THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

SPRING 1983 VOLUME 10 NUMBER 1

We're entering our Decade year. * Join us at the

TENTH ANNUAL PRESENTATION OF STUDENT PAPERS

SATURDAY APRIL 30, 1983 9:00 A.M.
ROOM 117 SCIENCE CENTER
MIDDLEBURY COLLEGE

From the center of the village of Middlebury, drive west on VT 125. The Science Center is the first large college building on the left near the Catholic Church. Use the large parking area east of the building by the loading dock.

* Historical Note: VGS was born Spring 1974. That very first year 16 students presented papers.

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PRESIDENT'S LETTER

Geology sparkles with great thinkers, viz. Charles Lyell, John Playfair, James Hutton and T.C. Chamberlin. Their thoughts have bordered on the religious to me, because many of their writings contain bits of those eternal truths which prove useful in developing a geologic approach. Perhaps these aspects can even be applied to life itself!

In 1897, Chamberlain wrote a perceptive article in the Journal of Geology. He introduced the concept of the "multiple working hypothesis". It is useful to keep in mind that his article follows over 100 years of debate between Neptunists and Plutonists and between catastrophists and uniformitarians.

Three approaches to problems are outlined in the article: the ruling theory, the working hypothesis and the multiple working hypothesis. The ruling theory approach may be characterized by the stimulus to find facts to support a single theory. Chamberlin writes, "As in the earlier days, so still, it is too frequent habit to hastily conjure up an explanation for every phenomenon that presents itself. Interpretation leaves its proper place at the end of the intellectual procession and rushes to the forefront. ... The habit of precipitate explanation leads rapidly on to the birth of general theories. ... Briefly summed up, the evolution is this: a premature explanation passes first into a tentative theory, then into an adopted theory, and lastly into a ruling theory."

The working hypothesis approach is an improvement over the ruling theory approach because it requires that facts be determined before a hypothesis can be established. As Chamberlain points out, it has been rashly stated that this <u>is</u> the scientific method, as if any one method could be cited as <u>the</u> scientific method. He also points out that "under the working hypothesis, the facts are sought for the purpose of ultimate induction and demonstration, the hypothesis being but a means for the more ready development of facts and their relations." Continuing, he says, "the distinction [between the above two approaches] is not such as to prevent a working hypothesis from gliding with the utmost ease into a ruling theory."

The multiple working hypothesis approach is an improvement on both of the above "in that it distributes the effort and divides the affections" of the investigator. All possible rational explanations must be considered and given equal initial weight. Hypotheses for each explanation need to be developed and tested impartially. "The investigator thus becomes the parent of a family of hypotheses; and by his parental relations to all is morally forbidden to fasten his affections unduly upon any one."

Chamberlain knew human nature. "For many reasons we are prone to refer phenomena to a single cause. It naturally follows that when we find an effective agency present, we are predisposed to be satisfied therewith. We are thus easily led to stop short of full results, sometimes short of the chief factors. The factor we find may not even be the dominant one, much less the full complement of agencies engaged in the accomplishment of the total phenomena under study." [continued on page 22]

PROGRAM

VGS SPRING MEETING APRIL 30, 1983
ROOM 117 SCIENCE CENTER MIDDLEBURY COLLEGE

REGISTRATION : COFFEE 8:30

STRATIGRAPHY

1. Hope Campbell: Structure and stratigraphy of the North Brittain Conglomerate 9:00
2. John Garver: The stratigraphy and depositional environments of the West Castleton Syncline, West Castleton, Vermont 9:20
3. Stephen Parker: Structure and stratigraphy of the Bascom Formation, Shoreham, Vermont 9:40
4. Hoyt Ammidon III: The stratigraphy and structure east of Shoreham, Vt.; Lithofacies identification and depositional environments of the Lower Ordovician Bascom Formation 10:00

STRUCTURE AND STRATIGRAPHY

5. Becky Dorsey: Geological synthesis of the Milton Quadrangle, Northwestern Vermont; A new interpretation 10:20
6. Bart Stryhas: Bedrock geology of the Ludlow area, Vermont 10:40
7. Matthew Nyman: Geology of the Cobble Hill area-Milton Quadrangle 11:00
8. Cullen Morse: Structure of the Hazen's Notch Formation, Waterbury, Vermont 11:20
9. Elizabeth Greer: Structural analysis of the Bittersweet Falls/Austin Quarry area near Weybridge, Vermont 11:40

LUNCH *** Executive Committee meets 12:00

PETROLOGY AND GEOCHEMISTRY

10. Carolyn Feakes: Geochemistry and petrology of an olivine gabbro in the eastern Adirondacks 1:30
11. Janet Montgomery: A theoretical and geochemical study of graphite genesis in the eastern Adirondacks 1:50
12. Daphne Perry: A geochemical study of greenstones in the Stowe Formation north of Waterbury, Vermont . 2:10
13. Charles Anderson: Major and rare earth element geochemistry of the Stowe Formation metavolcanics near Waitsfield, Vermont 2:30
14. Peter Conard: Geochemistry and petrology of alkaline rocks at Cannon Point, New York and Barber Hill, Vermont 2:50

LAKE CHAMPLAIN STUDIES

15. Anthony Rathburn: A paleoecological study of Late Pleistocene Ostracodes from the southern Champlain Sea 3:10
16. Lesley Woodberry: An examination into sedimentary characteristics of Lake Champlain in Northwest and Button Bays 3:30
17. Ainsley Beardwood: Pleistocene stratigraphy and sedimentology of central Lake Champlain 3:50
18. Josephine Hatton: Recent sedimentation in north-central Lake Champlain 4:10

PRESENTATION OF AWARDS

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ABSTRACTS

PHOSPHORUS IN THE SEDIMENTS OF ST. ALBAN'S BAY, LAKE CHAMPLAIN*

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Agricultural runoff and sewage effluent are contributing to high concentrations of phosphorus in St. Alban's Bay, Lake Champlain, resulting in accelerated rates of eutrophication. A major portion of the phosphorus (P) is deposited in sediments of the bay and in the adjacent wetlands. The present study addresses problems related to (1) the capacity of the sediments to act as a reservoir for phosphorus, (2) the potential for the release of phosphorus to overlying waters, and (3) the mobility of phosphorus within the sediment column.

Sediment parameters measured include: total P, organic P, "available" P, iron, organic matter, grain size and Eh. The data suggest that phosphorus concentrations are related to (1) release of phosphorus by decomposition of organic matter, (2) adsorption/desorption reactions with iron hydroxides, (3) precipitation of iron as iron phosphate, (4) diffusion of phosphorus through sediment pore waters, (5) deposition of P associated with organic matter and adsorbed onto clays, and (6) anthropogenic loading.

Vertical profiles of phosphorus indicate that P is a relatively mobile element in reducing zones of the sediment. Chemical diffusion of phosphorus to overlying waters appears to be restricted by the presence of an oxidized microzone at the sediment-water interface. Laboratory studies indicate that bay sediments have a large reserve capacity for phosphorus.

* Published in Graduate Research Day Abstracts, University of Vermont, February 25, 1983.

THE STRATIGRAPHY AND STRUCTURE EAST OF SHOREHAM, VT; LITHOFACIES IDENTIFICATION AND DEPOSITIONAL ENVIRONMENTS OF THE LOWER ORDOVICIAN BASCOM FORMATION

Ammidon, Hoyt III, Department of Geology, Middlebury College, Middlebury, VT 05753

The stratigraphy and structure of Upper Cambrian to Lower Ordovician formations belonging to the Beekmantown Group was investigated west of Shoreham, VT. The eastern side of the study area is the north-trending, east-dipping Pinnacle Thrust. This thrust placed Upper Cambrian formations on Lower Ordovician ones. The structure due west of the Pinnacle Thrust is an east-dipping homocline. This is contrary to the westward inclined syncline shown by Doll and others (1961). Folding due west of the thrust is confined to two west-verging, north-plunging open folds with amplitudes of no more than three meters.

A 160-m section was measured due west of the Pinnacle Thrust and three formations were identified. These include the Cutting Dolostone ? the Bascom Formation and the Bridport Dolomite. The uppermost 10 meters of the Cutting is a massively bedded tan dolostone containing lenses of black chert. The Bascom can be divided into three distinct zones. The lowermost zone has alternating beds of dolostone-laminated

? dolostone R.R. Shrock Sed. fragmental, concretionary precipitated dolomite of organic or inorganic origin

grey limestone and tan dolostone. The middle zone is composed of well-bedded tan dolostone and dolomitic and calcareous quartzite. The uppermost zone contains beds of limestone, and limestone with chained laminae of dolostone and shale. A total of 99.5 meters of Bascom is present. The Bridport is dolostone laminated with dark gray limestone. Situated east of the Pinnacle Thrust is the Upper Cambrian Danby Formation. It is a massive to well bedded, light gray to white quartzite interbedded with tan dolostone.

A detailed analysis of the Bascom Formation revealed the presence of four lithofacies which represent two distinct depositional environments.

Lithofacies A .. dolostone ..... Intertidal
Lithofacies B .. limestone ..... Intertidal
Lithofacies C .. quartzite ..... Intertidal
Lithofacies D .. shale-dolostone chained limestone .. Subtidal

MAJOR AND RARE EARTH ELEMENT GEOCHEMISTRY OF THE STOWE FORMATION METAVOLCANICS NEAR WAITSFIELD, VT

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Greenstones of the Stowe Formation just north of Waitsfield, VT, were analyzed for major and rare earth chemistry. The greenstone body consists of two distinct lobes separated by metasediments. The Stowe Formation greenstones consist of two predominant mineral assemblages of greenschist facies metamorphism. The entire western lobe is characterized by a chlorite-epidote-albite assemblage with variable calcite and accessory sphene, opaques, quartz and rutile. The eastern lobe of the greenstones consists of chlorite-albite-epidote grading into actinolite-epidote-chlorite. The actinolite-epidote-chlorite assemblage contains only minor calcite and albite with accessory biotite, muscovite, leucoxene, opaques and rutile. The metasediments are predominantly a quartz-muscovite schist with some albite and graphite.

Both the major and rare earth element chemistry of the greenstones is remarkably homogeneous. On the basis of the major element variation diagrams, the greenstones are clearly tholeiitic basalts. Furthermore, using the Al_2O_3-FeO-MgO discriminant proposed by Pearce and others (1977), the metabasalts fall within the chemical boundaries established for ocean floor basalts.

The conclusions based on the major element chemistry are substantiated by the rare earth element chemistry. Furthermore, the rare earth element patterns are more reliable as they consistently show little evidence of mobility as a result of sea-floor or regional metamorphism. The rare earth trends are flat and enriched to 9-11 times chondrite. All the samples are slightly depleted in the light REE and follow the characteristic pattern established for rare earths in ocean floor basalts. Most likely, these basalts represent a slice of the ocean floor that was tectonically emplaced with the surrounding metasediments during the closing of the proto-Atlantic.

PLEISTOCENE STRATIGRAPHY AND SEDIMENTOLOGY OF CENTRAL LAKE CHAMPLAIN

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A survey of Lake Champlain was conducted in the area between Cannon Point and Cedar Beach in the north, to Grog Harbor and Kingsland Bay in the south to determine the Pleistocene history of the region. Data collected include acoustic profiles, surface and subsurface sediment samples. The sediments were analyzed for mineralogy, grain size, fossil content, and conductivity. Profiles were used to determine bathymetry and sediment thicknesses, which were then mapped to define the basin structure and acoustic stratigraphy.

Analysis of the four cores and ten surface samples revealed a dark gray to brown, organic-rich, layered mud of recent Lake Champlain age, containing quartz, feldspars, chlorite, and illite, with intermittent appearances of hornblende, vermiculite, and possibly calcite, biotite, and muscovite, as determined by X-ray diffraction. Cores 3 and 4 were taken off the New York shore, and showed a marked increase in coarser-grained sediments when compared to Cores 1 and 2 taken off Vermont.

An unconformable surface at 50 feet, truncating gently warped beds, was penetrated by Core 2. It includes a buried stream channel and is overlain by flat-lying, recent sediments. Visual and X-ray analysis of the core revealed a much denser, light gray clay with less organic matter, and a 20% higher conductivity, compared to the organic-rich, less consolidated sediments above it. This evidence is compatible with the data for an erosional surface in the southern portion of the lake, cited by both Wiley (1972) and Whitman (1978) and can be correlated with the water plane for the Port Henry stage of the Champlain Sea, as defined by Chapman (1937), when the lake level was at its lowest, about 9000 yBP.

STRUCTURE AND STRATIGRAPHY OF THE NORTH BRITTAIN CONGLOMERATE

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The Lower Cambrian North Brittain Conglomerate of Zen (1961), within the Taconic Sequence, is exposed in a series of west-verging thrusts in the township of Fair Haven, VT. The "conglomerate" is comprised of ribbon beds, lenticular beds and nodules of limestone, separated by beds and matrices of black shale, silt and greywacke. In neighboring quarries, the unit is only as 5 meters thick, in 20 cm beds occurring in the upper part of a sequence of green and purple slates.

The underlying 6.5 m grade from grey-green slate and slaty limestones to a dark grey greywacke and are interpreted as a prograding deep-water deposit. Within the 20 meters of "conglomerate" in the field area, the limestone is a medium to dark grey ungraded micrite, locally fossiliferous. Bed thicknesses range in width from 4 to 100 cm. The terrigenous sediments include black to dark grey calcareous and non-calcareous slate, silt and greywacke, in beds ranging from 6 to 80 cm. The two compositions of the conglomerate unit suggest different depositional processes and sources.

Locally, the conglomerate shows anomalous deformation, compared with the green slates above and below. In this unit, the limestone beds are disrupted into lenticular beds, nodules and clasts. The terrigenous sediments are also locally disrupted into clasts. Soft-sediment deformation, recorded in folded nodules and beds, along with imbrication and thrusts must have developed during emplacement of the Taconic Allochthon.

GEOCHEMISTRY AND PETROLOGY OF ALKALINE ROCKS AT CANNON POINT, NEW YORK AND BARBER HILL, VERMONT

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The Cannon Point and Barber Hill alkaline igneous complexes intrude Ordovician shelf sediments of the Trenton Group on opposite sides of Lake Champlain in Essex, NY and Charlotte, VT, respectively. The Cannon Point complex consists of at least two sills of what has been termed trachyte porphyry exposed along 4400 feet of shoreline on the west side Lake Champlain. Little variation in the rock type was observed. The Barber Hill complex consists of two stocks of alkaline syenite which have coarse grained cores and grade outward to a fine grained periphery. The stocks are cut by dikes of bostonite and trachyte porphyry (Laurent and Pierson, 1973).

Feldspar compositions in the Cannon Point rocks range from Or_{98} to Or_2 in the orthoclase--albite system. Zoning is evident in some phenocrysts with sodic cores grading outward to a more potassic rim. Feldspars from Barber Hill also span a wide range of compositions between albite and orthoclase (Or_{96} - Or_{12}). These feldspars are primarily perthitic and unzoned. Samples from dikes at Barber Hill exhibit myrmekitic textures.

Bulk compositions of the rocks from both Barber Hill and Cannon Point place them in the alkali-feldspar quartz syenite and alkali-feldspar granite fields of the Q-A-P diagram (Barker, 1983). The rocks from both areas are all peraluminous or metaluminous with the former dominating. Alkali/alumina ratios for all rocks are high (0.905-0.968).

The compositional similarities between the rocks of Barber Hill and Cannon Point suggest that the two bodies were formed at the same time and under similar conditions and that the Cannon Point sills are contemporaneous with the dike phases of Barber Hill. The data indicate that the rocks from both areas are A-type granites. Collins and others (1982) postulate that A-type granites are formed by partial melting of an anhydrous source which is rich in fluorine and/or chlorine and contains quartz + K-feldspar + plagioclase, either as separate phases or as normative components.

GEOLOGICAL SYNTHESIS OF THE MILTON QUADRANGLE, NORTHWESTERN VERMONT; A NEW INTERPRETATION

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The bedrock geology of the Milton Quadrangle consists of rocks ranging from Late Precambrian to Lower Ordovician in age. They are divided into four conformable sequences according to lithologic association and inferred depositional environment: (1) rift clastic and transitional sequence, recording Late Precambrian continental rifting and deposition of immature clastic material belonging to the Pinnacle Formation; (2) eastern shelf sequence, representing the inception of the Lower Cambrian stable continental margin of the Cheshire and Dunham Formations; (3) western shelf sequence, which grades from the Lower Ordovician Cutting Dolomite through alternating siliciclastic and carbonate deposits; and (4) eastern basinal sequence, a thick shaley and conglomeratic unit consisting largely of the Lower Cambrian to Lower Ordovician Skeels Corners Formation. Sequence (4) is a northeastern lateral equivalent of sequence (3) that was deposited in a deep marine basin adjacent to the stable carbonate shelf.

Important structural findings of this study include: (1) a large scale recumbent nappe associated with the Hinesburg thrust, accompanied by mappable sections of inverted stratigraphy in and near the thrust zone; (2) the Arrowhead fold-and-thrust couple, previously interpreted as a klippe of the Hinesburg thrust, and (3) local "tectonic slides" (Fleuty, 1964) at Bald Hill. These structures formed during D_1 deformation and are associated with the Middle Ordovician Taconic Orogeny (Zen, 1972). S_1 is a penetrative regional schistosity which grades into intensely sheared mylonites of the Hinesburg thrust zone.

S_m is a sporadically developed phyllitic cleavage formed between D_1 and D_2. D_2 consists of Late Taconic or Acadian aged F_2 folds that deform the Hinesburg thrust in the Colchester Pond-Cobble Hill area; and S_2, a brittle widely spaced fracture cleavage. D_3 elements consists of Mesozoic high angle normal faults plus associated fractures and minor kink folds.

GEOCHEMISTRY AND PETROLOGY OF AN OLIVINE GABBRO IN THE EASTERN ADIRONDACKS

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A Grenville-age gabbro body in the eastern Adirondacks was studied to determine the record of metamorphic and igneous textural relationships. Modeling of a P-T regime and fractionation trends were made based on thermodynamic principles, REE analyses, electron microprobe results, and petrographic evidence.

These olivine gabbros exhibit complex yet systematic arrested reaction rims between olivine and plagioclase. Such corona textures record a progression from stable to unstable parageneses, thus reflecting changes in P-T conditions. This study presents a P-T model, based on the CMAS multisystem and SUPCRT, a thermodynamic data base. Peak metamorphic

conditions are inferred at 627-827 C at 4-8 kb. These results are consistent with Johnson and Essene's (1983) regional study of Adirondack gabbros and further discount formation of garnet coronas along an isobaric retrograde path (Whitney and McLelland, 1980).

Detailed descriptions of textural relationships provide insights as to the corona-forming processes. The presence of small amounts of an intragranular fluid is suggested by mobilization of spinel. Chemical potential gradients may be responsible for this redistribution of spinel components. Inclusion-free clinopyroxene and plagioclase crystal margins indicate a possibly separate interstitial fluid phase. Biotite and kaersutite compositions and textural features require an open system during amphibole genesis. Ubiquitous clouding of clinopyroxene and plagioclase by minute inclusions of spinel, ilmenite, and amphibole are crystallographically controlled and predictable in occurrence.

REE analyses of four gabbro and two charnockite samples provide a basis for modeling fractionation trends. Possible petrogenic relationships incorporating REE data, petrographic and field evidence are presented for the gabbro-charnockite suite.

THE STRATIGRAPHY AND DEPOSITIONAL ENVIRONMENTS OF THE WEST CASTLETON SYNCLINE, WEST CASTLETON, VT

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Stratigraphic intervals of early Paleozoic deep-water sediments on the West Castleton Syncline in the northern Taconic Sequence are found to have interbedded material which has been derived from the coeval shelf facies. Nearly 150 meters of section are described, starting in the West Castleton Formation and continuing into the Mount Hamilton units 1,2,3,6 (Zen, 1961). The described sequence has been divided into three sections. Section I, 0-30 m, is composed of black argillite with calcareous coarse sand to silt interbeds. A 3-m limestone conglomerate occurs at the top of this section. Section II, 30-96 m, contains very fine sand to silt quartz interbeds in green, grey, red-purple argillite. Very little carbonate is found in this section. Section III, 96-136 m, has interbeds of ankeritic sand and silts in a grey to dark grey argillite.

The occurrence, composition, average thickness and percentages of interbeds suggest that these sections have been deposited on the outer fringe of a submarine fan. Changes in grain sizes, average interbed thicknesses, average interbed percentages, the lensing of interbeds and the presence of the conglomerate unit are probably due to migration of distributary channels on the submarine fan between the deposition of Section I and Sections II and III.

The effects of relative changes in sea level are clearly reflected in the changes in percentages and composition of these interbeds. The predominance of carbonate-rich interbeds is assumed to reflect relatively high sea-level stands. An influx of quartzose interbeds (Section II) may reflect a relative drop in sea level which has resulted in regression and erosion on the shelf.

The carbonate-quartzose-carbonate sequence of these three sections have been correlated to the coeval shelf facies. The regressive Monkton Quartzite may correlate with the quartzose interbeds of Section II. Unusually high iron content in both Section II and the Monkton Quartzite might be genetically related. Sections I and III would then correspond to the Dunham Dolomite and the Winooski Dolomite, respectively. Other workers (Baldwin, 1983) have found similar correlations.

