

THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

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The Vermont Geological Society's Spring Meeting

Presentation of Student Papers

Twilight Auditorium
Middlebury College
Middlebury, Vermont
Saturday April 25th

Directions: The spring VGS student meeting will take place in Twilight Auditorium on the Middlebury College campus. Twilight Auditorium is housed in the old Grammar school, a three-story brick building located in the green between Franklin Street and College Street (downhill and east of the Science Center). Members may park in the parking lot behind the Science Center.

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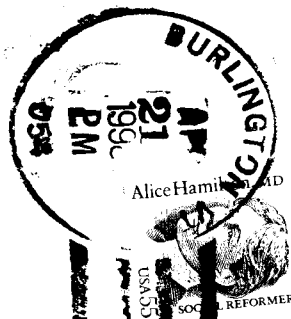
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SPRING MEETING PROGRAM

Middlebury College
Twilight Auditorium
April 25, 1998

- 8:30 **Coffee**
- 9:00 **Andrew Mowry:** *Vegetation and Channel Changes on Soda Butte Creek, Yellowstone National Park*
- 9:15 **William Obermann:** *Estimates of Volume and Mass for Flood-Deposited Mine Tailings along Soda Butte Creek, Yellowstone National Park*
- 9:30 **Philip Higuera:** *Debris Slide Processes and Forest Response in the Adirondack Mountains, New York*
- 9:45 **Sarah Brown:** *Lacustrine Records of Holocene Hillslope Erosion in New England*
- 10:00 **L. Ward Lyles:** *The effects of Downslope Processes on the Continental Shelf and Slope off the Coast of Cape Hudson, Antarctica*
- 10:15 **Break**
- 10:25 **Lawrence Klein:** *Effects of the Internal Seiche System in the South Main Lake of Lake Champlain, Vermont*
- 10:40 **Stephen Monninger:** *Mapping and Analysis of the Stability of Sediment Furrow Field in the Buffalo River, Buffalo, New York using Geographic Information System Technologies*
- 10:55 **A. Jones and W. Stansfield:** *Relationship between the Outcrop Geometry of a Segmented En Echelon Mesozoic Lamprophyric Dike and Local Joint Patterns in the Cambrian Underhill Formation, Johnson, Vermont*
- 11:10 **W. Stansfield and A. Jones:** *Determining the Mechanism of Magma Flow in a Segmented En Echelon Lamprophyric Dike, Johnson, Vermont*

- 11:25 **Ashaki Rouff:** *Geochemical and Mineralogical Analysis of a Siluro-Devonian Sheeted Dike Suite located near East Barnet, Northeastern Vermont*
- 11:40 **Break**
- 11:50 **Eric Ferguson:** *Stowe Formation, A Northern Vermont Connection?*
- 12:05 **David Johnson:** *A Geochemical Analysis of Stowe Formation Metavolcanics in the Mount Elmore Region of Vermont*
- 12:20 **Michael Stout:** *Geochemistry of the Newark Pluton, Northeast Kingdom, Vermont*
- 12:35 **R. Andrew Brodie:** *The Development of a Geophysical Field Site West of Bicentennial Hall in Middlebury, Vermont*
- 12:50 **Break followed by announcement of awards.**

SPRING MEETING ABSTRACTS

Middlebury College

April 25, 1998

THE DEVELOPMENT OF A GEOPHYSICAL FIELD SITE WEST OF BICENTENNIAL HALL IN MIDDLEBURY, VERMONT

Brodie, R. Andrew, Geology Dept., Middlebury College, Middlebury VT 05753

The development of a hydrological, geophysical and environmental geology laboratory field site occurred in the fall of 1997. The site is 3,200 m² and lies due west of Middlebury College's Bicentennial Hall. It runs 80 m north to south and 40 m east to west with a slope to the west. Initial topography and seismic refraction surveys of the subsurface stratigraphy were completed to ensure complex hydrological studies and sufficient surficial sediment depth for the burying of foreign objects to be used in applied geophysics investigations. Results of these surveys were modeled with Earth Visions software and showed the bedrock to have a north south ridge near the middle of the site, which outcropped at the southern end. Along the eastern and western borders and in the northern half of the field depth to bedrock was found to be between 3 m and 14 m.

