGSA as a VGS exhibitor, operating our own booth, or one shared with NEG or MeGSoc. The booth would be used to provide membership applications to interested parties, as well as provide a location for sales of VGS publications.

The meeting was adjourned at 10PM.

Respectfully submitted,
Char Mehrtens

RECENT PUBLICATIONS

1,500,000 Bedrock and Surficial Maps of Maine

Bedrock Geologic Map of Maine, 1985, edited by P.H. Osberg, A.M. Hussey, II and G.M. Boone, full color, 42" x 58". Price: $5.00 + 25c sales tax.

Surficial Geologic Map of Maine, 1985 edited by W.B. Thompson and H.W. Borns, Jr., full color, 42" x 53". Price $4.50 + 23c sales tax.

Please specify rolled or folded copies.
SALES TAX DOES NOT APPLY TO OUT-OF-STATE ORDERS.

Send check or money order made payable to
Treasurer, State of Maine to:
Maine Geological Survey
State House Station 22
Augusta, ME 04333

MINERAL OF THE QUARTER

PYRRHOTITE

Formula: Fe(1-x)S (where x varies from 0 to 0.2)
Specific Gravity: 4.6 | Hardness: 3.5 - 4.5
Streak: Grey-black | Color: Reddish bronze
Luster: Metallic | Brittle

Crystal system: Below 138° C hexagonal; above, orthorhombic. Seldom found in crystal form, usually granular and massive.

The name of Pyrrhotite comes from the Greek word for reddish which refers to the color of the mineral on a freshly broken surface. Otherwise it is brownish-bronze.

The composition of Pyrrhotite varies from Fe(5)S(6) to Fe(16)S(17). Troilite (found in nodules in iron meteorites) is considered the end member of the series. It is closest to FeS in composition. It may also carry nickel as in Pentlandite with which it forms a valuable nickel ore deposit in Sudbury, Ontario and Petsamo, USSR.

FeS is a common minor constituent of basic igneous rocks, pegmatites, high temperature veins and contact metamorphic deposits. It is often found with pyrite, chalcopyrite and magnetite.

With magnetite, it is one of only two naturally occurring ferromagnetic minerals. An interesting characteristic of Pyrrhotite is its variation from paramagnetism to ferromagnetism as it varies from highest iron composition to the smallest proportion of iron possible in its crystal lattice. Research has shown that the atomic cell spacing in pyrrhotite crystals which have the lowest concentration of iron atoms favors the parallel orientation of the electron spins which produces strong magnetic properties.

A Vermont Pyrrhotite Location

Massive Pyrrhotite can be found in the dumps of the old Ely mine which lies between W. Fairlee and So. Vershire in Orange County. To find this location, take Route 113A to West Fairlee. Go west one and a half miles toward So. Vershire. The ruins of the old smelter and the former village of Copperfield are visible on both sides of the road. Park and follow the dirt road 3/4 mile to the mine dumps. Minerals such as pyrite, sphalerite, chalcopyrite, actinolite, calcite, garnet, hornblende and malachite have also been found on these dumps.

Since this is not rockhounding weather, readers may appreciate a little of the wild history of this Vermont Copper Mining Company. This location was developed by Captain Thomas Pollard, who obtained the first charter from the Vermont legislature in 1853. He was a Cornishman who knew mining from his experiences in the rich Cornwall copper and tin mining area. Even after Smith Ely, a rich New Yorker, bought him out, he was kept on as a manager of the mines. By 1864 the mine was producing over 100 tons of copper ore, daily. After the smelter was built, the amount of copper shipped yearly was 3 million pounds. In 1880 this mine was producing more than half of the entire copper output of the United States.

Speculators were anxious to buy into this thriving company and the ownership changed. Due to financial mishandling, the company finally owed the miners a tremendous amount of back pay. By 1883 the miners decided to revolt and destroy the mines and miners tenements as they were not able to get any redress from the Conpany's new owners. The governor heard about the plot and sent Vermont National Guard troops into the mine area hidden in ore cars. The Guard, however, was sympathetic to the miners' cause and did not stop the miners from taking what little money had been left on the premises (as the owners had skipped during the night). Most of the miners moved on, but a few that were left burned down the plant on April Fool's Day in 1884.