STRUCTURAL ANALYSIS OF THE BITTERSWEET FALLS/AUSTIN QUARRY AREA NEAR WEYBRIDGE VT

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The area studied lies south of Weybridge Center across the northern end of the tongue of Hortonville slate mapped by Doll and others (1961). Detailed studies were made of the Austin Quarry off James Road and of the section of Beaver Brook over and above Bittersweet Falls. The stratigraphic sequence covers the mid-Ordovician carbonate rocks of the Middlebury Limestone through the Hortonville Slate. The stratigraphy is complicated by shear zones and faults. Differences in intensity of shear throughout the area are obvious in thin section. Cross-sections show faults inferred from missing lithologies and structural complexities. It is therefore implied that the western limb of what was thought to be the Middlebury synclinorium is marked by faulting rather than folding.

RECENT SEDIMENTATION IN NORTH-CENTRAL LAKE CHAMPLAIN

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Data were gathered from a portion of Lake Champlain extending from Thompsons Point to about a mile north of Essex, NY. Acoustic profiles provided bathymetric data, and the 25-foot subbottom penetration located layering and faults. Four 6-foot piston cores and ten surface sediment samples allowed X-ray diffraction analysis of the mineralogy of recent sediments. Grain size and sorting were also assessed. Electrical conductivity tests were made at 10 cm intervals down the cores, and X-ray radiographs were taken to reveal bedding.

Minerals such as kaersutite occur throughout all four cores and in most surface samples. The most likely source of kaersutite is the Adirondack massif. It is possible though unlikely that such minerals may have been transported from Canada by glaciers. Ice remained briefly on the Adirondacks after the Laurentian ice sheet retreated from the Champlain Valley. Icebergs laden with sediments broke away from the glaciers and drifted across Lake Vermont, depositing these sediments uniformly over the lake floor. The subsequent drop in lake level left these sediments exposed on both sides of the lake. Since then their steady redeposition back into the lake has caused their presence across the lake floor and throughout the sedimentary column.

A THEORETICAL AND GEOCHEMICAL STUDY OF GRAPHITE GENESIS IN THE EASTERN ADIRONDACKS

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Hooper Brothers' mine in Washington County, Whitehall NY, is the site of an old graphite mining operation. The graphitic quartzofeldspathic pyroxene gneiss has a homogeneous mineralogy with biotites and feldspars of composition Mg_{82} and An_{36} to An_{46} respectively. Strong foliation and lineations following the strike of the bed (east - west) indicate a main compressive stress perpendicular to the strike.

The five main lithologic units dip approximately 21 S. The top lithologic unit, unit 1, is a metagabbro, dominantly feldspar, olivine and biotite with plentiful ilmenite coronas surrounded by amphibole and biotite. Compositions are: biotite, Mg_{56}; olivines, Fo_{32} to Fo_{44}; clinopyroxenes, Mg_{71}; orthopyroxenes, Mg_{60}; and feldspars, An_{41} to An_{38}. This metagabbro, along with the graphitic gneiss, contain blastomylonitic zones which developed after the formation of the coronas and the graphite genesis. Below unit 1, the metagabbro, is unit 2, an amphibolite, lacking any foliation and is characterized by the variation in hornblende content from its contact with unit 1. Lithologic unit 3, a non-graphitic quartzofeldspathic blastomylonitic gneiss, shows evidence of foliation occurring before the intrusion of unit 2. The biotite in unit 3 is Mg_{49} and the feldspar is An_{11-12}. Below unit 3 is the graphitic unit, unit 4. Two generations of graphite are observed with strong foliations and many fluid inclusions. The lowest lithologic unit, unit 5, is a garnet - biotite - sillimanite gneiss. The sillimanite has been pseudomorphically replaced by muscovite and the garnets have a composition from $Ca_{16}Fe_{62}Mg_{20}Mn_2$ to $Ca_{16}Fe_{67}Mg_{15}Mn_2$ and the biotites and feldspars are Mg_{67} and An_{77} respectively.

Pressure and temperature values are difficult to compute in the Adirondacks. Biotite and pyroxene geothermometers were used to calculate temperatures of 803 - 950 C. These geothermometers generally give values that are known to be too high; therefore, a more reasonable temperature of 700 C was estimated to calculate a pressure of 11.9 kb. This pressure value is also high considering the presence of sillimanite. My calculated values, 803 - 950 C and 11.9 kb at 700 C, represent an upper limit for these rock types. A more reasonable pressure and temperature would be around 700 C and 7 kb.

Modeling of fluid composition in the C-O-H-N-S system was used to determine CO_2, H_2O, CO, CH_4, N_2, H_2S, H_2, O_2 and S_2 concentrations at 700 C and 7 kb with an 80% C-O-H fluid species. The composition was dominantly CO_2 with significant amounts of CO, NH_4, SO_4, and H_2S depending upon the acidity of the fluid. No significant amounts of CH_4, N_2, and H_2O were present. This contradicts Hoering and Hart (1964) and Salotti and others (1971), who inferred that graphite resulted from methane dissociation.

STRUCTURE OF THE HAZEN'S NOTCH FORMATION, WATERBURY, VT

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Prior to Christman and Secor's study (1961) of the Camel's Hump Quadrangle, little information had been collected on the Hazen's Notch Formation of the Camel's Hump Group. Since then, however, study within the area has increased. This study deals specifically with the Hazen's Notch Formation and structural relationships within it.

The study area lies below the spillway of the Waterbury dam on the Little River and covers approximately 3 sq. km. The area exhibits several different lithologies including carbonaceous quartzite, quartziferous graphitic phyllite, quartz-muscovite (sericite?)-chlorite schist, and a chlorite rich schist. The lithologies are intermixed and difficult to discern. Because the area was quarried during dam construction, the exposures are relatively fresh and structures are clearly visible. Concentrically folded isoclinal folds are present representing two periods of deformation. The first is represented by the isoclinal fold in the more coherent lithologies. The second is represented by cylindrical folds, except in the quartzite where it is seen as isoclinal folds. Dome structures and en echelon separation of quartzite beds can also be seen in the field.

Microscopic analysis clarifies the mineralogy and displays two prominent S directions. The first is determined by the alignment of mica grains and is perpendicular to the S_2 crenulation cleavage. Other micro-structures which can be seen are micro-isoclinal folds of graphite as inclusion trains in albite, and syn-crystalline boudinage of tourmaline.

Both microscopic and mesoscopic data suggest two deformational events. The direction of stress of the first event cannot be determined due to the possibility of rotation during the second deformational event, the stresses of which were oriented in approximately an E-W direction. Structural features such as folding patterns and en echelon separation of bedding can also be seen on a macroscopic scale on the Centennial Map of Vermont, which shows that macroscopic forms can be inferred from mesoscopic forms and vice-versa.

GEOLOGY OF THE COBBLE HILL AREA - MILTON QUADRANGLE

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Five lithologies are found in the Cobble Hill area. The Skeels Corners Shale is the most extensive and youngest unit and is comprised of deep water shales with narrow dolomitic beds. Interfingered with the shales are a series of carbonate breccias which were derived from the adjacent carbonate platform and deposited as debris flows. The Dunham Dolomite is a highly variable dolomicrite and is present as isolated klippes above and below the Hinesburg Thrust. Exposures of the Cheshire Quartzite at Cobble hill are part of the upper member and are generally arkosic sandstones with little to no argillaceous material.

The structure of the Cobble Hill area is the result of two regional deformation events. D_1 deformation produced a large recumbent nappe which moved older rocks from the east

over the younger Skeels Corners shale. The base of the nappe is cut by the Hinesburg Thrust. This basal thrust crops out only to the south, separating the overlying Dunham from the younger Skeels Corners Shale. F_1/S_1 parasitic folds and axial surfaces are found only in areas of diminished D_2 strain.

D_2 deformation is documented by map scale folding of the Hinesburg Thrust and klippes of Dunham. Parasitic folds are tight to isoclinal in profile and have rotated the S_1 surface parallel to bedding. Fold axes are oriented along the S_2 statistical surface indicating inhomogeneous strain during deformation. In the argillaceous units S_2 is a closely spaced fracture cleavage whereas in the more competent carbonates it appears as a sporadic pressure solution cleavage. In equal area projection, poles to S_2 surfaces form a point maxima, indicating the last major deformation event.

S_m is a sporadic pressure solution cleavage of which no folding event has been found to correlate. Cross cutting relationships found in outcrops indicate that S_m falls between S_1 and S_2 in age.

STRUCTURE AND STRATIGRAPHY OF THE BASCOM FORMATION, SHOREHAM, VT

Parker, Stephen J., Department of Geology, Middlebury College, Middlebury, VT 05753

The Cambro-Ordovician shelf carbonates of the Beekmantown Group in Shoreham, VT, are part of the western limb of the Middlebury synclinorium. The stratigraphic section, measuring 75 m, was described within the Lemon Fair Syncline northeast of the village of Shoreham. The structure is a gently east-dipping homocline truncated to the east by the Pinnacle Thrust that places the Danby Formation above the Shelburne Marble. A smaller fault west of the Pinnacle Thrust puts the Clarendon Springs on the Bascom or Cutting Formation. No exposures of the Cutting Formation were found. This mapping modifies that of Doll and others (1961).

The best exposures within the field area are of the Bascom Formation, along the bed of the Lemon Fair River. Petrographic work was done using hand samples and 25 thin sections. The sediments were recognized as tidal flat deposits with low terrigenous influx from a western source area. Six microfacies were defined and environments of deposition were assigned to each. These are:

Terrigenous Clastics .....Supratidal
Dolomitized Micrite .....Supra-intertidal
Biopelmicrite .....Subtidal
Biopelsparite .....Shallow-subtidal
Intrasparite .....Intertidal
Intramicrite .....Subtidal

A GEOCHEMICAL STUDY OF GREENSTONES IN THE STOWE FORMATION NORTH OF WATERBURY, VT

Perry, Daphne A., Department of Geology, Middlebury College, Middlebury, VT 05753.

Greenstone outcrops in the Stowe Formation north of Waterbury, VT have three lithologies: 1) a light-green quartz-muscovte-chlorite schist; 2) the greenstone proper, which is further subdivided into a massive epidote or actinolite-rich rock and a banded quartz and chlorite rock; 3) a black quartz-muscovite phyllite.

Geochemical analyses of greenstones show strong oceanic basalt affinities. On the TiO_2-K_2O-P_2O_5 ternary diagram (Pearce and others, 1975) the greenstones plot in the oceanic basalt field. On the FeO-MgO-Al_2O_3 ternary diagram (Pearce and others, 1977) the greenstones fall within the oceanic island and ocean floor basalt fields. The greenstones plot as an Fe-rich group on the AFM-diagram but do not show an Fe-enrichment trend. Metamorphism and Fe-mobility may be responsible for this lack of a distictive trend.

The greenstones have two distinctive rare earth element (REE) patterns. Three of the samples have slightly depleted to flat chondrite-normalized LREE patterns, between 9-20 times chondrite. These rocks are distinctive of the massive epidote or actinolite lithology. The patterns are similar to present-day oceanic basalt patterns. The other two samples plot as very enriched chondrite-normalized LREE patterns, with up to 95 times chondrite in La. The patterns are similar of Hawaiian alkaline series basalts and some island arc calc-alkaline basalts. These samples are from the banded quartz and chlorite lithology. There are two possible explanations for these differences: 1) if indeed these are all basalts, there must have been two separate environments of formation, or 2) those greenstones showing alkaline trends are metasediments and not metabasalts. These greenstones are probably ocean floor basalts which were incorporated into their present position between the sediments of the Stowe Formation and the Ottauquechee Formation during the closing of the proto-Atlantic Ocean. These rocks have since undergone at least three deformations and subsequent greenschist facies metamorphism.

A PALEOECOLOGICAL STUDY OF LATE-PLEISTOCENE OSTRACODES FROM THE SOUTHERN CHAMPLAIN SEA

Rathburn, Anthony E., Department of Geology, University of Vermont, Burlington, Vermont 05405

The interrelationships between piston core assemblage zones and the dry land assemblages of the three phases of the Champlain Sea described by Cronin (1977, 1981) have been established using foraminifera diversities and updated ostracode species data. The correlation of these assemblages has made a more complete and accurate assessment of the Champlain Sea possible.

Over twenty-eight species of Champlain Sea ostracodes from piston core samples taken from the central portion of Lake Champlain were identified and compared with foraminifera data from various studies of the same cores. From this data it is evident that zone C as described by Gunther and Hunt

(1976, 1977) is the deep water equivalent of Cronin's (1977, 1981) Transitional Phase. The presence of the freshwater ostracode, Candona subtriangulata, in the upper portion of this otherwise brackish to marine assemblage zone, suggests that glacial melt-water reestablished freshwater environments after the initial invasion of marine water into the Champlain Valley.

Gunther and Hunt's (1976, 1977) zone B_2 lies immediately above the transitional zone C and contains abundant foraminifera and ostracodes indicative of near-normal marine conditions. The salinity and temperature tolerance ranges of the ostracodes found in zone B_2 indicate environmental conditions similar to those of the Hiatella arctica Phase as described by Cronin (1977, 1981). The large dissimilarity of ostracode species between the core samples and Cronin's (1977, 1981) land samples is probably due to differences in depth of the Champlain Sea. Because of the absence of Cytheropteron pseudomontrosience along with a reduction in faunal diversity, zone B_1 as designated by Gunther and Hunt (1976, 1977) is probably the deep water equivalent of the Mya arenaria Phase as described by Cronin (1977, 1981). The upper limit of this brackish water assemblage zone marks the end of the Champlain Sea sedimentation and the beginning of Lake Champlain.

BEDROCK GEOLOGY OF THE LUDLOW AREA, VERMONT

Stryhas, Bart A., Department of Geology,
University of Vermont, Burlington, VT 05405

The Ludlow area lies on the eastern limb of the Green Mountain Anticlinorium and is transected by the Precambrian-Cambrian unconformity.

The oldest lithologic units belong to the Precambrian Mount Holly Complex which forms the highest peaks of the area, including Okemo Mountain. This is overlain to the east by the late Precambrian Tyson formation and lower Cambrian Hoosac and Pinney Hollow formations.

Two Acadian deformations have severely transposed an earlier schistosity of possibly Taconian origin. The earliest Acadian deformation involved small scale isoclinal folding accompanied by simple shear. The result was an east over west movement on this limb as the Green Mountain Anticlinorium formed. The second Acadian event produced crenulation folding and the development of a spaced slip cleavage. This is associated with the emplacement of the neighboring Chester Dome to the east of Ludlow.

Structural comparisons were made between the Precambrian and Cambrian lithologies. The result was a homogenous fabric throughout the entire field area.

Metamorphism has been predominantly in the chlorite and biotite grade throughout the deformational history of the area. Isolated garnet occurrences are associated with a static metamorphism accompanying the emplacement of the Chester Dome and were retrograded during the same event.

An east-west high angle fault is well exposed in the Precambrian units but is probably of Mesozoic age. Displacement here is minor, but a well developed shear zone attests to a prolonged period of minor readjustments in the bedrock.

AN EXAMINATION INTO SEDIMENTARY CHARACTERISTICS OF LAKE CHAMPLAIN IN NORTHWEST AND BUTTON BAYS

Woodberry, Lesley, Department of Geology,
Middlebury College, Middlebury, VT 05753

The section of Lake Champlain from Arnold Bay, VT to Partridge Harbor, NY, was examined to determine bathymetry and sediment characteristics. Echo-sounding profiles revealed the bottom topography and up to 20 meters of subsurface sedimentary layers. Sediment samples were collected from the surface by a grab sampler and three cores were collected with a 6-foot piston corer.

The profiles display an erosional surface throughout the area at 85 meters below lake level. X-ray diffraction analysis indicate the presence of albite, chlorite, illite and quartz in all samples. A few samples contain hornblende and muscovite. Microscope analysis indicated that all of the samples from the New York side of the lake contain mineral assemblages associated with the Adirondacks while sediments from the Vermont side are mainly comprised of clay minerals.

The uniform presence of an erosional surface suggests a period of erosional activity while sediments were collecting in this area. Mineral analysis from both X-ray diffraction and microscope studies suggests the Adirondacks were a source area for these sediments. In addition, minerals associated with the Adirondacks decrease from west to east as sampled across the lake, indicating a probable source area to the west. The relative amounts of minerals in the core samples does not vary from top to bottom within the core, suggesting these core samples represent one lithologic unit: the recent Lake Champlain unit.

VGS BUSINESS & NEWS

NOTE FOR APPLIED GEOLOGISTS

Two thoughts come to mind as I set fingers to keyboard for writing this note. The first is that the Ad Hoc Committee for Applied Geology is a misnomer. The second thought comes from a follow-up to last issue's President's Letter and member feedback.

On the misnomer problem, I've heard a number of criticisms of the term Applied Geology. Can someone come up with a better name for this group of people who are interested in geological consulting work? How about the "Committee for Geologic Consulting"? Are there other suggestions?

The second thought deals with what may really be a credibility problem for geologic consultants. What is it that keeps our work from slipping from state-of-the-art into beyond-the-fringe? Why is it that some projects receive State approval so easily and yet others with apparently equal or better merit are rejected? When submitting material to State review agencies, do we consultants "slant" our presentation to appeal to those who will review the material? Do we dare tell the entire story at the risk of casting an unfavorable light on the client's project?

As a private consultant, I have heard and made criticisms of the State. However, in all fairness, the State is at a disadvantage on two counts. First, the only information usually available to the State reviewers is that which the consultant chooses to submit. Second, the State reviewers are almost always overworked and underpaid. They also are often without the broad education necessary to adequately review work generated by a group which has a wide variety of skills and training.

What are our solutions? In regard to our conduct as consultants, clearly VGS is not set up to police its own members. Perhaps we may or may not wish to do such a thing in the future. But what about the diversity of approaches to consulting? What comes to my mind is the need for encouraging professional education, a frequent theme in some member's responses. I would like to see a short course offered on mining and quarrying in Vermont, on water well hydraulics in fractured bedrock, and on innovative techniques for large scale (for Vermont) subsurface wastewater disposal. The pattern of the courses would ideally follow the On-site course of March, 1982, which was co-sponsored by VGS.

I know that the consultants, including engineers outside VGS, would support such courses because the courses would educate them in order that they could pick up a new line of business. I would warn that such enabling expertise is not developed during a short two-day course. Those geologists who already claim much of the business in some of the above-mentioned areas of consulting will complain that creativity will be sacrificed for uniformity in developing commonly accepted geologic approaches to problems. There might well be a cry from the same consultants that they went out-of-State to expensive short courses for developing their own expertise, so why can't everyone else? Finally, there will be a very understandable guardedness about others possibly discovering the experienced consultant's most treasured field techniques.

On the positive side, better geology would be done. The sloppy field methods could be spotted more easily and improved. Additional competition in the market place will motivate us to stretch ourselves. I think that, paradoxically, additional competition will create additional consulting work. There will always be a need for critical reviews, specialized subcontractors, and second opinions.

The immediate benefactor is obvious. It would be the public. It is the public, though, that gives us many of our jobs through government contracts, environmental regulations, and State review. The ultimate credibility problem rests within these sectors. These sources of employment may already be threatened. We need to grow and mature in our work in order to correct this potentially harmful situation.

Chris White

NEW MEMBERS

We welcome these new members who have joined VGS since the beginning of the year:

Carla Yahi South Burlington, Vermont
Library, Geological Survey of Canada, Ottawa, Ontario

REPORT ON GROUND WATER LEGISLATION

Vermont's present statutory and judicial record regarding an individual's ground water rights is checkered at best. Cases such as Drinkwine v. State of Vermont (131 Vt. 127, 300 A.2d 616 (1973)) have reaffirmed archiac judicial approaches to ground water. These rulings, in support of absolute ownership, run counter to common sense and advances in hydrology since before D.E. Meinzer's work in the 1920's.

The Vermont House Natural Resources Committee has reviewed various efforts over the past two years to update ground water statutes. The VGS "Ground Water Watch Dog Committee" met on February 24th to review the present legislation embodied in H. 30. H. 30 uses the reasonable use doctrine. This concept says that a land owner may use however much water under his land as is necessary as long as the quantity withdrawn is a reasonable amount for whatever purpose the landowner wishes. If this withdrawal adversely affects the landowner's neighbors, the neighbors have no recourse. Our Committee felt that the reasonable use doctrine does not provide adequate protection for the adjacent landowners. We also felt that this doctrine did not take full advantage of the knowledge of hydrology. Therefore, after much cordial discussion, we decided that the doctrine of correlative rights most closely matched our sense of "fair play" as well as what was possible to do with the science of hydrology. We wish to publish the following as a trial draft for legislation:

> The doctrine of correlative rights shall govern all uses of ground and surface water in the State of Vermont. Correlative rights requires a balancing of the equities between the competing uses of adjacent landowners. The factors which may be used in the balancing of the equities include the following: the purpose of the respective uses, the suitability of the uses to the water course or lake, the economic value of the uses, the social value of the uses, the extent and amount of the harm caused, the practicality of avoiding the harm by adjusting the use or method of use of one proprietor or the other, the protection of existing values of land, investments and enterprises, and the burden of requiring the user causing the harm to bear the loss.

We wish to receive feedback from VGS membership on this proposed draft. From these responses we'll polish up the draft and submit it to the Executive Committee. We wish to gain their endorsement of it as a VGS-supported position on ground water legislation. If all goes smoothly, our hope would be to submit the draft to the Legislature for the next session.

N.B. All but the first sentence of the draft legislation was taken from a footnote in Sahl, J.P., 1979, Case Comment: ground-water rights in Vermont, Drinkwine v. State. In: Vermont Law Review, v. 4, no. 1, pp. 189-202.

Submitted by:
VGS Ground Water Watch Dog Committee
Brewster Baldwin
David Tarbox
Chris White

MEMBER FEEDBACK

I wanted to share with you the collection of responses from various VGS members. As you may remember, an informal request for ideas on VGS' future appeared with the dues notice last December. Below I've distilled the resulting comments as best I could. I hope that I haven't left anyone out. If you have additional thoughts, please send them to VGS.

What is striking is the breadth of responses. This, parenthetically, was also reflected in the talks at the VGS Winter Meeting. It shows that one of VGS' strengths is its diversity.

The Executive Committee has already acted on the recommendations regarding the By-laws. Firstly, the President's term is to stay at the 1-year's duration (to the relief of this president). This is because the person who serves as President is actually on the Executive Committee for three years as Vice-president, then President and finally as a board member. It was felt that that was long enough. Secondly, the Professional Committee was merged with the Ad Hoc Applied Geology Committee.

Beyond this, members generally focused on three general areas: publications, education (both for teachers and for professional consultants), and the development of popular forums for issues of public concern. Read the responses yourself for they point out important directions for us to pursue in the future. Don't forget, though, that the Society can go nowhere without the assistance of its members.

I. OVERVIEW
   High praise for VGS and its activities

II. "LOBBYING" - "POLITICAL CONCERNS"
   1. Although a desire for greater activity here, some expressed concern for losing tax-exempt status
   2. Requires VGS to formulate stands ... therefore, is this premature?

III. PUBLICATIONS
   1. High praise for GMG and Vermont Geology
   2. Requests for continuing Vermont Geology (encore!)
   3. Requests for more reports such as Chuck's State Geologist's Report on geological activity in Vermont
   4. Valuable vehicle for informing membership of issues
   5. Requests for:
      a. interpretative geological information
      b. field trip guides - might include:
         1. past NEIGC classics
         2. VGS fall field trips
         3. on-going research
   6. Publication of VGS position papers (see comment II #2)
   7. "Don't make too many changes in VGS Newsletter"

IV. RESEARCH
   1. Encourage research ... Spring Meeting good way

V. BY-LAWS
   1. Change President's term from 1-year to 2-year duration to allow for President's initiatives to "take"
   2. Merge Professionalism Committee with "Ad Hoc Applied Geology" Committee
   3. Review Committee roles and structure in light of this member feedback

VI. EDUCATION

1. Discuss possiblilty of providing 2 small scholarships to Earth Science teachers to attend the VGS Annual Fall Teacher's Workshop
2. Develop a closer, more active link with VINS (Vt. Institute of Natural Science)

VII. APPLIED GEOLOGY + PUBLIC EDUCATION - PUBLIC FORUMS

1. Implications of oil and gas activity
2. Implications of waste disposal, ground water - VGS should not take stands at this point, but simply provide the forum for the discussion. VGS can utilize members' knowledge for expert, objective discussion of issues

VIII. APPLIED GEOLOGY

1. Work on encouraging professional education - information exchange and outside speakers (short courses)
2. Encourage UVM to provide instruction in ground water hydrology, geology engineering, soils engineering and economic geology (through School of Natural Resources?)
3. Investigate and inform on implications of oil and gas industry - viz. environmental and social implications

EXECUTIVE COMMITTEE MINUTES

January 19, 1983 -- Vermont Geological Society Executive Committee Meeting -- Pavilion Auditorium, Montpelier, VT.

The meeting opened with the acceptance of the October 23, 1982 minutes prepared by Jeanne Detenbeck. C. White then introduced his agenda for the meeting.

Proposed agenda

Minutes, fall, 1982 meeting
Treasurer's report
Old business
- a) appoint nominating committee
- b) spring meeting
- c) fall, 1983 meeting

New business
- a) report on responses to Prez' request for input VGS future
- b) review of existing committees - suggestions for changes
- c) report on ground water legislation (H. 30)
- d) material for Publications
  - Barry Doolan's magnum opus
  - C. Doll's material

The treasurer's report indicated that our current balance was $1,632.15 as of February 19, 1983.

Discussion of appointments to the nomination committee began. Members on the executive committee could not serve though F. Larsen and L. Meade would be eligible soon when their terms were up. The committee decided to appoint Chuck Rattè, Bud Ebbett and John Malter because of their long term association with the organization. Chuck was suggested as chairman.

The executive committee expresses thanks to Rock of Ages for their help with this year's coffee and donuts. The spring meeting and refreshments will be handled by Middlebury College.

Plans for the fall meeting were discussed. Chuck Ratté's offer of conducting a field trip in the Okemo area was supported and the date was discussed. B. Doolan suggested that as a rule, the fall field trip should follow one week after the NEIGC meeting. This was accepted and this year's field trip will be held then; the date will be set soon for the NEIGC.

Discussion of new business began with the report on responses to the president's request for input on VGS's future. C. White's member feedback summary, with eight categories [which appears starting on page 19 of this issue, ed.], was submitted. The categories included: I) Overview, II) "Lobbying-Political Concerns", III) "Publications", IV) Research, V) Bylaws, VI)Education, VII) Applied Geology and Public Education--Public Forums, VIII) Applied Geology.

General discussion began with the agreement that most items could go to the appropriate committees for further consideration. B. Doolan suggested we start with item V, whether to change the president's term from 1 year to 2 years to allow for the president's initiative to "take". F. Larsen stated that this is done, in a way, in that the president becomes a member of the executive committee in the following year. Others felt that a yearly change brought "new blood" into the organization. Therefore, it was left to keep the yearly term the same and encourage the nominating committee to bring new people into the executive committee.

Brew Baldwin moved that we merge the professionalism committee and the Ad Hoc Committee on Applied Geology as suggested in the member feedback summary. This was passed.

Barry Doolan suggested that normal contributors to the GMG could be on the publication committee. The executive committee agrees that the GMG is very successful with high praise to Jeanne Detenbeck for her efforts.

It is suggested that Bill Glassley be asked to be responsible for number VII as he made the comments. Brew Baldwin suggests we use the Vermont Department of Water Resources ground water strategy as a basis to accomplish some of the things proposed in feedback statement number VIII.

Discussion of H. 30 begins. L. Becker states that the bill has been tabled over the issue of Agricultural practices and their effects on ground water. The representatives who opposed the bill were as follows: Harry Pickering, Lannie Smith, Mark Candon, Richard Westman, and Falzarano of Northfield. It was suggested that VGS set a meeting with the Commissioner of Water Resources (John Ponsetto) to learn more about the bill. Brew Baldwin will write the letter to request the meeting with J. Ponsetto, members of the executive committee and other VGS members concerned with the issue.

Discussion of Barry Doolan's magnum opus. An idea was presented to send copies to all geology teachers around the state. Barry will set a meeting to get ideas and the organization going and then apply to the state to get money for publication.

A publication of Charlie Doll's pictures and text of Vermont metamorphosed fossils needs the endorsement of the executive committee. It will need a glossy character because of good picture quality. The committee suggests the size of Vermont Geology would be appropriate and maybe we should set aside one issue for the publication of this material.

The executive committee endorses the third volume of Vermont Geology if we get enough articles.

Concerning the Decade of North American Geology. Brew Baldwin will meet at UVM with Barry Doolan and Rolfe Stanley.

The meeting was then adjourned.

Respectfully submitted,

Larry Becker

WINTER MEETING REPORT

A special thanks to Rock of Ages for defraying the cost of coffee and donuts for this meeting. Fred Larsen and Dave Westerman were responsible for supplying these refreshments which get our meetings started properly.

After some slight confusion (in spite of all the planning!) the meeting got off to a late start but proceeded smoothly from then on. About 45 persons were in attendance for a great variety of papers.

Chuck Ratté had side-looking airborne radar photos and their equivalent maps from the Glens Falls 2-degree quadrangle for examination and comment about their possible uses by the members present.

[PRESIDENT'S LETTER - continued from page 2]

Please forgive all of the above quotes, but the message, I feel, is important. For example, when we are in a map area, does each new piece of evidence automatically support plate tectonics, verify our favorite sedimentological model, or disprove some unpopular glacial theory? Are we wedded to our adopted theories to the exclusion of all others? How do we approach field investigations as consultants when we are hired to confirm or deny a specific problem? Today we do not face issues of the catastrophists versus the uniformitarians. But we are faced daily with questions of impartially approaching explanations to the phenomena around us. Part of geology's magic is that it demands such impartiality from us.

Chris White

FROM THE EDITOR

It seems possible right now that two more volumes of Vermont Geology may be in the works. VGS may have a part in publishing Charles Doll's manuscript about his very valuable study of the metamorphosed fossils he has recognized and collected in Vermont. I also have had positive answers from five persons who are interested in submitting manuscripts based on papers presented at winter meetings. From past conversations, I also can recall three other "probable" papers, and I shall try to contact those people at the Spring Meeting. On the basis of this number of manuscripts, I shall proceed with the planning for a third volume of Vermont Geology. I would like to have first drafts available for review by June 1, in hopes that the volume will be published no later than the 1984 Winter Meeting. It is not too late to consider papers other than those mentioned above. For those who might be interested in submitting a manuscript for this or any future volume of Vermont Geology, the following criteria have been established for these manuscripts:

1) The major context of the paper must relate to an accepted earth science discipline, and must involve Vermont geology but not necessairly restricted to Vermont geographical borders.
2) The paper must present some element of new information gathered either through research or observation and and experience, or must be a compilation of information from a variety of sources, presented in a creative fashion using new analytical and interpretive procedures.
3) Papers must be written in a clear, concise and well-organized style, and must show literary integrity and honesty through proper credit-giving and referencing techniques.

An "average" manuscript which we expect to publish contains about 15-20 pages of double-spaced text and about 6 figures and/or tables. We require 3 copies of the first draft for review.

I am still hoping to have answers to my request for articles for the GMG under the topic "Below the Surface". This was described in the Winter 1983 issue of GMG, and I also sent off a dozen letters to those who seemed to be potential authors. As always, I welcome articles submitted by members for the GMG. These don't have to be the result of some serious research project, but can just be a shared gem of Vermont geology that you have discovered.

I take a serious interest in the responses about publications included in Chris White's member feedback outline (published starting page 19 of this issue). Vermont Geology will continue in the foreseeable future, and GMG will always try to include information that is important to the members - just let the editor know your needs and we will do our best. For at least 5 years, interest in field guides has cropped up in a number of private conservations. We do have some rather informal publications resulting from fall field trips, but we never have made a concerted effort to establish a standard format and deliberately write field guides for a specific use. Perhaps the time is coming when all interested parties should meet to discuss this issue.

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

PUBLICATION IN PROGRESS

[Published here is an outline for the Vermont geologic history which Barry Doolan is in the process of writing. Although it has been dubbed "Barry's magnum opus", there is a serious need for just such a publication to keep us in touch with the recent developments in the understanding of Vermont Geology. Barry notes that this outline is subject to change. The text is to be written in layman's terms with abundant footnotes and a bibliography to satisfy those with the need of more specific information.]

Geologic History of Vermont Rocks

I. Introduction
II. Overview of Appalachian Geology (Geographic limits; correllatives in Europe; major stratigraphic and tectonic provinces; history of views concerning origin)
III. Overview of Vermont Geology
  A. Definition and distribution of major tectonostratigraphic zones
  B. Relationship of geography, geomorphology to major tectonostratigraphic zones
  C. Vermont minerals and rocks of economic importance and relationship to tectonostratigraphic zones
  D. Overview of stratigraphy, deformation, metamorphism and igneous activity in time and space
IV. Vermont Geology in new perspectives
  A. Introduction - purpose to compare Vermont Geology to modern environments
  B. Wilson Cycle: Definition and plate tectonic processes involved in each stage; examples from Red Sea, East Africa, present North American margins, Timor, Taiwan
  C. Applying the Wilson Cycle to Late PreCambrian to Ordovician History
    1. The Pre-rift Stage - Vermont in the Late Pre-Cambrian (Adirondacks)
    2. The Rifting Stage - intracontinental basins (Late PreCambrian)
    3. The Rift-Drift-Transition - formation of oceanic crust (Early Cambrian)
    4. The Drift Stage - opening of Iapetus and thermal subsidence of continental margins (Middle Cambrian to Middle Ordovician)
    5. The Inception of Closure of Iapetus - Trench and Arc formation
    6. Collision of Island Arcs against the continental margin of ancient North America
      a. The emplacement and descruction of oceanic crust (ophiolites)
      b. The emplacement of allochthons: Origin of the Taconic Mountains; new and old controversies
      c. Metamorphic and igneous activity

(NOTE: Each of the stages of the Wilson Cycle (1 to 6 above) will be evaluated according to:
  a. Processes involved
  b. Structural geology associated with the processes
  c. Sedimentary sequences produced

d. Paleoenvironments and paleontology of the various sedimentary sequences (when known)
e. Specific examples from Vermont which best provide the criteria for recognizing the particular stage
f. Field stops which display particularly well the geologic processes involved during this stage. (These may better be summarized in an Appendix to make them more accessible, but will be referred to in the text.)
g. Economic geology of each stage)

D. Summary of Late PreCambrian to Ordovician History of Vermont with:
   1. Discussion of Suspect Terranes
   2. Alternative viewpoints
E. Silurian and Devonian History of Vermont
   1. Stratigraphy and relationships to Quebec and New England
   2. Tectonic processes leading up to Acadian Orogeny
   3. Acadian Orogeny in Vermont and adjacent areas
   4. Alternative viewpoints
F. Late Paleozoic and Mesozoic History of Vermont
   1. Late Paleozoic (Permo-Carboniferous) tectonics in New England and possible effects in Vermont
   2. Mesozoic History of Vermont and New England - renewed rifting activity and initiation of new Wilson Cycle to form present Atlantic
      a. Effects in Champlain and Connecticut Valleys
      b. Intrusive activity associated with rifting

V. The Future outlook for Vermont Geology: Problems to solve, Research directions; Economic prospects, etc.
VI. Bibliography

APPENDIX I: Glossary of terms
APPENDIX II: Overview of Plate Tectonics Processes with modern day examples (to supplement IVB)
APPENDIX III: Field stops referred to in text with summaries of important features, process discussed in IV C,D,E,F
APPENDIX IV: Guide to further reading subdivided by chapters

FOR THE TEACHER

[Sandria Ebbett has contributed a review of McPhee's new book from a different view point from that presented in the last issue of the GMG. Editor]

Geology Popularized: A Defense

In Suspect Terrain, by John McPhee. Farrar, Strauss and Giroux, $12.95; 210 pp.

A recent perusal of the local bookstore showed me that astronomy has Sagan, anthropology has Leakey, physics has Dyson and biology has Gould. Perhaps not since Playfair has geology had a popularizer of its major ideas like John McPhee. In Suspect Terrain succeeds in making accessible to the general reader the geologic history of the Appalachians in a way that no elementary text book does. Published first in The New Yorker, the book was written primarily for a reasonably well-educated reader - a non-geologist and probably a non-scientist. An

informed teacher can use much of the book even with beginning students. McPhee attempts the difficult task of answering the questions: What is geology all about? What are the contemporary debates? In answering these questions, he shows how geologists unravel this history, but his is no conventional account (see review by Jeanne Detenbeck in the Winter 1983 Green Mountain Geologist).

Uniformitarianism? McPhee quotes geologist Anita Harris. "...What we see in the geologic record are the catastrophes. Look at a graded sandstone and see the bedding go from fine to coarse. That's a storm. ... In the rock record the tranquility of time is not well represented." (Except possibly in the "paper-laminated" lagoonal redbeds behind a barrier beach.) A study of the stratigraphy of the western margin of the Appalachians allows McPhee to evoke changing depositional environments during the Paleozoic. In Cambrian algal limestones he portrays a shallow tropical sea; in Ordovician black shales, the collapse of the carbonate platform. In Silurian quartz-pebble conglomerates he sees braided rivers rushing out of the young Taconic mountains, carrying the mud far away; in the Devonian Catskill Delta, the disintegration of the "great sierra" of the Acadians. Further west in a Devonian siltstone, we're shown "a tidal flat stuffed with razor clams".

A view of the Delaware Water Gap leads McPhee into an excellent discussion of the relationship of topography to stream action and to the bedrock - its structure as well as its susceptibility to weathering and erosion. I wonder how many times I've had a student answer, to whatever question, "The glacier did it." Glaciers, however, are not neglected. McPhee describes the origin of glacial landforms: of moraines, of pitted outwash, of eskers (those Irish pathways across the bogs), of kames. Crossing the Midwest, he takes us to a periglacial boulder field, across the floors of glacial lakes, over moraines, to glacial grooves and scratches, to erratics and a diamond-bearing indicator fan. (Somewhere between Indianapolis and the Otish mountains of Quebec is a Kimberlite pipe.)

In Suspect Terrain is also about the development of ideas and their reception. McPhee tells of the development of the theory of continental glaciation - Agassiz's work in the Alps, his realization that glaciers had once covered all of northern Europe and his excitement upon finding in America abundant evidence of his "Epoque Glaciaire". "...polished rocks everywhere, magnificant furrows on the sandstone and on the basalt, and parallel moraines...like ramparts upon the plain". Nine years later his successor at Harvard would conclude, "The so-called glacial epoque...so popular a few years ago...may now be rejected without hesitation." Similarly, the development of the theory of plate tectonics parallels McPhee's discussion of Appalachian stratigraphy. The book leans in the direction of skepticism, perhaps because the core of the Appalachians was not examined. What, after all, are serpentine belts? For a good reply from one of the "plate-tectonics boys" see Robert Hatcher's review in the April Natural History. A sense of the debate is there though, a sense of geology undergoing a major revolution in its thinking.

Sandria Ebbett

[The following announcement is included in the "For the Teacher" section because it may be of particular interest to teachers.]

The Burlington Gem and Mineral Club invites you to attend a lecture (open to the public) on "The Geology of Vermont" by Barry Doolan, at their Thursday, April 28th meeting held at 8:00 PM in room 101 of Perkins Geology Hall at the University of Vermont. Club members will be displaying their best or most interesting Vermont specimens at this meeting and the final details of the spring and summer field trip schedule should be decided at this meeting.

MINERAL OF THE QUARTER

Essonite Garnet

Essonite Garnet, $Ca_3Al_2(SiO_4)_3$, specific gravity 3.59, occurs as a light yellow to brownish-orange form of grossularite garnet. It is found in the contact metamorphosed impure limestones exposed at the Vermont Asbestos Corporation mine on Mt. Belvidere in Eden Mills, Vermont. Essonite can also be found in Quebec at Asbestos and Thetford Mines in what is a continuation of the same serpentenized dunite deposit of rocks bearing asbestos.

Beautiful translucent to transparent dodecahedral Essonite crystals of a light cinnamon shade can be found here surrounded by crystalline white calcite or perched on light grey-green diopside ($CaMgSi_2O_6$).

To reach the Eden Mills location, take route 100C to Hyde Park, then continue to Eden Mills on route 100. At the intersection in Eden Mills take a half left up the hill to Mt. Belvidere. Follow the road to the mine gate. Although the mine is not in operation at this time, considerable material had been dumped outside the gate for rockhounds to work over. Some digging and turning over boulders should turn up nice specimens of garnet and diopside. Over thirty different minerals have been recorded from this site. Among them are - serpentine varieties (antigorite, picrolite, williamsite, lizardite and chrysotile asbestos), epidote, calcite, clinochlor, chrome grossular garnet, white diopside, chrome diopside, aragonite, analcime, idocrase, magnetite, bornite, chromite, etc.

Submitted by Ethel Schuele

28 FOSSILS

FOSSIL COLLECTING

With summer coming our thoughts are turning to field work, and for some, that means expanding or beginning a collection of fossils. Although this is a desirable pursuit, we all should follow a code of ethics when entering any site. Whether or not you wish to collect samples, ask permission before you enter private property. Don't overcollect any site or reduce an outcrop to rubble. If you do collect, record any information regarding geographic location, date collected, rock formation and any other relevant information that will insure your being able to return to that spot. MacFall and Wollin (pg. 125) have an "Emily Post" for paleontologists, as well as many helpful suggestions.

Basic equipment for the collector includes the following:

1. Field guides and maps to locate potential sites and indicate what might be found there.
2. A rock hammer and chisel to remove the chosen specimen. Fine development of fossils collected should not be done in the field.
3. A field book or notepad to record relevant information. In the field, black magic marker on an inconspicuous spot is a handy way to identify slabs.
4. Paper bags and newspapers are useful to protect samples as they are collected.
5. A hand lens is useful to examine small fossils.

In the Champlain Valley, much of the black limestone is fossil-bearing, although some is more productive than others. Outcrops that are badly deformed are not likely to have recognizable fossils. Welby's Paleontology of the Champlain Basin in Vermont is one source of locations together with line drawings and descriptions of fossils found in specific formations. This is available from:

Vermont Department of Libraries
Geologic Documents Section
111 State Street
Montpelier, VT 05602

The Pleistocene fossils should not be ignored. Shells can be found in Pleistocene sands. The foraminifera and ostracodes can be found in marine clays but they are not easy for the novice to collect.

Large slabs or partially exposed fossils can be prepared at home for display. A chisel or rock hammer works well on large specimens. Dental tools are excellent for developing smaller delicate fossils.

The following books are a few of many that would be helpful to collectors of varying levels of expertise:

Cassanova, R., 1960, Fossil Collecting: An Illustrated Guide. Faber and Faber, London, 142 p.