No one seemed to be able to get the mines in this area back into production until the new Vermont Copper Company was formed during the 1940's. After this, production of ore continued for several decades. The ore was shipped to southern New England to be smelted.

This mine is not in operation at this time. It does still add acid copper-bearing water to Vermont streams. The environmental problems caused by a mine that is not in operation are even harder to solve than those of an operating mine that has funds to pay for the technology needed for pollution abatement.

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Submitted by Ethel Schuele

STATE GEOLOGIST'S REPORT

A summary of 1985 events

EXPECTED MOVE. In January the adminstration announced that the Agency of Environmental Conservation would be moved from the State Capitol in Montpelier to renovated buildings at the state hospital complex in Waterbury. The move is expected to be completed by fall of 1986.

LEGISLATION. The legislation submitted during the 1985 session to officially create a Vermont Geological Survey died in the Government Operations Committee.

GEOLOGIC MAPPING. Two new COGEOMAP projects were initiated in 1985:

1. Lithostratigraphic mapping of Cambrian-Ordovician sequences in Northwestern Vermont - Dr. Charlotte Mehrtens, University of Vermont.

2. Gilson Mountain Quadrangle in north central Vermont - Dr. Barry Doolan, University of Vermont.

NUCLEAR WASTE. The Department of Energy extended the grant to monitor the DOE high-level radioactive waste crystalline rock program through 12/31/86.

MINERAL RESOURCES DATA SYSTEM. The compilation of data for all of Vermont's non-metallic mineral resources will be completed by 1/31/86. This will complete the second phase of our grant from the U.S.G.S.

TOPOGRAPHIC MAPPING. Two quadrangles were published in 1985. These maps are in the provisional format covering 7 1/2 minutes of latitude and 15 minutes of longitude at a scale of 1:25,000 and 6 meter contours:

Bellows Falls, Vermont - New Hampshire
Walpole, New Hampshire - Vermont

CUSMAP. The Glens Falls U.S.G.S. $1^{\circ} \times 2^{\circ}$ area CUSMAP project completed the third summer of field work which was commemorated by a week long field trip August 5-11, 1985.

SLOPE STABILITY STUDIES. U.S.G.S. completed the third year of field studies under a MOA with the State Geologist's Office. Several papers are in the process of review. Charlie Baskerville and Greg Ohlmacher (U.S.G.S.) presented some of their work in a paper at G.S.A. in Orlando in October entitled "Slope Movements on Fliudized Zones in Varved Deposits of Glacial Lake Hitchcock, Windsor County, Vermont".

Submitted by
Charles Ratté, State Geologist

MEETINGS

FEB 15 **VGS WINTER MEETING** - see page 3.

MAR 12-14 Northeastern Section of Geological Society of America annual meeting at Kiamesha Lake, New York. For information write to: Registration NEGSA, Earth Science Department, State University College, Oneonta, New York 13820-1380. Stop at Booth #2, **"VERMONT AND MAINE GEOLOGICAL SOCIETIES"**.

SEPM (Society of Economic Paleontologists and Mineralogists) has asked us to announce their projects for 1986, and as room permits, we will. Information about the following can be obtained from: Joni C. Merkel, SEPM, P.O. Box 4756, Tulsa, OK 74159-0756 [(918) 743-2498].

MAR 6-7 SEPM Short Course "Modern and Ancient Deep Sea Fan Sedimentation", Calgary, Alberta.

APR 7-9 SEPM Short Course "Platform Margin and Deep Water Carbonates", Calgary, Alberta.

MAY 8-9 SEPM Short Course "Relationship of Organic Matter and Mineral Diagenesis", Houston, Texas.

MAY 11-14 SEPM Field Seminar "The description and Depositional Analysis of Marine Carbonates - A Field Techniques Workshop", Little Rock, Arkansas.

GREEN MOUNTAIN GEOLOGIST
VERMONT GEOLOGICAL SOCIETY
BOX 304
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The **GREEN MOUNTAIN GEOLOGIST** is published quarterly by the Vermont Geological Society, a non-profit educational corporation.

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

REMINDER - DUES ARE DUE!!!!

FIRST CLASS

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