MacFall, R.P. and Wollin, J., 1972, Fossils for Amateurs. Van Nostrand, Reinhold Company, New York, 341 p.

Ransom, J.E., 1964, Fossils in America. Harper and Row Publishers, New York, 402 p.

Rixon, A.E., 1976, Fosil Animal Remains: Their Preparation and Conservation. The Athlone Press of the University of London, 304 p.

Welby, C.W., 1962, Paleontology of the Champlain Basin in Vermont, Special Publication No. 1, Vermont Development Department, Montpelier, Vermont, 87 p.

Submitted by Shelley Snyder

RECENT PUBLICATION

A last minute notice from the Office of the State Geologist informed us that Supplement #1 to the Bibliography of Vermont Geology (1980) is available. Cost of the supplement is $2.00, and cost for a set of both the bibliography and the supplement is $6.00. Orders should be accompanied by payment and Vermonters should be certain to add 4% sales tax. Mail your requests to:

Department of Libraries
Geologic Document Section
111 State Street
Montpelier, Vermont 05602

STATE GEOLOGIST'S REPORT

*** NOTE: NEW PHONE NUMBER FOR THE STATE GEOLOGIST IS:

*** 802-828-3365 ***
***

The State Geologist's Report for this issue contains the listing of U.S. Geological Survey work being done in Vermont.

MINERAL RESOURCES ACTIVITIES

Project No.: 9330-02253
Project Chief:
F.C. Canney
Start date: 10/78
Estimated Completion Date: 9/83

Title: Sherbrooke-Lewiston 2-Degree Quadrangle, Maine-New Hampshire-Vermont (CUSMAP)

Compilation and analysis of all geochemical data collected in the Sherbrooke-Lewiston 2-degree quadrangle will be completed in FY 1983. Appropriate geochemical maps and reports will be prepared for publication.

Project No.: 9330-03332
Project Chief:
K.C. Watts
Start Date: 10/81
Estimated Completion Date: 9/85

Title: Geochemical Exploration in the Glens Falls 2-Degree Quadrangle

Regional geochemical sampling of Glens Falls 2-degree quadrangle will continue in FY 1983. Sample media, based on determinations resulting from FY 1982 investigations, will be heavy mineral concentrates and water and will be conducted using a density of one sample per 3 square miles.

Project No.: 9340-03266
Project Chief:
W.J. Bawiec
Start Date: 10/81
Estimated Completion Date: 9/83

Title: Geostatistical Analysis of Resource Potential of Maine, New Hampshire, and Vermont

The relationship between the standardized geologic data set and the standardized mineral production set developed in FY 1982 will be evaluated in FY 1983. This evaluation will involve the application of different techniques to determine the interrela-

tionships and dependencies between geologic and mineral production diversities. The results obtained from these studies will be incorporated in a report on the mineral potential of Maine, New Hampshire and Vermont.

Project No.: 9350-02253 Title: Geologic Studies of the Sherbrooke-Lewiston 2-Degree Quadrangle, Vermont, Maine and New Hampshire (CUSMAP)
Project Chief:
R.H. Moench
Start Date: 10/78
Estimated Completion Date: 9/83

Preliminary geologic maps of the Lewiston-Sherbrooke 2-degree quadrangle will be prepared for publication in FY 1983. Geologic maps of the Old Speck Mountain, Milan and Percy 15-minute quadrangles and of the Mahoosuc Range in the Shelburne and Berlin 7 1/2-minute quadrangles will also be prepared. Research on tin in the White Mountain batholith and potential massive sulfide settings in the Ammonoosuc Volcanics, Jim Pond Formation and Kidderville-Frontenac belt will continue.

Project No.: 9360-00248 Title: Geology of Chromite (R)
Project Chief:
B.R. Lipin
Start Date: 10/80
Estimated Completion Date: 9/85

Geochemical investigation of the Stillwater Complex, Montana, and mineral resource evaluation of the mafic and ultramafic rocks of the Glens Falls quadrangle in New York, New Hampshire and Vermont will continue in FY 1983. Drill cores from an ultramafic body in the Precambrian of northwestern Iowa was examined and sampled in FY 1982. The samples have been submitted for chemical analyses, and a report will be prepared after the analyses are received and interpreted.

Project No.: 9360-02339 Title: Massive Sulfides of New England
Project Chief:
J.F. Slack
Start Date: 10/78
Estimated Completion Date: 9/83

Geochemical data for samples from coticule rocks and sulfide deposits in New England will be evaluated and compiled in FY 1983. The following reports will be in preparation: stratiform tourmalites in metamorphic terranes and their geologic significance; geochemistry of tourmalines from Appalachian-Caledonian massive sulfide deposits; lithogeochemistry of wall rocks at the Elizabeth mine, Vermont copper belt; and structures, unusual wall rocks and massive sulfide deposits in the Great Gossan Lead district, Virginia.

Project No.: 9360-02958 Title: Vermont RARE II and Wilderness Areas
Project Chief:
J.F. Slack
Start Date: 10/80
Estimated Completion Date: 9/83

Reports and maps on the geology, geochemistry and mineral-resource potential of the Bristol Cliffs, Devils Den, Lye Brook and Breadloaf study areas will be completed in FY 1983.

Project No.: 9360-03014
Project Chief:
R.A. Ayuao
Start Date; 10/80
Estimated Completion Date: 9/85

Title: Geochemical Characteristics of Granites Associated with Cu-Mo Porphyry Deposits

Detailed petrographic and electron probe analyses of minerals to determine zonation with respect to ore concentration will continue in FY 1983. Sample collecting will continue in the Carheart, Maine area and will be initiated to obtain unaltered samples from a Cu prospect at Sally Mountain, Maine. Isotopic dating (Rb/Sr) and Pb isotopic studies will be conducted on samples from the mineralized porphry Mo-Cu deposit in Catheart. Field work is also planned in Maine, Vermont and New Hampshire, and will focus on granites associated with Mo occurrences.

Project No.: 9360-03243
Project Chief:
C.E. Brown
Start Date: 11/81
Estimated Completion Date: 9/85

Title: Mineral Resource Appraisal of Glens Falls 2-Degree Quadrangle

Field mapping and sampling will be underway in FY 1983 in selected areas that have significant resource potential. Resource maps that are related to tectonic-lithologic units will be in preparation.

ENERGY RESOURCE ACTIVITIES

Project No.: 9440-01827
Project Chief:
E.L. Boudette
Start Date: 10/80
Estimated Completion Date: 9/85

Title: Uranium Resources in Plutonic Rocks, Northeastern United States (R)

Field and laboratory studies of the geochemistry and emplacement tectonics of New England igneous rocks will continue in FY 1983. Uranium genetic models for application to exploration and resource evaluation will be developed and refined. The global distribution and geochemistry of two-mica granite will continue to be studied.

REGIONAL GEOLOGY ACTIVITIES

Project No.: 9510-02253
Project Chief:
N.L. Hatch
Start Date: 6/78
Estimated Completion Date; 9/83

Title: Lewiston 2-Degree Quadrangle Maine, New Hampshire and Vermont

Final reports and maps will be completed in FY 1983.

Project No.: 9510-03207
Project Chief:
Carl Koteff
Start Date: 6/81
Estimated Completion Date: 9/85

Title: Postglacial Uplift in the Northeast United States

Altitudes for glacial lakes in interior Vermont will be obtained in FY 1983. The glacial lake history, including gathering of altitudinal data, of the Merrimack River valley, New Hampshire, will continue to be studied, and the remaining shoreline ele-

vations for the Champlain Valley will be determined. A surficial geologic map of the Essex Junction, Vermont 7 1/2-minute quadrangle will be prepared.

Project No.: 9510-03362
Project Chief:
J.B. Thompson, Jr.
Start Date: 10/81
Estimated Completion Date: 10/85

Title: Geology of the Glens Falls 2-Degree Quadrangle (CUSMAP)

Field investigations of the Adirondack massif will be initiated in FY 1983. The internal structure of the Green Mountains, the Siluro-Devonian sequences along the Connecticut River, and the Cambro-Ordovician sequence in eastern Vermont will continue to be investigated.

Project No.: 9590-02728
Project Chief:
A.G. Harris
Start Date: 10/79
Completion Date: 9/82

Title: Conodont Succession Across the Lower/Mid-Ordovician Boundary, Central Appalachians

This project was terminated at the end of FY 1982; similar studies will continue under project no. 9590-03511, see status report below.

Project No.: 9590-02729
Project Chief:
A.G. Harris
Start Date: 10/79
Completion Date: 9/82

Title: Conodont-Based Age Determinations of Low-to-Medium-Grade Metamorphic Rocks, Appalachian Orogen

This project was terminated at the end of FY 1982. Similar studies will continue under project no. 9590-03511; see status report below.

Project No.: 9590-03511
Project Chief: A.G. Harris
Start Date: 2/83
Estimated Completion Date: 1/85

Title: Lower Paleozoic Conodont Studies of the Appalachian Basin

New sections in structural and depositional belts in the Appalachian basin will be sampled in FY 1983 in order to extend and amplify the biostratigraphic framework established under previous projects nos. 9590-02728 and 9590-02729, and to obtain additional conodonts for study. Present plans include fieldwork in Alabama, Virginia, West Virginia, Maryland and Pennsylvania; however, other states in the Appalachian basin may be visited as the work of other investigators in the USGS and State geological surveys encounter areas where conodont research is needed. Conodont color-alteration maps based on current data will be compiled for the Appalachian basin, and a report on the conodont microbiofacies of a late Silurian carbonate mudflat in the Tonoloway Formation will be prepared.

GEOCHEMICAL AND GEOPHYSICAL ACTIVITIES

Project No.: 9730-02253
Project Chief:
W.A. Bothner
Start Date: 10/78
Estimated Completion Date: 9/83

Title: Sherbrooke-Lewiston 2-Degree Quadrangle, Maine-New Hampshire-Vermont (CUSMAP)

Additional aeromagnetic data for the study area will be acquired in FY 1983 and merged with digitized data from existing analog records to produce a single, common-level aeromagnetic map. Detailed interpretation of the gravity field in the study area will continue.

Project No.: 9730-03065 Title: Tectonics of New England
Project Chief:
Warren Hamilton
Start Date: 9/81
Estimated Completion Date: 9/83

Efforts during FY 1983 will be limited to preparing reports on the results of investigations conducted by this project.

Project No.: 9730-03399 Title: Central and Eastern U.S. Tectonics
Project Chief:
M.F. Kane
Start Date: 10/81
Estimated Completion Date: 9/83

Two major reports will be prepared in FY 1983. One report will describe a system of crustal structures, based on gravity data and linked to a plate-tectonic framework, that will offer a preliminary explanation for the principal seismicity of the central and eastern United States. The other report will describe the crustal structure of the conterminous United States, based on an analysis of the gravity fields. Final revisions will be made on reports on a model for compressional deformation of crustal rifts, on seismicity and crustal structure in the eastern United States, and on the crustal structure of the Central United States.

Project No.: 9730-03413 Title: Geophysical Analysis of Glens Falls Quadrangle
Project Chief:
D.L. Daniels
Start Date: 4/82
Estimated Completion Date: 9/84

The gravity field measurements collected in the Glens Falls 2-degree quadrangle during FY 1982 will be reduced, checked, plotted and incorporated into the existing gravity data base in FY 1983. Gravity surveying and density- and magnetic-susceptibility sampling will continue. Modeling and/or depth analysis of selected gravity and magnetic features will be initiated.

Project No.: 9740-00375 Title: Geochronology, Reston (R)
Project Chief:
T.W. Stern
Start Date: 10/81
Estimated Completion Date: 10/85

Geochronologic studies will continue in FY 1983; a brief description of major activities follows. U-Th-Pb geochronology will focus on the Appalachian Piedmont in the Fredericksburg, Virginia, area and on the Atlantic 2-degree quadrangle in Georgia in order to refine the ages of critical units and to develop structural models for these terranes. Rb-Sr geochronology and Sr isotopic studies will focus on the post-tectonic plutons of northern New England, particularly the Derby, Echo Pond, and Willoughby granites of northern Vermont, to determine their age, fractionation history, nature of the source terrane, and isotopic character of the crustal block underlying this portion

of the Appalachian orogen. Detailed geochronology is lacking for the Glens Falls 2-degree quadrangle in New York, New Hampshire and Vermont. Cooperative studies will be conducted to establish the age of critical bodies, using U-Pb zircon dating techniques. Minerals from metamorphic and plutonic rocks from the Glens Falls quadrangle will be analyzed using the 40-Ar/39-Ar age spectrum technique, to establish the timing of metamorphism, and post-metamorphic and post-plutonic cooling and uplift histories will be measured to evaluate the tectonic history of the area. Argon studies will be completed on an east-west traverse in the Charlotte 2-degree quadrangle, South Carolina/Georgia. The following geochronologic studies will be conducted to establish a temporal framework for the Triassic to Jurassic rift basins of eastern North America: 40-Ar/39-Ar dating of diabasic rocks; U-Th-Pb zircon dating of granophyres; Sr isotopic tracer studies will be conducted on mafic igneous rocks to provide constraints on source materials and magma evolution models; and fission-track ages will be determined on detrital apatites and zircons and 40-Ar/39-Ar ages determined on detrital K-feldspar and authenigenic micas to establish time-temperature models for thermal evolution of basin sediments.

Project No.: 9740-01761 Title: Radiometric Age Data Bank (R)
Project Chief: R.F. Marvin
Start Date: 10/80
Estimated Completion Date: 10/85

The Radiometric Age Data Bank currently contains about 95% of the published radiometric ages for the states of Connecticut, Florida, Georgia, Idaho, Maine, Massachusetts, Michigan, Minnesota, Montana, Nevada, New Hampshire, North Carolina, Oregon, Rhode Island, South Carolina, Utah, Vermont, Washington, Wisconsin and Wyoming. During FY 1983 data will be entered for the following additional states: California, Missouri, Kansas, New York, Virginia, New Mexico, Colorado, Arizona, Texas and Oklahoma.

Project No.: 9780-02253 Title: Sherbrooke-Lewiston 2-Degree Quadrangle, New Hampshire-Maine-Vermont Geophysics (CUSMAP)
Project Chief:
F.C. Frischknecht
Start Date: 1/79
Estimated Completion Date; 9/83

Processing and preliminary interpretation of airborne geophysical data acquired for the study area will be completed in FY 1983, along with ground checking of airborne results.

Project No.: 9790-03366 Title: Remote Sensing of Glens Falls 2-Degree Quadrangle
Project Chief: N.M. Milton
Start Date: 10/81
Estimated Completion Date: 12/83

A preliminary lineament map of the Glans Falls 2-degree quadrangle has been compiled and will be field checked in FY 1983. Landsat data will be correlated with geobotanical data collected on the ground.

Charles A. Rattè, State Geologist

MEETINGS

APRIL 28	Burlington Gem and Mineral Club meeting, guest speaker, Barry Doolan holding forth about "The Geology of Vermont". See the "For the Teacher" section for details.
APRIL 30	VERMONT GEOLOGICAL SOCIETY Spring meeting at Middlebury College. See front page for deatils.
AUG 6&7	Champlain Valley Gem and Mineral Show at South Burlington High School. Details below.
JUNE 18-20 1984	Finite element analysis and hydrology conference in Burlington, Vermont
JULY 9-11 1984	Special lecture series, "Geotechnical Engineering Practice", at Massachusetts Institute of Technology. Contact: Thomas K. Liu, Haley & Aldrich, Inc., 238 Main Street, Cambridge, Mass. 02142.

CHAMPLAIN VALLEY GEM AND MINERAL SHOW

On August 6 and 7 from 10 AM to 6 PM, the Burlington Gem and Mineral Club will hold its 4th Annual Champlain Valley Gem and Mineral Show at South Burlington High School. The featured speakers of the show will be Frederick and Alice Kraissl, friends of the Sterling-Hill, Franklin, New Jersey Mineral Museum. They will give two 40-minute slide illustrated lectures - one on the general geology and mineralogy of that world-famous fluorescent mineral area and one on the recently identified rarer micro-minerals from that area. George Robinson, mineral curator of the Ottawa National Museum and Chuck Ratté, Vermont State Geologist, are also expected to speak at the show. An exhibit of Mt. St. Hilaire minerals from the Ottawa National Museum and one on pegmatite minerals will be featured at the show. Members of the club will be demonstrating soap-stone carving, gemstone cutting, cabochon making, scrimshaw carving and tumble polishing at various times during the two days. Earl and Marie Melendy of the Brattleboro Mineralogical Society will staff a mineral identification booth during the show as a service to collectors. A swapping area will be available. Twelve dealers will offer minerals, fossils, jewelry, mineral novelties, lapidary equipment, books and other hobby aids. Admission to the exhibits, demonstration area and the dealers is a $1.00 donation for adults , 50c for children 6 to 16. No admission is charged for the lectures or films. Two color films will be shown, one a short color film on fossils, "The Story in the Rocks", the other a 29 minute color film on the origin and geological history of the Appalachians Mountains, "Mountain Heritage - the Appalachians", produced by the Ontario Educational Communications Association. An excellent slide and tape show on Mt. St. Helens will also be shown at intervals during both days. Food will be available during the day so you can make a day of it.

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

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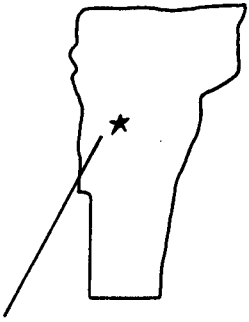
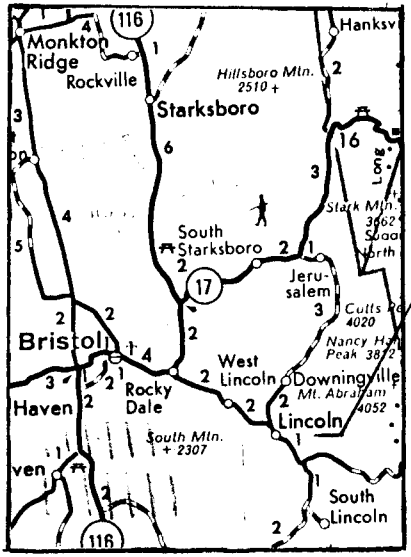
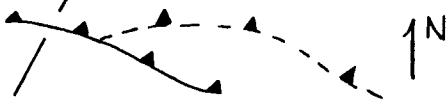


QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

SUMMER 1983 VOLUME 10 NUMBER 2



[Official Vt. State Map]



New Interpretations Revealed!

See for yourself on a

SUMMER FIELD TRIP

SATURDAY, AUGUST 27

Meet at 9:30 A.M.

General Store, Lincoln, Vt.

[See Page 3 for details]

CONTENTS PAGE

PRESIDENT'S LETTER

All the recent political noise concerning the quality of public school education raises the question of what is our Society doing? Ought we rush in with new cirricula emphasizing various earth sciences? Should we be encouraging new ties with interested teachers across the State? How can we best "sell" the science of geology not only to the teachers of Vermont, but also the kids?

I look forward to Barry Doolan's account of Vermont geology. It will be a long-needed reference that will hopefully prove useful to Vermont teachers (and geologists!). What we really need to do, though, is to go out there and sell the product. Otherwise, all of our best efforts will sit on the shelf gathering dust.

One way to peddle our science is to develop our ties with school boards and administrators. Too often, geology courses are relegated to electives and fall-back electives at that. Unfortunately, geology means simple rock or fossil identification with dusty samples in old varnished wooden boxes. That perception places the science in a subsidiary role. Actually, geology and earth science really are the foundations of all other sciences!* It is time that we acknowledged and advocated these facts.

We can also help peddle our science by strengthening our associations with teachers. Avenues for this may exist by further developing a relationship with the Vermont Institute of Natural Science (VINS) or by encouraging teachers to attend our famous field trips. One VGS member has suggested that scholarships be made available to those teachers attending the field trips.

We can also do the outrageous and actually sally forth into the classroom to teach a class or two. Contrary to popular belief, the kids do not bite. In fact, they challenge you to present the material in a lively and exciting manner. I have found the teachers in whose classes I have taught to be welcoming and appreciative. This goes a long way towards bridging that unfortunate gulf between public school teacher and academician or professional consultant.

It is also fun to see the kids in a new light. Who can deny the terrific feeling when an excited sixth grader's hand flies skyward asking to show you his dusty rock collection. The rocks may all be quartz and micaceous schist, but they are pure gold to him.

Why might we as geologists get involved in our local school systems? Because there is a central role for geology in our schools. There are also many benefits for us if we choose to become even peripherally involved. After all, understanding and communicating geologic processes require creative and insightful thinking on the part of both students and teachers. What better educational experience could you ask for?

*Together, the two disciplines are great vehicles for teaching analysis, synthesis and evaluation.

Chris White

SUMMER FIELD TRIP

Date: August 27, 1983
Time: 9:30 A.M.
Place: General Store, Lincoln, Vermont

Rolfe Stanley from UVM will lead the trip through two recently mapped field areas in Lincoln and Starksboro. Details of this work are found in Vermont Geological Survey Special Bulletins Nos. 2 and 4*. The areas are included in the Bristol, Mt. Ellen, South Mountain and Lincoln 7.5 minute USGS Quads for those who might prefer to use topo maps. After a short orientation session (during which appropriate handouts will be provided), we will procede to outcrops in Lincoln and South Lincoln where we wil look at contacts with Precambrian rocks, depositional on the western side of the Lincoln anticline and tectonic contacts on the eastern side.

Lunch: We will return to Lincoln where those who need lunch may buy some.

The afternoon will be occupied with a half hour hike through the woods north of Route 17 to a site where the Underhill thrust is exposed in tectonic contact between the Underhill and Pinnacle Formations. Return to the trailhead will be between 3 and 4 PM. If there is interest, those driving north may also want to arrange a stop at the Hinesburg thrust.

*Tauvers, Peter, 1982, Bedrock Geology of the Lincoln Area, Vt.: Special Bulletin No. 2, Vermont Geological Survey and DiPietro, Joseph, 1983, Geology of the Starksboro Area, VT.:Special Bulletin No. 4, Vermont Geological Survey are available for $2.00 each ($1.00 for the map only) from: Vermont Department of Libraries, Geological Documents Section, Montpelier, VT 05602. Be certain to enclose your check in payment plus 4% sales tax for Vermont residents.

VGS BUSINESS & NEWS

NOMINATIONS COMMITTEE REPORT

The nominations committee, Chuck Rattè, chairman, John Malter and Bud Ebbett, reported the following slate of nominations for officers for 1983-1984:

President	Barry Doolan
Vice President	Ray Coish
	Roger Thompson
Treasurer	Dorothy Richter
	David Westerman
Secretary	Larry Becker
	Shelley Snyder
Board of Directors	Davis Cable
2-year term	Cammy McCormack
	Diane Vanecek

Note: On the advice of past presidents, in order to maintain continuity on the executive committee we have been pursuing the policy of nominating the Vice President for President the following year.

Election will take place at the Annual Fall Meeting on October 15. Details of this meeting and absentee ballots will be published in the Fall GMG.

CURRENT ISSUES FORUM - REPORT

The executive committee of the Vermont Geological Society has established a working group which will deal with geological aspects of issues of public concern. The purpose of this group is primarily educational. The intent is to produce pamphlets which provide information in a way the public can understand and use. The approach to be taken is purely objective, with no intent of espousing or endorsing a particular view. Issues which may be dealt with soon are ground water concerns, oil and gas exploration and production, and radioactive waste disposal. The VGS is in a particularly strong position to provide this information because of the broad range of expertise and views held by the membership. If you have any suggestions regarding subjects to be covered, or would like to volunteer for a role in developing material for a specific subject area, please contact:

William Glassley
Department of Geology
Middlebury College
Middlebury, Vermont 05753

VGS COMMITTEES

The following list of VGS committees and members is up-to-date and printed here for your information. It is an indication of the activities of the Society and shows the areas of interest in which members can become involved.

Standing Committees

Budget - Roger Thompson
Education - Sandria and Ballard Ebbett
Nominations - Charles Rattè, John Malter and Ballard Ebbett
Executive - the present 7 elected officers
Publications - Jeanne Detenbeck
Editorial - Charles Rattè, Rolfe Stanley, Brewster Baldwin and Chris White

Ad Hoc Committees

Ground Water Watchdog - Brewster Baldwin, David Tarbox, and Chris White
Applied Geology - Lance Meade
Current Issues Forum - Bill Glassley, Barry Doolan and Chris White

SPRING MEETING REPORT

The cast and crew for our Tenth Annual Spring Presentation of student papers on April 30th in Warner Science Hall on the campus of Middlebury College reads as follows:

Stars: Becky Dorsey of UVM and John Garvey of M.C. who each won a $25 prize.
Co-stars: 16 more students who made a terrific program complete.
Judges: Dorothy Richter, Gene Simmons and Chris White.
Moderator: Brew Baldwin
Timer: Barry Doolan
Lights and projector: Ray Coish

In attendance were 30-35 students and members.

VGS EXECUTIVE COMMITTEE MINUTES

The meeting was conducted during lunch break at the spring meeting, April 30, 1983, at Warner Science Hall at Middlebury College. Present were Chris White, Dorothy Richter, Barry Doolan, Brewster Baldwin, Chuck Rattè, Bill Glassley and Jeanne Detenbeck.

Thanks were expressed to Brew Baldwin for hosting the spring meeting and compliments to the editor about the spring GMG.

The minutes from the winter executive committee meeting were read and approved.

The treasurer reported about $1800 on account, to be balanced by a bill for $208 and paid-up back dues of $28. Dorothy mailed out 32 overdue notices for dues and has so far received 12 answers. The treasurer's report was accepted. B. Baldwin moved that the secretary or treasurer send notes to those in default of dues for a greater time period than that stated in the bylaws, that they are being removed from the mailing list as specified in the bylaws. The motion was seconded and passed.

OLD BUSINESS:

C. Rattè gave a preliminary report for the nominating committee (composed of himself and John Malter) that they have so far had the following people agree to run for office:

Pres. Barry Doolan
VP Ray Coish, Roger Thompson
Treasurer Dorothy Richter, David Westerman
Secretary Larry Becker
Board of Directors Davis Cable, Cammy McCormack, Diane Vanecek

C. Rattè will run the fall field trip at Okemo and arrange for the dinner in that area. The date is about the third weekend in October, depending upon the date of NEIGC, which Barry will check on.

The question was raised as to what the State Geologist expected to publish in the way of field trip guides. Money is committed for maps, so Barry suggested that we publish past field trips in a copy of Vermont Geology. Brew moved that a forthcoming issue of Vermont Geology publish the field guides of past VGS field trips; the editorial committee (of five people, current edit. comm. + Barry) is to decide what modifications are needed to the original handouts. Barry amended the motion to have a note in the next GMG that we would also like suggestions of other field areas for future publications. The motion was seconded and passed. Jeanne will write to the authors and get the field guides together for publication.

J. Detenbeck reported that there were at least six responses to the request for papers for another volume of Vermont Geology, enough to proceed with publishing volume 3. The date should be no later than the winter 1984 meeting. She noted that there is also a need for a non-professional type of field guide for our state such as she has found published by Pennsylvania, Nova Scotia and New foundland, and advertised in Geology - Roadside Geology, a series published by Mountain Press in Montana

Brew reported for the Ground Water Watchdog Committee that H.30 has been tabled. The committee would like to see the legislation based on Sahl(1979) (doctrine of correlative rights) rather than reasonable use doctrine (water belongs to the land). We should see if VGS can publicize the proposed changes (i.e. lobbying) without losing our tax exempt status. Chris would like to have lawyers (Richard Taylor and Betty Nuovo) put the proposed legislative draft into legal language. Brew will keep working on a meeting of the committee with John Ponsetto (Commissioner of Water Resources).

Brew reported concerning the DNAG field guides that Rolfe Stanley has submitted the Champlain thrust and that he (B.B.) sent in existing copies of his Fair Haven, summer Crown Point and Thetford Mines field trip guides to Roy Palmer at GSA in order to find out what topics they are really interested in and what shape they want the proposals in. Brew would really like to have Roger Laurent work on the Thetford Mines guide as the first author (with B.B. as second) and have it published by VGS in Vermont Geology.

Bill Glassley presented his ideas for a current issues forum. He, as well as many other geologists in the state, receives many questions about oil and gas leases, ground water problems and other geological concerns. There is a need to put information together in a professional way to answer these questions. A committee should be formed to develop presentations, seminars, publications and testimony (for the legislature). Experts (ideally through VGS) could put all points of view together. Discussions in the State would be more intelligent if VGS focused on this. C. White suggested that this could be done under an organizing committee. Barry said it should be published in a form to be legally defended. We can be prepared to refer questions to the correct source and can compile information published in the past as a service. C. White thought VGS can focus on the scientific information. Barry added that we can show why geologists look at a problem in a certain way. B. Glassley wondered what issues will come up in the future and whether we can outline uncertainties. A committee named Current Issues was appointed with Bill Glassley as chairman, B. Doolan and C. White. It was suggested that a list of expertise of the members be kept and that a checklist should be sent out with the yearly dues renewal so that a list could be compiled.

Barry reported that the outline of his Vermont geologic history is all he will be able to do until his summer field trips are completed. He has, however, been trying out his ideas in several talks. He needs to find out what level os understanding he has to write at. Brew suggested that the introduction to each section could be to a high school student level but that the text should be at the level of an introductory geology college student.

NEW BUSINESS

Rolfe Stanley will lead a summer field trip in the Lincoln area (re Peter Tauver's recently published map area).

The next two GMGs will be published the first week in August and the first week in October.

An audit of the books should be planned for fall 1983.
Meeting adjourned.

Respectfully submitted,
Jeanne C. Detenbeck, protem

TENTH ANNIVERSARY SPECIAL

In the spring of 1984, the Society will be celebrating its tenth anniversary. In anticipation of this occasion, I have asked our past Presidents to write about their early activities in the Society, what they consider has been the most important accomplishment and what they see in the future. Their responses will appear in the GMG as I receive them. Brew Baldwin has been the first to respond, providing interesting reminiscences from his ever-present notebooks.

[The editor]

The Society got off to a fast and useful start. My first notes on the Society are dated 17 January 1974, and the Charter Meeting was held just 5 weeks later. Geologists with the State government in Montpelier played a key role; I think especially of Art Hodges, John Malter, Charles Fox, and Jim Ashley, who continued as prime movers in our early years. The organization went so well that just two months later the Society was sponsoring the first of its annual spring meetings devoted to student papers. Also, GMG was in business by spring, 1974.

From the fall of 1975 to mid-1976, the Society mounted a major and effective effort to save the State Geologist, who had become an endangered species. In brief, Charles Doll's excellent service as State Geologist was forgotten in recent years, through over-quiet public relations. State funds were tight and the legislature was moving to delete the budget and position. The Society reversed this attitude, after countless executive committee meetings, long Society business meetings, and many individual hours on the part of most of the members. My notes must list 20 persons who worked on this. Some highlights follow:

On October 18, 1975, the annual society meeting discussed the problem at length (and at the cost of not hearing the talk that Rolfe Stanley had prepared) (GMG, v. 2, n. 3). The meeting triggered several kinds of response. Rolfe got many state geologists to write in support of the Vermont Geological Survey, and he agreed to serve temporarily as Assistant State Geologist. Carolyn Merry wrote state geological surveys for information on their administrative structure and priorities. I chaired the ad hoc committee that prepared a preliminary position paper on the need for and preferred structure of a geological survey. On December 2, 1975, President John Malter and I met with Dr. Martin Johnson, Secretary of the Agency of Environmental Conservation, in order to share our concerns with him and to understand the concerns he had. John followed this with several other meetings with Johnson. Phil Wagner's letter to the Society (GMG, v. 2, n. 4) discussed roles of geology in public service, and ways to focus this through the position of a State Geologist. He followed this on February 20 with a fuller and more mature statement for the ad hoc committee, and this was distributed to legislators (GMG, special issue, March 1976). On March 3, 1976, I accompanied Phil to the Senate Appropriations Committee hearing. The senators listened, and by 10 March they convinced the State legislature to continue the position of State Geologist. →

More than this, the Society had gained the confidence of the state government to the extent that our views were sought on the merits of the several candidates. In early June 1976, the Society wrote to Martin Johnson, recommending that Charles Ratte be appointed State Geologist and that the office be fully funded. It worked.

Brewster Baldwin

BELOW THE SURFACE

In the Winter 1983 GMG and in a subsequent letter to some of our members, I requested manuscripts for a series of articles which would identify buried bedrock surface configurations. Such sites could not be identified by ordinary surface mapping but might be recognized from well depth data, seismic work or excavation at construction sites. There should be some unknown but interesting hidden geologic facts out there and I hope to collect and publish them for this series. Brian Fowler has submitted the first article - presented here - and for the Fall GMG I expect to publish the results of Lake Champlain studies by three Middlebury students.

[Editor]

KAOLIN MINERALOGY, SHAFTSBURY, VERMONT

Brian K. Fowler, CPG
Appalachian Geological Services
RFD 7 - Box 159
Gilford, N.H. 03246

In 1979, during the extensive structural and hydrologic studies that were conducted in connection with the design and construction of a 500,000 cubic yard crushed stone quarry for the extension of U.S. Rte. 7 through North Bennington, Shaftsbury and Arlington, Vt., several samples of kaolin were recovered from residential wells near the quarry. The locations of the wells are shown on the sketch map (Fig. 1), which is a tracing of a portion of the Bennington 7.5-Minute Quadrangle (USGS). The sample from Well No. 1 was recovered from a depth of 287 feet. The sample from Well No. 2 was recovered from a depth of 74 feet. The purpose of the sampling was to determine the source of fine sediment in the well water, and whether or not it was being derived because of the blasting in the nearby quarry (6000 feet for No. 1 and 2000 feet for No. 2) or as a result of lateral collapse along the walls of the wells, both of which had been drilled in unconsolidated materials and both of which had been cased to only 70 feet for No. 1 and 28 feet for No. 2.

In order to be certain of the composition of the sediment samples, they were subjected to X-ray Diffraction examination. The work was performed by Dr. Charles W. Burnham and his students at Harvard University. The specific purpose for the detailed examination was to determine whether the sediment was related to the till typically deposited in that area or to the kaolin deposits that exist at scattered but common locations in that area. The results of the X-ray work are given in Table 1, and will be of interest to those workers in the area who are investigating the nature of these kaolin deposits. →

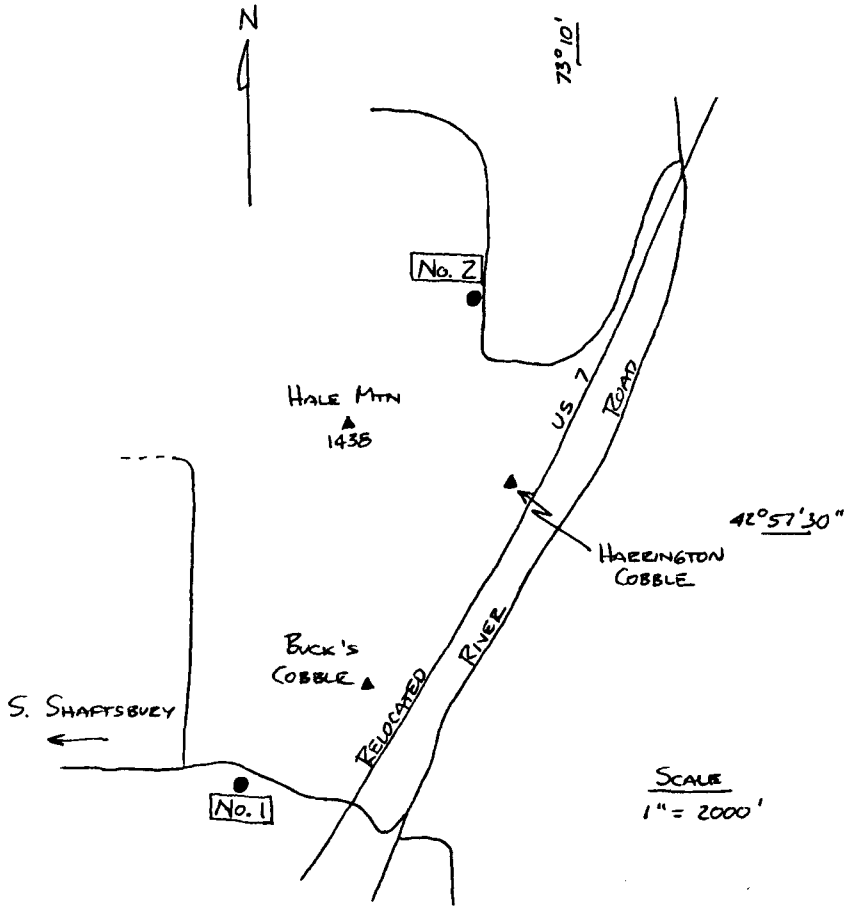


Figure 1. Location map for wells from which Kaolin was recovered near Shaftsbury, Vt. Tracing is a portion of the Bennington 7.5-Minute Quadrangle.

TABLE 1

Mineralogy of Kaolin Samples
Shaftsbury, Vt.
(X-ray Diffraction Analysis)

Mineral	No. 1	No. 2
Quartz	55%	50%
Kaolin	5%	35%
Muscovite	30%	15%
Microcline	10%	0%

Note: These are approximate percentages only; however, there were no significant percentages of any other phases in the samples.

[Continued on Page 11]

STATE GEOLOGIST'S REPORT

Two new maps have been published this summer by the State Geological Survey and are now available.

1. Bedrock Geology of the Milton Quadrangle, Northwestern Vermont by Rebecca J. Dorsey, Paul C. Agnew, Craig M. Carter, Eric J. Rosencrantz and Rolfe S. Stanley: Special Bulletin No. 3, 1983. Price is $3.00 for the complete report or $2.00 for the map only.
2. Geology of the Starksboro Area, Vermont by Joseph A. DiPietro: Special Bulletin No. 4, 1983. Price is $2.00 for the complete report or $1.00 for the map only.

To order, send check for amount of purchase (plus 4% sales tax from Vermonters) to:

Vermont Department of Libraries
Geological Documents Section
Montpelier, Vermont 05602

The State Geologist and his crew have been busy this summer reviewing the Department of Energy reports "Regional Characterization Reports for Geology and the Environment as Related to Vermont's Potential for High Level Radioactive Waste Disposal in Crystalline Rocks". Their reviews and comments are being collated and will be sent to DOE in time to meet the September 1 deadline. Members of VGS are invited to review the documents and make comments. Contact:

Charles Rattè, State Geologist
Agency of Environmental Conservation
Montpelier, Vermont 05602
(802) 828-3365

Two field crews are working under the auspices of the State Geologist for this summer. In northwest Vermont, Becky Dorsey and Diane Vanacek are doing ground radiometric surveys for the purpose of checking aerial radiometric surveys for ground truthing. In southern Vermont, a crew is working to locate and identify serpentine-talc associations and attempting to develop the property ownership associated with these sites. The purpose of this study is to provide information for the Act 250 process to enable protection of mineral resources which might be compromised by other types of development.

Cooperation between the USGS and the State Geologist has been initiated involving slope stability studies in the Green Mountains from Route 4 in Lyndonville south to Dorset Mountain near Dorset. This is the first year of a three year program.

The State Geologist has also initiated and is sponsoring a new bedrock and surficial mapping project for the Northfield Quadrangle. Work is being done by Fred Larsen and David Westerman.

The USGS Glens Falls $1^{\circ} \times 2^{\circ}$ Quadrangle CUSMAP (Conterminous U.S. Mineral Assessment Program) project is underway in its second year.

MEETINGS

AUG 27 VGS SUMMER FIELD TRIP - See Page 3

SEPT 1 Deadline for abstracts of papers for a symposium, "Theory and Application of Advanced Scientific Methods and Statistical Approaches to Hydrology and Ground Water Geology" sponsored by the Hydrogeology Division at the Geological Society of America Northeastern Section meeting at Brown University March 14-17. If you are interested in submitting a paper and need information contact Chris White, White Geohydrology Inc., 52 Seymour St., Middlebury, VT 05753, 388-6667.

SEPT 24-25 New York State Geological Association meeting at Potsdam, New York [Neal O'Brien, Department of Geology, SUNY, Potsdam, NY 13676, (315) 267-2286].

SEPT 24-25 Models in Geomorphology, annual Binghamton Geomorphology Symposium in Buffalo, New York [Michael Woldenburg, Department of Geography, Fronczak Hall, SUNY, Buffalo, NY 14260, (716) 636-2281].

OCT 8 NEIGC (New England Intercollegiate Geologic Conference) in northern Maine. Details of this meeting (except for the date) have eluded this editor, who will try to get on their mailing list for future reference!!

OCT 15 VGS FALL FIELD TRIP AND ANNUAL MEETING. Trip in Okemo area led by Chuck Ratté. Details of field trip and banquet will appear in the Fall issue of GMG, which should be in the mail very early October.

OCT 31/ NOV 3 Annual meeting of the Geological Society of America, Indianapolis, Indiana.

[Kaolin Mineralogy continued from Page 9]

The samples that were recovered from the wells were both fine to very fine grained, with a pronounced ferric staining from medium tan to dark tan and light brown. No till-like matrix of coarser grained material was retrieved, and both samples were collected above the water levels in both wells. Binocular microscope (10X) examination of the grains indicated that they were highly weathered, each covered by a similar coating of ferric oxide (ochre). No faceted or striated grains were observed, nor did there appear to be a wide variation in grain-size distribution. Both of the samples were collected in areas that lie within boundaries of reported kaolin deposits in the Shaftsbury area (see Burt, F.A., 1929, Origin of the Bennington Kaolins; Vermont State Geologist, 16th Report, p. 65-84). However, this author does not wish to speculate further upon the significance of this information. It is provided here so that it may be of use to others.

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

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SHELBURNE VT
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1983
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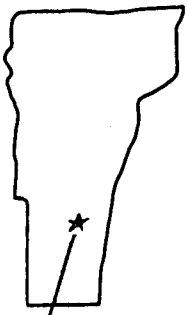
FIRST CLASS

Charles A Ratte
4 Chestnut Hill
Montpelier, VT 05602

THE GREEN MOUNTAIN GEOLOGIST



QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

FALL 1983 VOLUME 10 NUMBER 3

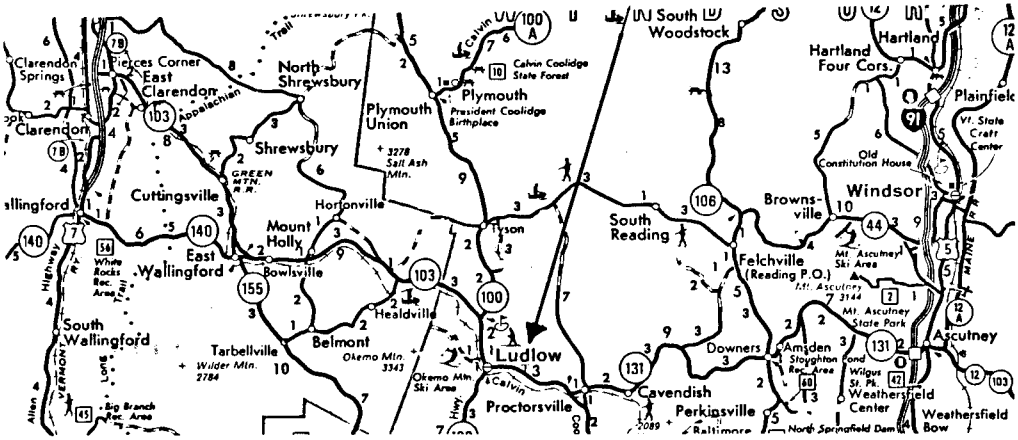
TWICE NICE FOR FALL

A PAIR OF DYNAMIC FIELD TRIPS PRESENTED BY THE DUO OF RATTÉ & KARABINOS

SATURDAY, OCTOBER 15, 9:30 A.M. & 1:00 P.M.

MEET AT LUDLOW SHOPPING CENTER

See page 3 for details



CONTENTS PAGE

PRESIDENT'S LETTER

Where has this past year gone? It was not that long ago that we gathered at the August Lion in Randolph following Chuck Ratté's field trip. Now we look forward to another of Chuck's trips, this time in the Okemo-Ludlow region. Thank you, Chuck!

The VGS in 1983 is a healthy and active organization. Our next president, Barry Doolan, will be a fearless leader. Thanks to the earlier work of the Nominating Committee, we have contested seats on the Executive Committee for the next year. Members, be sure to vote at the annual meeting, which follows the Okemo trip.

The academicians are an exciting and stimulating bunch. Rolfe Stanley's and Joe DiPietro's field trip in the Lincoln area this summer was very well attended by geologists from all over the State and, indeed, the northeast U.S.

The secondary school educators also look like they are organizing. The Ebbetts, from Lyndonville, and Jeff Pelton, of Springfield, are talking of forging links between VGS and the Vermont Science Teachers Association. Hopefully, one of next year's teacher's meetings will be devoted to earth science and geology.

The consulting geologists tend to be buried in their business. It is difficult to become deeply involved in VGS when vocational duties call. Yet ascendant issues of professional education, a form of self-policing, and possible professional registration, plus concerns of public relations are all questions VGS is ideally suited to help answer. On a related topic, the Current Issues Forum has been established to help impartially address geologically-oriented public issues such as waste disposal and oil and gas exploration. This forum is the brain-child of Bill Glassley. Interested persons should contact him at Middlebury College.

We have challenges in front of us in rewriting Vermont's bedrock and tectonic geology, renewing our commitment to secondary school earth science instruction and dealing with potential problems for the consulting geologist. Because of you, VGS is alive and well. With your help, these challenges and others can be met.

Chris White

FALL FIELD TRIP

AND ANNUAL MEETING

SATURDAY, OCTOBER 15, 1983

9:30 A.M. Meet at Ludlow Shopping Center
Leader: Charles Rattè, State Geologist
Topic: Stratigraphic variations and uranium occurrences in the Okemo Quartzite.

Noon: Lunch

12:15 - 12:45 P.M. EXECUTIVE COMMITTEE meeting

1:00 P.M. Meet at Ludlow Shopping Center
Leader: Paul Karabinos, Williams College
Topic: Basement-cover relationships on the east and north central sides of the Green Mountain massif.

5:00 P.M. Cash bar opens at Royal's Hearthside Restaurant, Rutland, Junction of Routes 7 and 4. [Reservations for banquet should have been made by October 1 in response to a special mailing.]★

Dinner will be followed by the annual meeting at which officers for 1983-1984 will be elected.

ABSENTEE BALLOT

Ideally, we would like to have everyone attend the annual meeting in order to vote for next year's officers, but for those who absolutely can't come, please exercise your franchise in the society and use the ABSENTEE BALLOT provided on the last page of this issue.

★ Check with Chuck Rattè (802-828-3365) for last minute reservations. He says there are still some left.

VGS BUSINESS & NEWS

CALL FOR DNAG

At the lunch stop on the Lincoln field trip, Rolfe Stanley make an impassioned plea for additional sites of regional geologic significance to be submitted for the Decade of North American Geology field guide for the northeast U.S. So far, Vermont has only one site submitted, and that was by Rolfe! Surely our state has more to offer than that! Pick your brains, folks, and at least suggest some places that you think might qualify. Get in touch with Rolfe. Help dissolve the preconceptions that Vermont is in the backwaters (sorry fluvial geomorphologists) of U.S. geology.

SUMMER FIELD TRIP

In spite of the general threat of inclement weather and the additional information passed on to us by our trip leader, Rolfe Stanley, that the Lincoln area has a propensity for thunderstorms, VGS had just about the biggest turnout for a summer field trip ever. Among the 37 adults were several old friends visiting from out of state and new graduate students from UVM. Along with one well-behaved toddler and one small dog, we investigated two outcrops showing basement (PreCambrian)-cover relationships exposed in the New Haven River and then trudged up a hill in the steamy afternoon to see an exposure of the Underhill Thrust. Here we were shown folds whose fold axes are parallel to the direction of motion in the thrust zone. Joe DiPietro, whose thesis included the afternoon field area, assisted Rolfe in answering our questions all day. At the Underhill thrust area, Rolfe introduced his grad student, Barbara Strehle, who is looking at this thrust (along with a number of other thrust zones in Vermont) in microscopic detail, in order to determine deformation mechanisms and the structural evolution of fault zone fabrics in Vermont.

TENTH ANNIVERSARY SPECIAL

Here continues the reflections of past VGS presidents about the activities and accomplishments of the first ten years of VGS as they saw them. The first essay by Brew Baldwin appeared in the Summer 1983 GMG.

As a past president, founder and charter member of the Vermont Geological Society, it is perhaps appropriate that I should be allowed to make public my reflections on the occasion of the tenth anniversary of the organization.

I would like to do this in a personal way, i.e., how has the Vermont Geological Society affected me as a person and professional geologist. My association with the Vermont Geological Society has been especially beneficial both professionally and socially. During my initial years as a member of the society, I was somewhat isolated from other professionals working on and in Vermont geology. I was perhaps the only practicing geologist/teacher in southern Vermont at the time. Through the society I was introduced to geologists and their work in Vermont. Much of what was going on was centered in Montpelier, the University, Middlebury and Norwich. I greatly appreciate the influence membership in the society has had in the development of new and old acquaintances at the time. Dave Butterfield, Jim Ashley and Art Hodges were in the vanguard of ground water geology in Vermont, Phil Wagner saw the value of applying geology to Vermont's environmental problems long before Act 250 was passed, Rolfe Stanley, new at the University as I was at Windham College, recognized the need to keep the new ideas of metamorphic and structural geology alive and applied to

Vermont's geology, Fred Larsen was and remains our real expert in Vermont's glacial geology, Brew Baldwin I recall as the master of geological pedagogy and appreciate his invitations in those early days to participate in his field mapping exercises at James Pastures. I cherish these early and lasting friendships, and those too numerous to mention that continue to develop largely through my association with the society.

The society has been extremely receptive to my humble efforts to display my interests in Vermont geology. It has provided me a forum through field trips, oral presentations at the winter meetings, and publication in the Green Mountain Geologist to have my say "so to speak". I am both honored and professionally satisfied by the society's acceptance of my efforts.

And finally I could not end this reflection without expressing my sincere gratitude to the society for the great effort it made in 1976 to save the position of State Geologist. I am convinced that were it not for these efforts there would be no State Geologist today and the outstanding efforts of my predessors may have been lost in the shuffle. Of course, the society's influence in saving the State Geologist's position is especially meaningful to me since the society also saw fit to recommend me as successor to this position. I have and continue to enjoy my work as your State Geologist.

Many thanks to the Vermont Geological Society for what I consider to have accrued an accomplished ten year record.

Chuck Ratté

FOSSILS

BRYOZOANS

The Bryozoans (moss animals) are colonial organisms similar in appearance to the corals. The scale, however, is much smaller for the Bryozoans. Individuals (zooids) are generally less than 1.0 mm in diameter. They are with one exception marine. The exoskeleton is chitinous, gelatinous or calcified. They are probably related to the Brachiopods as both Phyla have a lophophore, a structure surrounding the mouth that supports tentacles used in feeding.

Recent Bryozoans are found to be limited in geographic range by temperature and salinity. They like normal to slightly less than normal salinity. Few species are found in brackish waters. They range from the tidal zone to great depths. Because they are filter feeders, they are generally found in clear waters such as reefs. They are not thought to be major contributors to reef building, though. The Bryozoans range geologically from the early Ordovician to the present. Because many species were short-lived and had a wide geographic range, they make excellent markers for correlation.

The bryozoans are confusing but interesting to study. Because individuals are so small, it can be difficult to identify the "in hand" specimen. The orders Cryptostomata and Treptostomata are present in the Ordovician rocks of the Champlain valley.

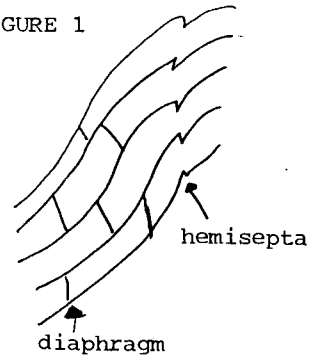
→

The order Trepostomata (the Greek means change mouth): The order name refers to the change the zooid experiences as it grows. The spacing of the diaphragms (Fig. 1) becomes closer in the mature individual. The colonies are generally massive and are calcareous. The zooecium (skeleton of an individual, see Fig. 2) aperture is circular or polygonal. The zooecium is long curved and circular or polygonal in cross section. In thin section, cystophragms and diaphragms are present (Fig. 3).

The order Cryptostomata (the Greek means hidden mouth): The name refers to an operculum, a chitinous hatch door that closes when the animal retracts. The colonies are lace- or twig-like. They are more delicate than the Trepostomes. The aperture is round and the zooecium is cylindrical in cross section. In thin section, hemisepta (Fig. 1) are present, which aid in differentiation between twig-like Trepostomata and Cryptostomata.

Submitted by Shelley Snyder

FIGURE 1



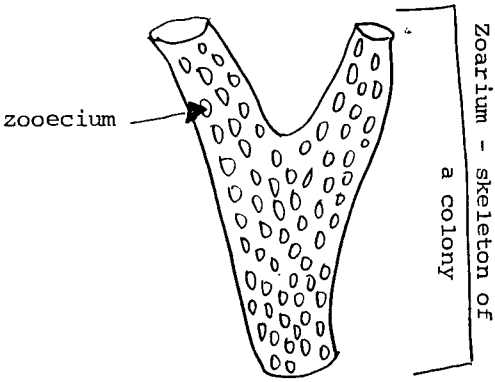


FIGURE 2

Zooecia

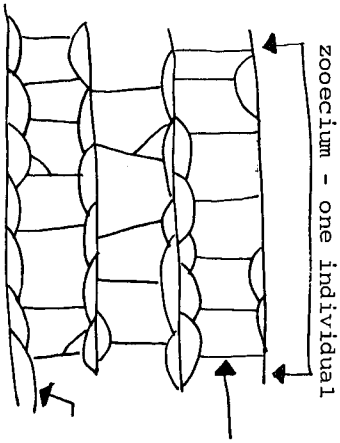


FIGURE 3

MINERAL OF THE QUARTER

MUSCOVITE [var. FUCHSITE]

$K(AlCr)_3Si_3O_{10}(OH)_2$
Hardness: 2 1/2
Specific gravity: 3 1/2
Luster: glassy to pearly
Color: bright blue-green

There are two Vermont occurrences which are very widely separated geographically. One is near the saddle at the top of Round Hill, south of Rutland. The second is in Lucas Brook east of Richford in Franklin County.

The fuchsite location in Franklin County can be reached by following Route 105 east of Richford to the junction of 105 and 105A. Continue on Route 105 for 2.7 miles further to where the power line crosses the road. Park and follow the power line northwest for .2 miles to Lucas Brook. Bushwack to the stream and follow it downstream for about .1 mile. Large boulders in the stream and along the sides of the brook contain the fuchsite and light green actinolite in long blades in talc. The blue-green pearly material is clearly distinguishable from the actinolite blades in the talc boulders. Ray Grant* suggests that the fuchsite was formed by the alteration of chromite found in small ultramafic bodies in the area.

A granular, compact variety of fuchsite which is cuttable for lapidary work is found at the Round Hill location. This occurrence is difficult to gain access to now as summer homes have been built on the hill recently. To reach this location, go east from North Clarendon and follow the road along Cold River. As the general area is flat in the vicinity of Round Hill (1400 feet elevation), it can be seen from quite a distance. Take the road going up the hill as far as you can drive up to the ridge. Park and ask permission to cross private property to walk over the ridge to the west side below a saddle shaped depression. The fuchsite is found in a 100 foot wide deposit in Precambrian schist and gneiss. The even texture and deep blue-green color of a freshly broken surface will distinguish the fuchsite here. Ray Grant* suggests a hydrothermal origin for this deposit. He postulates chromium-rich solutions probably altered the muscovite schist originally occurring here to form the chromium-rich fuchsite.

* Grant, Ray, Mineral collecting in Vermont: Special Publication No. 2, Vermont Geological Survey, pages 17 and 32.

Submitted by Ethel Schuele

A GEOLOGICAL FABLE

HOW THE WATER SPIRIT GOT HER POWER

Once, long ago, Sun was the ruler of all the earth. Next to him the other spirits were as the sparrow beside the grizzly bear. So the spirits had a secret meeting and elected the water-spirit to approach Sun, to persuade him to give up some of his power.

Water went to Sun, and formed a clear, deep pool at his feet. When Sun saw his own face reflected in the pool, he was so delighted that he promised Water anything she wanted. When she demanded some of his power, he realized he had been tricked, but according to his word, he gave power to all other spirits. Water, for her part, got more than anyone, and became, next to Sun, the most powerful force on earth.

HOW THE WATER SPIRIT CARVED THE MOUNTAINS

As soon as Water received her power, she went laughing and dancing through the hills, carrying pieces of land off to the sea until the landscape was filled with canyons of Water's making. Seeing that the rugged mountainous terrane Water sculpted made the world he created more beautiful, Sun became jealous and turned his face away from the earth.

Deprived of Sun's warmth, Water froze, her power locked in icen chains. Being very sly, Water allowed her icy form to build up in the high mountains, until slowly, slowly, the ice moved down the valleys, tearing the earth as it went. In this way, Water put the finishing touches on her mountainous landscape, smoothing out the canyons into broad valleys. Seeing that Water had once more outwitted him, Sun relented and smiled again upon the earth.

HOW THE WATER SPIRIT MADE TAKAKKAW FALLS

Freed from the great age of ice, Water sang down the mountain faces and through her valleys once again. But she kept some of her ice high in the mountains, safely out of reach of Sun. From one of these ice masses, she sent forth Takakkaw Falls to tumble with awesome power down the side of one of her valleys, reminding the world of her still-great power.

But even to this day, at the end of Summer, Sun begins to turn his face away to show Water that he is still ruler of all the earth. Water's flow decreases to hardly a trickle, and finally that freezes into an icy castle. Thus, although the mountain landscape was carved by Water, Sun still rules.

[Copied from tablets along the trail to Takakkaw Falls in Yoho National Park, British Columbia, Canada. The falls plunges one-fifth mile over Cambrian limestone into the Yoho River. It is fed by the Daly Glacier, an arm of the Waputik Icefield.]

ALL YOU GLACIAL GEOLOGISTS, HOW'S THIS FOR A SIMPLE EXPLANATION?

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BALLOT

MEETINGS

OCT 15	VGS FALL FIELD TRIP AND ANNUAL MEETING - see page 3.
OCT 31/ NOV 3	Annual meeting of the Geological Society of America, Indianapolis, Indiana
MAR 15-17 1984	Annual meeting of the Northeastern Section of the Geological Society of America at Province, R.I. ABSTRACTS are due October 19, 1983.

WANTED

Attention rock, mineral and fossil collectors:

I am trying to build a teaching collection for the Orchard School in South Burlington. If you have a neat rock, mineral or fossil that you no longer need or want and think it might be appropriate for use in grade school, please bring it (one or more) to the fall meeting. I will collect them there.

Thank you.

Shelley F. Snyder

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

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THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

WINTER 1983 VOLUME 9 NUMBER 4

MAT DYNAMICS - ACADIAN FORELAND - WASTEWATER RENOVATION -

PALINSPASTIC RESTORATION - CLOGGING

SUSPECT TERRANES - ST. ALBANS BAY

The VERMONT GEOLOGICAL SOCIETY
Announces the
SIXTH ANNUAL WINTER MEETING
SATURDAY, FEBRUARY 19, 1983 8:30 A.M.
PAVILION AUDITORIUM (State & Taylor)
MONTPELIER, VERMONT

SUBSURFACE INVESTIGATIONS - RESERVE DETERMINATIONS

CONTENTS PAGE

PRESIDENT'S LETTER

Everything's up-to-date in Kansas City! Certainly in the early 20th century the technological advances that could be witnessed in that metropolis must have been wonderous to see for settlers on the Oklahoma frontier. But how up-to-date are we here in Vermont in 1983? Are there advances elsewhere that we have not seen? Can these advances be applied to the geological quandries we face in this state? What geological perspectives of other workers can be applied successfully to our problems at hand?

Think of the limited insights gained by provincialism! Think of where we would be in glacial geology if Louis Agassiz had stayed in Switzerland and had not shared problems and insights in North America. Think of the limited knowledge of western North American geology without the travels and thinking of G.K. Gilbert and J.W. Powell. Charles Darwin's voyages broadened and deepened his understanding of evolution and paleontology. Alfred Wegener's conceptualization of continental drift is a profound example of cosmopolitan thought.

Today the problems are no less significant. We are fortunate that our world has shrunk in terms of travel and communication. We can now read about Carribean carbonate formation and apply the models to the Champlain Valley. Kenya's Rift Valley development gives new understanding to the lower Connecticut River Valley. Work at Penn State and in Arizona opens new insights for our own fracture bedrock wells. Workers on Ellesmere and in Keewatin provide fresh thoughts for glacial geology in New England. Advances in tectonics provide for reinterpretation of Vermont's structure and stratigraphy.

Last March VGS and the Department of Water Resources hosted two two-day seminars in Montpelier on on-site wastewater treatment led by a group from the University of Wisconsin. A conference in finite-element analysis and hydrology is scheduled for Burlington June 18-22, 1984. Can there be other seminars or conferences, in water well hydraulics, mining geology, Vermont stratigraphy or structure?

The applications abound. The potential is immense. Yes, we have geological problems around us, but Vermont is not an island (with apologies to John Donne). By communicating with our fellow geologists from various parts of the globe, we can develop new perspectives. These new perspectives will give us a chance to view geological processes in a new light. We can be students of the world so that we can be better geologists of Vermont.

Chris White

PROGRAM

VGS WINTER MEETING PROGRAM

February 19, 1983

Pavilion Auditorium, Montpelier, Vermont

COFFEE AND DONUTS 8:00

MORNING SESSION Introductory remarks 9:00

Bedrock geology - New work and historical study

1. R. Stanley: Palinspastic analysis of west-central New England 9:10
2. B. Doolan: Suspect terranes in the New England-Quebec Appalachians: New views of old problems 9:30
3. D. Bradley: Tectonic controls of sedimentation in the Acadian foreland 9:50
4. K. Dann: John Bulkley Perry and the "Taconic Question" 10:10

Introductory remarks for Glacio-fluvial studies 10:35

5. P. Thomas and R. Parker: A preliminary model of the changing riverine landforms in one segment of the lower Missisquoi River valley . . 10:40
6. F. Larsen: Glacial Lake Hitchcock in Vermont and New Hampshire 11:00
7. L. Meade: Reserve determination of non-uniform geological materials 11:20

Concluding remarks and LUNCH 11:40

EXECUTIVE COMMITTEE MEETING . . . . . 12:00 - 1:00

AFTERNOON SESSION Introductory remarks 1:00

8. J. Laible: Finite element analysis of the surface of St. Albans Bay 1:05
9. J. Humphrey: Preliminary geological and geo-technical assessment - proposed Rouses Point bridge, Lake Champlain, New York to Vermont . . 1:25
10. F. Magdoff: Clogging mat dynamics in subsurface septic tank seepage fields 1:45
11. C. White and D. Tarbox: Interim report on the on-site wastewater renovation project 2:05

MEETING OF THE AD HOC COMMITTEE FOR APPLIED GEOLOGY . . 2:45

4

ABSTRACTS

TECTONIC CONTROLS OF SEDIMENTATION IN THE ACADIAN FORELAND

Bradley, Dwight C., Department of Geological Sciences,
State University of New York at Albany, Albany, NY 12222

Devonian stratigraphic relationships on the North American side of the Merrimack Trough suggest that during the Acadian Orogeny, a flexural foreland basin developed in response to thrust loading in the east and southeast. In front of a westward advancing thrust load, the following sequence of events should ideally occur at a given location: (1) shoaling or emergence on the site of a low-amplitude flexural bulge, (2) rapid subsidence, accompanied by mainly down-to-east normal faulting, (3) arrival of east-derived synorogenic clastics, and (4) west-vergent deformation. Each of these events should migrate across the foreland and get younger to the west. In the Acadian Orogen, events 3 and 4 do show this predicted relationship. The first arrival of synorogenic clastics occurred in Siegenian in the Piscataquis Volcanic Arc (PVA), Emsian in the Connecticut Valley-Gaspe Trough (CVGT), Eifelian on its western margin, and Givetian in the Catskills. Similarly, Acadian deformation happened in Emsian to Eifelian in the Piscataquis belt, but not before Givetian in the CVGT. Although evidence of a migrating flexural bulge and pre-flysch normal faulting is less complete, both can be demonstrated near Utica (New York) in mid-Devonian, and the latter is probable at Beck Pond (PVA in western Maine) just before the arrival of flysch in Siegenian. A thrust load moving toward the craton would seem to offer the only unifying rationale for these aspects of the Devonian record.

Because Vermont lies between the undeformed molasse basin in New York and key fossil localities within the mountain belt in Maine, Quebec, and New Hampshire, rocks here would provide important links if fossil control was better. If the model is correct, the following inferences can be made which, it is hoped, can ultimately be tested by a combination of detailed mapping and insoluble microfossil studies: (1) The base of the Devonian flysch (Gile Mountain Formation, etc.) is likely to be older in the east than in the west; (2) Two or more pre-Acadian down-to-east normal faults may exist across Vermont and Quebec which successively blocked the westward spread of clastics, located beneath the Devonian flysch of the CVGT, and in the Taconian-deformed terrane to the west; and (3) Early Acadian structures in the CVGT are probably west-vergent.

JOHN BULKLEY PERRY AND THE "TACONIC QUESTION"

Dann, Kevin, Department of Geography, University of Vermont,
Burlington, VT 05405

The Taconic controversy involved the most able minds and the most powerful egos of post-Wernerian geological science. Although John Bulkley Perry was as familiar with the "Taconic" rocks as his more famous contemporaries, his contributions have been overlooked by scholars of American geological history. During the years 1855-1870, Perry studied the Taconic

strata, particularly in northwestern Vermont and through the discovery of fossils, through field work and correspondence with the principal Taconic proponent, Jules Marcou, and later via his few publications, Perry made original and significant contributions to the development of thought regarding the Taconic system of Ebenezer Emmons. The nature and timing of his publications, his extreme humility, his ultimate concern for theological questions, and his death at an early age were all factors in obscuring Perry's role in the history of the Taconic question.

SUSPECT TERRANES IN THE NEW ENGLAND-QUEBEC APPALACHIANS: NEW VIEWS OF OLD PROBLEMS

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

The concept of suspect terranes (Coney and others, 1980) provides a rationale for actualistic plate tectonic reconstructions of mountain belts. Previous analyses of the Appalachian Orogen have emphasized the along-strike similarities of tectonic lithofacies (e.g., Williams, 1978) which support the general concept of the Wilson cycle and especially the collisional aspects of geologic terranes accreting against opposing margins of a closing ocean. The continuity of process implied in the opening and closing of an ocean does not, however, fully describe the diachronous nature of orogenic events such as the Taconic, or allow for discrete orogenic events which affected only parts of the orogen (e.g. the Penobscot orogeny, the Salinic "event", Acadian, Alleghanian, etc.). The "stop and go" history of the Appalachian Orogen as evidenced by contrasts in stratigraphy, petrology and deformation between or even within previously defined tectonic lithofacies is more easily conceptualized with suspect terrane concepts.

Suspect terranes are identified and described within the New England-Quebec Appalachians following, in part, previous analyses (Williams and Hatcher, 1982; Rowley, 1983) in which all terranes outboard from the well-defined North American Miogeocline are considered "suspect". The review emphasizes contrasts in history of terranes presently juxtaposed against the ancient North American Margin in hopes of elucidating the structural, metamorphic, stratigraphic and plutonic diversity in rocks involved in the "Taconic Orogeny". The review does not provide "answers" to the old problems, but instead asks new questions which need to be addressed before the anatomy of the Appalachian Orogen is properly dissected.

PRELIMINARY GEOLOGICAL AND GEOTECHNICAL ASSESSMENT - PROPOSED ROUSES POINT BRIDGE, LAKE CHAMPLAIN, NEW YORK TO VERMONT

Humphrey, John T., Haley and Aldrich, Inc., P.O. Box 60, Cambridge, Massachusetts 02142

The existing Rouses Point Bridge, which spans northern Lake Champlain between Alburg, Vermont and Rouses Point, New York, is an important link in the area's interstate and international vehicular traffic system. Constructed in 1937, the bridge has experienced continued deterioration and is in need of major repair and rehabilitation, in addition to not meeting current traffic lane standards. The Lake Champlain Bridge Commission has studied various plans and recommendations for replacement of the 6,500-ft. long combined steel bridge and earth-filled causeway structure.

In September 1981, Howard Needles Tammen and Bergendoff (HNTB), Boston, Massachusetts, were selected to prepare an Environmental Impact Statement and a staged design for a replacement bridge.

Preliminary subsurface investigations and geotechnical engineering design studies were undertaken by Halley and Aldrich, Inc., Consulting Geotechnical Engineers and Geologists in July for HNTB. Two alternate alignments, located immediately north and south of the existing structure, were evaluated for preliminary design and EIS purposes. A total of 11 exploratory borings with in-situ borehole tests were obtained from floating barges along the potential alignments. Large diameter, undisturbed, thin-wall, piston tube samples of cohesive soils were obtained for laboratory testing. The results of this preliminary investigation reveal very complex subsurface soil conditions consisting of soft, compressible, cohesive soils and loose, cohesionless sediments which were deposited in a variety of constantly changing geologic environments.

Preliminary design analyses indicate that a combination of foundation support systems and causeway construction techniques will be required to meet the engineering, environmental and ecomonic challenges of the proposed Rouses Point Bridge. Detailed final design investigations, including extensive subsurface investigations and laboratory testing will be required for the selected structure configuration.

FINITE ELEMENT ANALYSIS OF THE SURFACE OF ST. ALBANS BAY

Laible, Jeffrey P., Department of Civil and Mechanical Engineering, University of Vermont, Burlington, VT 05405

A finite element wave equation model of depth varying nearly horizontal flow has been developed and applied to St. Albans Bay, Vermont. The model solves the transient form of the governing equations of momentum and continuity by an explicit time marching scheme. The present program extends the analysis capability of the shallow water equation models to directly include the vertical structure of the flow. The vertical structure is represented by a cubic approximation and provides a means to assess reverse currents typically present in shallow bays subjected to wind loading. A direct

assessment of the depth varying flow allows for a more realistic quantification of exchange rates, bulk diffusion coefficients and flux values for use in a multi cell pollution transport model.

Finite elements are used to model the variable geometry and bathymetry. In order to obtain stable and useful results, it has been found that a modified wave equation formulation must be used in place of the continuity equation. This process eliminates the numerical noise ($2\Delta x$ waves) which commonly plague many finite element flow models based on the primitive equations.

A 124 node (1116 unknowns) model of St. Albans Bay has been analyzed for various wind loadings. A preliminary estimate of the exchange rate between the Bay and the Lake has been estimated to be approximately 1/4 of the Bay volume/day under 5-10 mph south west wind. Surface flows of 10-15 cm/sec and reverse flows of 5-10 cm/sec are predicted by the model and are in good agreement with measured values.

GLACIAL LAKE HITCHCOCK IN VERMONT AND NEW HAMPSHIRE

Larsen, Frederick D., Department of Earth Science,
Norwich University, Northfield, VT 05663

In late-glacial time a northward-retreating ice margin in the Connecticut valley of Vermont and New Hampshire was accompanied by a northward-expanding glacial Lake Hitchcock. The presence of the lake is shown by coarse-grained, Gilbert-type deltas built by meltwater streams flowing directly into the lake from the ice or from tributary valleys. The contact between topset beds and foreset beds in a delta is a crude approximation of the level of the former lake into which the delta was deposited. During the summer of 1982, the elevation of the topset-foreset contact was surveyed by transit at 11 deltas between Brattleboro, Vermont, and Lisbon, New Hampshire. The 11 data points define two water planes about 12m apart that rise toward N 20° W with a gradient of 84.5 cm/km. The rise to the north-northwest is presumed to be the result of isostatic rebound of the land following removal of the weight of the ice sheet.

The maximum extent of Lake Hitchcock, represented by the higher water plane, is believed to have extended up the valley of the Second Branch of the White River and into the south end of Williamstown Gulf. Large elongate gravel bars just south of Williamstown Gulf are below the level of the higher water plane and indicate that Lake Hitchcock had dropped at least 12m while glacial ice dammed the northwest-draining Winooski valley. Water draining south through Williamstown Gulf from glacial Lake Winooski formed the gravel bars after Lake Hitchcock drained and prior to removal of the Lake Winooski ice dam west of the Green Mountains.

CLOGGING MAT DYNAMICS IN SUBSURFACE SEPTIC TANK SEEPAGE FIELDS

Magdoff, Fred, Department of Plant and Soil Science,
University of Vermont, Burlington, VT 05405

The commonly observed decrease in permeability of soils and sand filters receiving septic tank effluent is the result of the development of a clogged layer at the gravel/soil interface. The seepage field may eventually be unable to accept the amount of liquid added daily and surfacing of unpurified effluent can result.

This paper discusses various explanations for the development of the clogged mat. Experiments indicate that clogging is promoted by the following: (a) high solids + BOD levels; (b) low temperatures; (c) high loading rates; and (d) low levels of aeration (caused by low O_2 concentrations or high water contents).

Ways of lessening the chances for the mat to develop or coping with it once it develops are discussed.

The severity of the clogged layer is evaluated by using crust resistance, as described below.

Darcy's Law can be written as follows:

$$Q = (K)\ dH/dL \qquad [1]$$

where Q is the infiltration flux (cm/day), K is the hydraulic conductivity (cm/day), and dH/dL is the hydraulic gradient (cm/cm). Since it has not been possible to assess the depth of the mat (or L in equation [1]), the term crust resistance (R_c hours) is defined as:

$$R_c = dL/K \qquad [2]$$

allowing Darcy's Law to be modified to:

$$R_c = dH/Q \qquad [3].$$

RESERVE DETERMINATIONS OF NON-UNIFORM GEOLOGICAL MATERIALS

Meade, Lance, CPGS, Geomapping Associates Ltd., P.O. Box 113,
Pittsford, VT 05763

By using a method of ore reserve calculations that was developed in the metallic minerals industry, the geometry of various variable lenses of sands, silty sands, gravels and gravely sands can be determined prior to reserve determinations.

This method is time-consuming in that the amount of effort needed for drafting the trenching and bore hole data is considerable, but with the extreme variations found in the average Vermont gravel deposit, it is the best system for computing available cubic yards of in-place materials.

PALINSPASTIC ANALYSIS OF WEST-CENTRAL NEW ENGLAND *

Stanley, Rolfe S., Department of Geology, University of Vermont, Burlington, VT 05405, U.S. Geological Survey, Reston, VA 22092
Ratcliffe, Nicholas M., U.S. Geological Survey, Reston, VA 22092

A new cross section extending from Albany, N.Y., east to the Bronson Hill anticlinorium in central Massachusetts, derived from a new tectonic map of western New England, has been retrodeformed to produce palinspastic sections that depict the space-time evolution of the Taconic orogeny. Predeformational distances are determined from structural overlap of lithotectonic units, from palinspastic restoration of Taconic allochthons to their continental margin setting, and from removal of structural shortening due to folding. Important results of this analysis are: 1) Approximately 1,000 km of shortening took place during the emplacement of the Taconic allochthons as compressional thrust slices, and during imbrication of Proterozoic Y basement during the latter stages of compression. One third of this value is attributed to multiple generations of folding and cleavage development. 2) The bulk of the structure in pre-Silurian rocks is Taconian. 3) Eugeoclinal rocks above the Whitcomb-Summit thrust zone overrode the root zone of the Taconic allochthons and other major faults in Vermont, resulting in a cryptic suture zone. The complex fault history did not follow a simple east-to-west accretionary sequence. 4) The clastic Taconic allochthon is not a preassembled composite allochthon but was emplaced onto the autochthon during several stages of overthrusting. 5) Taconic medium-high-pressure metamorphic rocks in northern Vermont were transported westward on reactivated surfaces (the Whitcomb-Summit thrust) and remetamorphosed during later Taconic dynamothermal events that transgressed toward the craton with time. 6) The anticlinorial form of the Green Mountain massif and the Middlebury synclinorium to the west may result from fault-end folding on deeply rooted thrusts that formed late in the sequence.

*Published with Abstracts to National Geological Society of America Meeting, GSA Abstracts for the 95th Annual Meeting, New Orleans, 1983.

A PRELIMINARY MODEL OF CHANGING RIVERINE LANDFORMS IN ONE SEGMENT OF THE LOWER MISSISQUOI RIVER VALLEY

Thomas, Peter A., Department of Anthropology, University of Vermont, Burlington, VT 05405
Parker, Ronald, Department of Geology, University of Vermont, Burlington, VT 05405

As part of an archaeological site evaluation program conducted in 1982 along the Missisquoi River in Highgate, Vermont, eleven backhoe trenches were excavated across portions of three flood plains and a higher alluvial terrace to test for deeply buried cultural remains and to describe the underlying stratigraphy. Three structurally and texturally different alluvial sequences have been identified. Definition

of these sequences is based on 2.5-4m stratigraphic profiles and C^{14} dates derived primarily from logs buried in near-bank deposits, in conjunction with temporally diagnostic cultural artifacts and dated features near the surface. Each sequence is topographically and temporally distinct. The oldest sequence is associated with an 8090± 100 B.P. date; the middle sequence is partially defined by log samples dating to 6400± 70 B.P., 5650± 80 B.P., and 5370± 70 B.P.; what is probably a younger sequence is undated, but is partially defined temporally by cultural debris dating to approximately 70 B.P. in the top foot of the profile.

A preliminary model of flood plain genesis hypothesizes that flood plains in this portion of the Missisquoi Valley have resulted from lateral channel migration and overbank accretion. Chute cutoffs and heavy bank slumpage have modified these landforms in some instances. Positive correlations between dated episodes of flood plain accretion and relative stability and variations in regional temperature and precipitation patterns in the past suggest that climatological factors have been prime determinants in flood plain genesis since roughly 8500 B.P. after the rate of isostatic rebound slowed. Comparisons of the preliminary Missisquoi data with the results of more rigorous studies of alluvial sequences from some valleys in the midwest and Tennessee suggest that broad periods of flood plain development and stability can be recognized on a pan-regional scale.

INTERIM REPORT ON THE ON-SITE WASTEWATER RENOVATION PROJECT

White, Christopher M., White Geohydrology, Inc, 52 Seymour St., Middlebury, VT 05753
Tarbox, David L.,David L. Tarbox and Associates, 52 Seymour St., Middlebury, VT 05753

The purpose of the On-Site Wastewater Renovation Project is to study the renovation capacity of three different designs of leach fields: traditional, mound and wedge. Monitoring arrays installed during the summer and fall of 1982, generally follow a pattern of dosing tank, bed monitor(s), suction lysimeter(s), gypsum blocks, near-field monitors, down-gradient monitors and, if applicable, break-out monitors or stream monitoring sites.

Monitor installation and subsequent hydrologic study have indicated very low mound build-up in the innovative, non-traditional sites. This may be due to low loading, higher-than-expected permeability values or high rates of evapotranspiration. Even in the traditional systems, multi-level monitoring was deemed impractical because of the relatively thin saturated thicknesses and heterogeneous material.

Preliminary chemical sampling has revealed several important trends. In general, a large proportion of phosphorus is removed or complexed in leach field clogging mats. Although no minimum contaminant levels (MCL) have been set for phosphorus, 0.010 mg/l levels can reportedly cause eutrophication. The systems are generally unable to remove phosphorus to this level. Nitrogen sampling generally indicates a low redox condition in the dosing tank. As higher redox levels are met in the beds and the unsaturated zone, nitrification occurs.

→

Denitrification should ideally occur in the saturated zone since pH levels are generally above 6.0. However, some sites show increases in NO_2-NO_3 values down-gradient from below the leach field to the break-out points. At this point, it is unclear why the increase in values occurs. Removal of fecal coliform has been very effective. Dosing tank levels have been >600,000 at some sites, yet break-out levels are <1 or <2. Chloride levels provide mappable plumes because of the anion's high mobility. Outside sources of chloride at traditional systems complicate this interpretation. Chloride may be useful for mapping hydraulic short-circuiting of the fill at innovative systems.

FROM THE EDITOR

Outpourings of articles (solicited and unsolicited) for this issue of the GMG has been rewarding. The GMG is published nominally to report VGS business and news, but it has also served as a vehicle for an ongoing series of reports and articles which are appropriate for a newsletter of this sort. Chuck Ratté has used this as an outlet for reports of his work since he was appointed State Geologist. For a number of years, Ethele Schuele has provided a series of "Mineral of the Quarter" articles with up-to-date field locations. Shelley Snyder has provided another fossil article for this issue and is interested in continuing a series. Greg McHone on several occasions has shared new dike locations with us. Jim Ashley has recently suggested an intriguing topic for a series which could be called "Below the Surface". He points out that occasionally, well logs or other subsurface studies reveal bedrock configurations which are not predicted by traditional surface bedrock mapping. He has cited several examples of this and names of field workers whom I shall contact. (I also wonder if caves wouldn't fit here - anyone have any unpublished cave data to share?) I would like to publish information from state and federal agencies about new, ongoing or old, completed projects and publications that can be obtained by the public.

Articles for the GMG do not have to pass any rigorous editing process. Editing is usually at a minimum although we do reserve the right to edit any manuscript received for publication. Two to four pages of single space typewritten manuscript is an acceptible size. It is not necessary, however, to submit typed copy; I only ask that it be legible! Articles are welcome at any time, but note that the deadling for the spring issue of the GMG is April 5, 1983. Please send mail to the editor at the address below.

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

TREASURER'S REPORT

The financial condition of the Vermont Geological Society for January 1, 1982 to December 31, 1982 is as follows:

Beginning Balance January 1, 1982		521.85
Income		13924.14
Dues	936.00	
Vermont Geology sales	319.00	
GMG back orders	31.00	
Coffee cash at winter meeting	7.43	
NOW account interest	115.71	
Disposal Conference	12515.00*	
Total income	13924.14	
Expenses.		13326.70
Refunds	21.00	
Printing and Xeroxing	635.93	
Postage	234.92	
Office supplies	106.06	
Typing	6.25	
Advertising	8.83	
Student Awards	50.00	
Coffee at winter meeting	27.50	
Canadian Exchange	0.86	
Disposal Conference	12235.35*	
Total expenses	13326.70	
Year end balance December 31, 1982		1119.29

*VGS handled funds for a disposal conference sponsored by the Department of Water Resources. $12515 received -12235.35 disbursed = 279.65 balance which may be returned to the department. VGS will keep interest on funds while in our NOW account.

Respectfully submitted,

Dorothy Richter, Treasurer

New members in 1982 included 9 individuals and 3 organizations. Our mailing list contains 113 individual members and 10 organizations. So far in 1983, 66 members have paid dues - a pretty good record!

NEW MEMBERS

Welcome to these new members, accepted since spring '82.

Cameron McCormack	Montpelier, VT
David Westerman	Northfield, VT

THANKS STEW

Although many people have worked to further the goals of the Vermont Geological Society, the office of treasurer particularly requires commitment to keep the society running. In more than eight years of its existence, VGS has been fortunate to have had two members who have served four years each as treasurer. In 1978, Stewart Clark took over from Charlie Fox, and continued to keep careful watch over our finances. During his tenure the duties of membership chairman were added to Stew's treasurers duties for convenience, and he further streamlined the process of accepting members by setting up a postal round robin among members of the Executive Committee. He handled the orders for Vermont Geology and established a fair charge for back GMGs when the demand for them became evident. So thanks Stew for your service, and, now, welcome Dorothy!

A VERMONT GEOLOGY HISTORY

Vermont Geology: The Great Untold Story

Understanding Vermont geology is difficult. Conveying the message of how it evolved to those not familiar with structural geology, petrology, stratigraphy and tectonics is perhaps even more difficult. It is however important to bring some of our insights into the evolution of our bedrock geology to the interested students (both secondary and college level) and lay people of Vermont. In a fit of inspiration (?), I have decided to undertake to write a "short course" on Vermont geology. Brew Baldwin has offered his help and I seek here further help and suggestions from the society. The writing is only in incipient stages and will be about one year in the making. Although I am willing to do the bulk of the writing (sabbatical coming!), this could easily be farmed out to a variety of people if interest and time allows. Suggestions from earth science teachers and others who are interested in the project are welcome and sorely needed. Please give some thought to the project. I will have a general outline available for the winter meeting for discussion. For those unable to attend, please send your comments and suggestions to me at University of Vermont.

Barry Doolan

CALL FOR PAPERS - SPRING MEETING

This year's spring meeting has been scheduled for April 23 at Middlebury College. Undergraduates and graduate students from any college or university who are doing research in Vermont or on Vermont related geology are encouraged to participate. Talks are allotted 15 minutes, with an additional 5 minutes for questions. Abstracts should be limited to 300 words and submitted no later than April 5 to:

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

COMMITTEES

A tentative list of committees and members is published here. Chris White is assessing the situation, asking some people to serve on well-established ones and determining the functions of others for the future. Committees will be discussed at the Executive Committee meeting at the winter meeting, and a more complete list of committee members and perhaps even some reports will be published in the next GMG.

Budget - Roger Thompson, chairman
Education - Ballard and Sandria Ebbett
Nominations - to be appointed at this meeting
Executive - 7 elected officers, see address page for names
Publications - Jeanne Detenbeck
Editorial subcommittee (primarily for Vermont Geology)
Chuck Rattè, Rolfe Stanley, Brew Baldwin and Chris White
Professionalism - interest may have waned
Ad hoc Committees
Ground water strategy watchdog - Chris White,chmn., Dave Tarbox, Brew Baldwin
Applied Geology - Lance Meade, chmn.

DNAG FIELD GUIDE PROJECT

Part of the ambitious program (designated DNAG for Decade of North American Geology) to celebrate the centennial of the Geological Society of America in 1988, is a series of field guides which are scheduled to be published during 1985. One guide will be published for each GSA section, a 400 page book describing the 100 best field locations. The invitation for nominations from the Northeastern Section, of which Vermont is a part, was released in January to members of GSA, but an open-nomination policy is being used to encourage non-members to participate. From these nominations, sites will be selected and manuscripts reviewed by a committee of the Northeastern Section members under the Field Guide Chairman for the NE, David Roy of Boston College.

Field locations should be those critical to our present understanding of the regional geology, or an outstanding example of an illustration of some basic geologic principle. Specifically excluded are good mineral or fossil collecting sites. Nominators who are successful will be responsible for preparing the manuscript. Deadline for nominations is April 15, 1983.

VGS should support this DNAG project. Non-GSA members who wish to submit a nomination directly may obtain a nomination form from David C. Roy, Department of Geology and Geophysics, Boston College, Chestnut Hill, MA 02167. Those who do not want to submit a formal nomination but have a strong preference for a particular field site might want to discuss it with VGS members such as Chuck Rattè, Rolfe Stanley, Brew Baldwin or Barry Doolan, for example. →

Vermont represents only a small part of the area covered by the NE Section (which includes about 11 states), so although we may know that Vermont is favored with much interesting and significant geology, probably only a few sites can be chosen here. To those VGS members who do submit nominations, would you please send a copy of the application form to the VGS editor so that we might list the areas that have been nominated in a future GMG?

MEMBERSHIP LIST - ADDITIONS AND CHANGES

The following list contains additions and changes to the membership address list as it appeared in the Winter 1982 GMG.

Vernon Anderson	RFD, Thetford Center, VT 05075
Donald Balmer	Shannon & Wilson, Inc. P.O. Box C-30313, Seattle, Wash. 98115
David Bucke	Dept. of Geology, University of Vermont Burlington, VT 05405
Davis Cable	RD 1 Box 349, Charlotte, VT 05445
John Cotton	P.O. Box 31, East Andover, NH 03231
Kevin Dann	Texas Hill Road, Huntington, VT 05462
Barry Doolan	Dept. of Geology, University of Vermont Burlington, VT 05405
Richard Eliot	42 Skyline Drive, Lyndonville, VT 05851
Richard M. Fischer	P.O. Box 1057, Montpelier, VT 05602
Charles Fox	1917 Main St., Glastonbury, CT 06033
Richard Gillespie	15 Spencer Drive, Nashua, NH 03060
William Glassley	Geology-Science Center, Middlebury College, Middlebury, VT 05753
Malcolm Heyburn	201 Walnut Tree Hill Rd., Sandy Hook, CT 06482
Winslow Ladue	Vt. Dept. of Health, Burlington, VT 05401
Cameron McCormack	RD #1 North Street, Montpelier, VT 05602
Robert Mitchell	2301 First City National Bank Bldg., Houston, TX 77002
Thomas Olivo	Box 84 Baldwin Road, Hinesburg, VT 05461
John Oski	P.O. Box 191, Fairhaven, VT 05743
Gail Pascotti	RD 1, Northfield, VT 05663
Stephen Revell	RD #1 Box 128-B, Bristol, VT 05443
David Rowley	Dept. of Geophysical Sciences, University of Chicage, Chicago, ILL 60637
William Stockwell	6890 W. Cedar Ave. #206, Lakewood, CO 80226
Bart Stryhas	Box 215, Ludlow, VT 05149
Phillip Wagner	285 North Street, Burlington, VT 05401
Bruce Watson	P.O. Box 941, Burlington, VT 05401
David Westerman	Earth Science, Norwich University, Northfield, VT 05663
Christopher White	52 Seymour St., Middlebury, VT 05753
Michael Wurth	Richmond, VT 05477
General Library	British Museum of Natural History, London SW7 5BD England
Geological Sciences Library	Harvard University, 24 Oxford St. Cambridge, MA 02138
Rutland Historical Society	101 Center St., Rutland, VT 05701

FALL MEETING REPORT

Sixteen members and guests joined the fall field trip in the vicinity of Royalton. Chuck Ratté provided a well-documented field trip guide for us. Looking at graded beds in folded lithology, we sought to follow arguments presented in a recent paper (Fisher and Karabinos, 1980) to resolve the stratigraphic sequence of the Gile Mountain and Waits River Formations. In the afternoon, we examined outcrops across the Pomfret Dome, noting ore mineralizations and quaquaversally dipping beds.

At the annual meeting, 23 votes were cast for the slate of officers, electing Barry Doolan vice president in the only contested race.

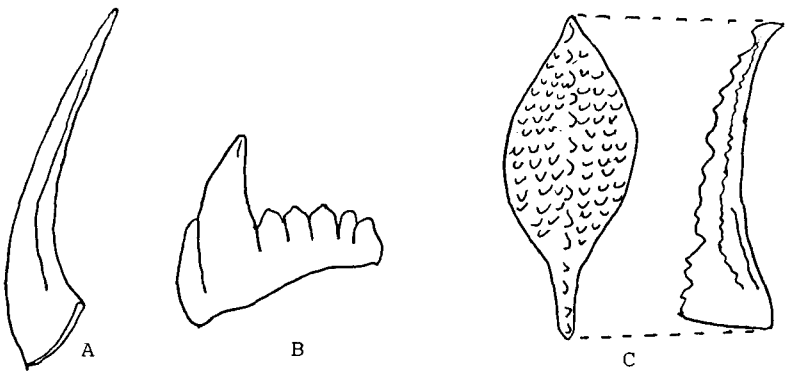
FOSSILS

Conodonts

The conodonts have been an enigma to the student of paleontology since their first description in 1856 by C.H. Pander. There has been much conjecture regarding their classification. Conodonts are spiny, toothlike or platelike fossils of unknown affinity. They range geologically from the late Cambrian to the late Triassic and had worldwide distribution. Rarely reaching a 5 millimeter maximum dimension, the conodonts are composed of calcium phosphate, the same material bones are made of. Although the material is similar to bone in vertebrates, they are thought not to be directly related.

Some researchers thought the conodont-bearing organism was a mollusk. The teeth on the radula (rasping tongue) are reminiscent of some conodonts, but are composed of chitin not calcium phosphate. It is unlikely that an unknown mollusk would have been a calcium phosphate secretor. Although trilobites and conodonts are not always found in association with each other, until the end of the 19th century it was suggested that conodonts were the tips of trilobite spines. However, the geologic range of the conodonts exceeds that of the trilobites, ruling out that hypothesis. Annelid worms as candidates for the conodont-bearing organism was a more favored hypothesis. The conodonts were not worn, which suggests that they were not used for grinding, but perhaps as a grasping part. Some annelids have grasping parts and do secrete calcium phosphate tubes. The other favored hypothesis is a fish origin for the conodonts. Superficially, they look like shark teeth and chemical analysis indicates a relationship with the vertebrates. Using the jigsaw puzzle approach, conodonts can be arranged to resemble gill structures, spines and other fish parts. They do, however, predate the sharks and other fish with jaws. There are no analogous structures found in the animal kingdom today. Recently a few conodont-bearing animals have been found. They are soft bodied with the conodonts placed in what appears to be a gizzard. Although the controversy is not ended, it appears that the conodont-bearing animal belongs in its own subphylum under the phylum Chordata.

Although they are intriguing to study from a systematic perspective, conodonts have practical value as index fossils. They are found worldwide in shales as well as sandstones. Oil companies are interested in conodonts because they are good stratigraphic markers. Because they evolved rapidly, the conodonts are an easy way to date rocks. Presence of conodonts does not assure the presence of oil or gas. Oil and gas are produced at temperatures ranging from 120 to 480° F. Anita Harris discovered that the color of conodonts changes from pale yellow (at no more than 140° F) to black (up to 570° F) when exposed to heat. In recent years, conodonts have become a useful tool in petroleum exploration both as stratigraphic markers and as paleothermometers.



A A. Acontiodus rectus, B. Ozarkodina flabellum,
C. Top and side view of Polygnathus pennatula.
After, Linstrom, M., 1964, Conodonts, Elsevier Publishing Co., 176 pp.

The presence of conodonts in Vermont is not well documented. They have been found in both the Beekmantown and Trenton Groups in New York State and Canada. Their absence may be due to excessive water depth in Vermont environments that were not favorable for their growth.

Submitted by Shelley F. Snyder

FIELD REPORT

A New Mantle Xenolith Locality in Vermont

Recently, I have been organizing a project to study deep-level xenoliths from northern New England mafic dikes. Among these, Vermont has several "breccia dikes" on the Shelburne Peninsula that are almost completely comprised of Champlain Valley-type rocks, and in addition, Stan Corneille has mapped over 30 Champlain dikes with varying percentages of rock inclusions. Another interesting occurrence exists in the woods of Shrewsbury northwest of Cuttingsville, apparently a mafic diatreme or breccia-rich plug that has never been well examined.

The locality that caused my renewed interest in dike xenoliths was found in June of 1981 at the North Hartland flood-control dam, built by the Army Corps of Engineers in the 1960's and open as a recreational area. Walking across the earth-fill dam. I noticed many blocks of red-brown dike material that had pebble-to-cobble size inclusions of rock quite unlike any bedrock exposures in the area. A quick search revealed the parent dike in the spillway below the dam, best accessed from Route 5 north of Ottauquechee River. The dike, i.d. no. HN-15 in my system, is an augite-olivine camptonite 33 to 49 cm wide where it can be reached, and oriented N74E, 68NW, Quartz-plagioclase granulites and gneisses, coarse pyroxenite, and handsome pea-green peridotite nodules are easily recognized in the dike and are remarkably fresh.

I have a student now studying the inclusions, and we have made several microprobe analyses with more to come. Brown spinel is present in some of the peridotites (mostly lherzolite) and the rocks generally have mineralogies like mantle-type xenoliths described elsewhere. It seems likely that the inclusions are samples of the lithosphere carried up by the dike magma from the upper mantle and lower crust, possibly from 20 to 30 km down (not as deep as the garnet-equilibrium boundary). Useful geobarometer-geothermometer calculations await good spinel analyses, not yet obtained.

Needless to say, such a rock suite can provide information about the deep New England lithosphere that is otherwise impossible to examine. A new K-Ar whole-rock date on the dike host gives 130 $\pm$ 6 m.y., in line with other Vermont lamprophyre dikes of the New England-Quebec igneous province. The New England lithosphere may not be the same today as it was in the Early Cretaceous, but it certainly provides an interesting contrast with the much older ultramafic rocks of the Vermont ophiolites. Although my schedule depends upon funding, I will eventually make a thorough study of the Hartland dike and other xenolith sites in the region. If anyone wants to participate, especially in chemical studies of the rocks, please contact me. I would be grateful for notification of any similar finds, and also for restraint in sampling this locality.

J. Gregory McHone (317) 264-8383
Department of Geology
I.U.P.U.I.
425 Agnes Street
Indianapolis, IN 46202

MINERAL OF THE QUARTER

DOLOMITE - $CaMg(CO_3)_2$
A double carbonate of calcium and magnesium

Cleavage: Perfect rhombohedral
Hardness: 3 1/2 - 4
Fracture: Concoidal
Luster: Glassy or pearly
Specific Gravity: 2.8
Color: Pearly white to pinkish or other light tints

Crystals of dolomite are rarer and smaller than the more common calcite crystals which they often resemble. They are often found in pockets in dolomite rock beds (such as Vermont's Dunham Dolomite) in pearly, pinkish, saddle-shaped intergrowths of rhombohedral crystals. They also occur in veins in the serpentine pods found near Route 100 in Vermont. Large, light yellow dolomite crystals from one of Vermont Marble Company's serpentine quarry (Quarry #7) in Roxbury are listed as notable occurrences in many texts of mineralogy. Directions to this location are given in Morrell and Chaffee's "Vermont Mines and Mineral Localities" published by the Dartmouth College Museum. Proceed from the junction of Routes 12 and 12A south of Northfield as follows: Take 12A south 5.3 miles and park. Walk west on an old dirt road, cross railroad tracks and the Dog River. Continue along the north bank of the west tributary for .7 miles. Serpentine, talc and large dolomite crystals are listed here. Good luck!

We have found veins of light pink dolomite crystals in a Duxbury serpentine quarry. Take Waterbury exit from I-89, proceed south on Route 100; continue through Duxbury past the Harwood Union High School. Continue past .3 mile, cross a small bridge, then take a right turn onto a dirt road going uphill. Continue about .3 miles up this road, passing an auto graveyard on the right to a cut where a trail goes left. Park here and walk up the trail past a tailings pile. Here take a right turn to where this path meets another trail. This trail leads to the "Verde Antique" (serpentine marble) quarry. Besides the veins of intergrown dolomite crystals in serpentine, up to 1/2 inch octahedrons of magnetite in chlorite schist have been found here.

Submitted by Ethel Schuele

STATE GEOLOGIST'S REPORT

Oil and Gas Legislation. The State Geologist worked cooperatively with the Attorney General's Office and legislative committees in developing the state's first comprehensive oil and gas legislation which was passed during the 1982 legislative session. The legislation calls on the State Geologist to provide geological services to the newly created Natural Gas and Oil Resources Board and to serve in an advisory capacity to the Board.

Special Programs. Three contractors were hired to provide a state overview capability and coordinate communications with the DOE regional literature studies regarding the state's potential for geologic disposal of high level nuclear waste in crystalline rocks. This program has been continually frustrated by the lack of DOE communications and inability to meet deadlines or produce draft reports for review.

Cooperative Programs. Vermont continues to maintain a cooperative topographic mapping program with the National Mapping Division of the U.S. Geological Survey. A new cooperative program, which will involve the assessment of Vermont's potential for damaging landslides in the higher elevations of the Green Mountains is in the negotiation and budgeting stage. This program will be conducted by the Engineering Geology Branch of the U.S. Geological Survey's Geologic Division.

The State Geologist continues to maintain agreements with the U.S. Bureau of Mines for the purpose of providing statistical data on mineral production, and to investigate and evaluate the mineral resources of the state.

New Publications. Two new publications were completed in 1982:

1. Vermont Handbook for Soil Erosion and Sediment Control on Construction Sites - Special Publication #3. This is a limited printing with one free copy going to consulting and engineering firms.
2. Bedrock Geology of the Lincoln area, Vermont - Special Bulletin #2, by Peter Tauvers. Map and text are available for $2.00, $1.00 for the map only. Order from the Vermont Department of Libraries, Geological Documents Section, Montpelier, Vermont 05602.

Also note that an updated supplement to the "Bibliography of Vermont Geology" is in preparation and will be available for purchase soon.

Workshops. The 4th Annual Water Well Driller's Workshop was co-sponsored by the State Geologist's Office. The theme of the March 1982 workshop was protection of Vermont's ground water quality.

Charles A. Ratté
Director and State Geologist
Division of Geology and Earth Resources
Agency of Environmental Conservation
State Office Building Post Office
Montpelier, Vermont 05602

(802) 828-3357

WATER RESOURCES REPORTS

The following short report from the Ground Water Section of the Department of Water Resources was submitted by Larry Becker:

The Vermont Ground Water Protection Strategy is complete. Copies are available from the Department of Water Resources.

The Vermont Aquifer Protection Area Reference Document in its final form will include the following sections: Methods Used to Define Aquifer Protection Areas, Ground Water Use in Vermont and a land use survey of activities occuring within Aquifer Protection Areas. Blue Ray copies of the APA maps will be distributed to public agencies and will be available at cost to private entities. The Reference Document will be freely distributed to all interested parties.

Our computer has arrived. Throughout this next year we will be bringing the system up to its full potential. This includes putting 27,000 well logs into the system for storage, retrival and manipulation.

On November 4, 1982, the Vermont Water Resources Research Center at University of Vermont sponsored a colloqium "Ground Water Quality and Contamination in Vermont". Many of the participants are VGS members. The following list of talks illustrates the ongoing research in ground water quality:

Susan Guhl: Background water quality for selected ground water supplies (1978-1981)
Don and Connie Marsh: Vermont underground ejection practices and ground water contamination
Davis Cable: Bacteria in rock wells
Larry Becker: Analysis of Vermont aquifer protection areas; the land use survey
Chris White and David Tarbox: Update on leach field renovation study - hydrodynamic aspects of leach field systems
Stephen Shea: The fertilizer industry's effect on ground water quality in Vermont
Winslow Ladue: Fertilizer induced contamination of shallow wells in Sheldon Jct, VT
Jeffrey Noyes: Hydrogeologic investigation of the South Burlington landfill

RECENT PUBLICATIONS

1) Wall map of portion of Lake Hitchcock available

A wall map entitled "Approximate shorelines of Lakes Hitchcock and Upham" is available from its cartographer, Mrs. Jan Bent, P.O. Box 8, Lyme, New Hampshire 03768. The black and white map is printed on heavy bond paper and measures 36 inches north-south and 24 inches east-west. It shows the approximate shorelines of Lake Hitchcock and Lake Upham at a scale of 1:125,000. Lake Hitchcock was 1.5 to 4 miles wide along the Connecticut valley between Hartland and Wells River. The map shows how Lake Hitchcock extended into the valleys of the First, Second, and Third Branches of the White River in central Vermont. It also shows how most of the present-day real estate in towns like Randolph, Tunbridge, White River Junction, Hanover, Norwich, Lyme and many others was briefly under the cold waters of a glacial lake shortly after the retreat of the last ice sheet. The cost of $4.00 includes postage and mailing tube.

2) DNAG Special Publication 1, "Perspectives in Regional Geological Synthesis: Planning for the Geology of North America", $7.50. This is the set of preview statements and/or annotated outlines describing the organization of geological information for the 20 volumes of regional geology in The Geology of North America to be published by DNAG. Order from: Publication Sales, Geological Society of America, P.O. Box 9140, Boulder, CO 80301.

3) Subscriptions for Volume 5 of Northeastern Geology is available for $18.50. Order from Northeastern Geology, Inc., P.O. Box 746, Troy, NY 12180

4) Two new publications are also described in the State Geologist's Report in this issue on page 20.

5) In Suspect Terrain by John McPhee, Farrar, Straus and Giroux, $12.95.

For a second time in the '80's, John McPhee has written a book popularizing geology. Like the previous one, Basin and Range (1981), this book appeared as a series of articles in The New Yorker. In Suspect Terrain is based on a field trip along Interstate 80 from the New Jersey Highlands to the Indiana Dunes, taken with Anita Harris, a geogolist well known for her study of conodonts. McPhee has applied his flowing literary style to the descriptions of rock outcrops and their history as seen through the eyes of Harris, we must assume. Much undefined geologic language is used, however, which will present a consideralbe stumbling block to the uninitiated. The Appalachian geologic history as seen in the rock outcrops along I80 is presented as "gospel" and is interspersed, perhaps for relief, with interesting human history of the places visited. Also interspersed in the story are the opinions of Harris, and her late husband, averse to the current interpretations of plate tectonic theory in the Appalachians. These attacks are allowed to go undocumented and unanswered in

McPhee's book. Since a book stays around a long time, is it fair to the science of geology to print together, undocumented, both well-established geologic history and quarrels with theory in the making? (By the way, McPhee admits that he is using "terrain" incorrectly instead of "terrane" by his own choosing. It is hoped that he has taken no more liberties with the geology than that!) Perhaps this book should be taken as a flattering biography of one geologist, Anita Harris.

Reviewed by Jeanne Detenbeck

MEETINGS

FEB 19	VERMONT GEOLOGICAL SOCIETY Winter meeting at the Pavilion Auditorium in Montpelier, VT.
MAR or APR	The annual Water Well Drillers Workshop has not been scheduled at this writing, but is expected to be held in either March or April. If you are interested in attending this workshop, contact James Ashley at Water Resources, (802) 828-2761.
MAR 11	Geological Society of Maine sponsors student papers at Bates College.
MAR 23-25	Northeastern Section of GSA at the Concord Resort Hotel, Kiamesha Lake, New York [Constantine Manos, Department of Geological Sciences, SUNY College at New Paltz, New Paltz, NY 12561]
APR 15	Deadline for submitting nominations for DNAG Centennial field guide project - see article page 14.
APR 23	VERMONT GEOLOGICAL SOCIETY Spring meeting at Middlebury College. See page 13 for call for papers.
JUNE 18-22 1984	Finite element analysis and hydrology conference in Burlington, VT.

GREEN MOUNTAIN GEOLOGIST
VERMONT GEOLOGICAL SOCIETY
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FIRST CLASS

DUES ARE DUE

Dues for 1983 have been rolling in, making our new treasurer happy. This is a reminder to those of you who have not yet mailed in your dues, that you should do it soon and keep the treasurer happy!