Pits of varying depth were dug and filled with iron and steel pipe, 55-gallon steel drums, or scrap metal. The objective was to simulate real life environmental contamination sites, which could be detected using geophysical methods such as Ground Penetrating Radar (GPR) and magnetics. The "salted" area was then surveyed using a proton precession magnetometer and GPR unit. Magnetic anomalies obtained in the survey were then mathematically analyzed for object size and depth calculations and compared to known values and theoretical anomalies for the buried objects.

The site is fully prepared for any future undergraduate geophysics laboratory investigations using magnetic, seismic refraction or GPR methods. Magnetic, topographic and stratigraphic models obtained in this study are to be used as a reference for such future studies. Hydrology laboratory investigations must await the installation of ground water monitoring and sampling wells.

LACUSTRINE RECORDS OF HOLOCENE HILLSLOPE EROSION IN NEW ENGLAND

Brown, Sarah, Department of Geology, University of Vermont, Burlington, Vermont 05405

Lakes record the history of erosion and landscape development in watersheds by accumulating sediment over time. In most New England lakes, the sediment record consists of organic debris produced by algae in the lake, and sand, silt and plant matter eroded from the surrounding watershed. Changes in the amount and type of sediment delivered to the lake are tied to changes in climate and land use. The sensitivity of lakes to rare but severe events, such as hurricanes and floods, make them ideal for investigating the history of hillslope erosion events in Vermont. Gray sand and silt deposits known as turbidites are found in the otherwise black organic sediments of Ritterbush Pond, Eden VT. Turbidite sedimentation is caused by episodic erosion events that may have resulted from climate-induced changes in forest fire or storm frequency. Most previous paleoclimate reconstructions from New England lakes have been based on pollen and plant macrofossils. Neither terrestrial sediment deposition in mountain lakes nor its sensitivity to climate have received much attention in New England.

My research will 1) document the spatial and temporal distribution of turbidites in the sediments of Ritterbush Pond, 2) use these deposits to infer a history of Holocene hillslope erosion in the lake's drainage basin, 3) compare the inferred erosion history with existing geologic and biologic records for the region, such as pollen chronologies, alluvial fan deposits, and other lake sediment records, and 4) from this comparison, infer causes for the erosion events, such as forest fires, intense storms, and specific events in New England's paleoclimate record (e.g. hemlock decline c. 4800 yr BP). In the past year I collected and analyzed three, 6 meter-long sediment cores from Ritterbush Pond. I used a variety of methods to investigate each core including: visual logs, organic carbon content, X-ray density, magnetism, grain size, stable carbon isotopes and percent charcoal. I also matched my cores to a well-dated, nearby core for which there is a pollen chronology. Together, these data characterize the type, thickness, and distribution of individual deposits in each core, and define time periods of increased terrestrial sediment deposition. These periods are common to all cores and imply that during some eras hillsides became unstable and eroded, in much or all of the drainage basin of Ritterbush Pond. My research will culminate in the construction of an "event chronology", that will allow for interpretation of changing geomorphic, environmental, and climatic conditions during the Holocene.

STOWE FORMATION, A NORTHERN VERMONT CONNECTION ?

Eric W. Ferguson, Jo Laird, W. A. Bothner, Department of Geology, University of New Hampshire, Durham, NH; R.A. Coish, Department of Geology, Middlebury College, Middlebury, Vermont.

Recent work on the Stowe Formation within the Worcester Range shows distinct deformational patterns and different degrees of metamorphism and garnet growth between Elmore Mountain and Stowe-Waterbury regions. A plagioclase-rich layering found in numerous locations within the Worcester Mountains shows lithologic similarities to the Hazens Notch Formation, such as rusty brown-tan weathering, abundant plagioclase porphyroblasts (up to 70%), and cotecule-like textures.

The deformational history of the Stowe Formation in the Stowe-Waterbury region has rootless fold hinges (F1) parallel to the dominant foliation (S2), overprinted with a crenulation cleavage. The Elmore Mountain region also has rootless fold hinges (F1) parallel to the dominant foliation (S2), overprinted with a crenulation cleavage. The distinct difference between the two regions becomes apparent in stereonet projections of S2 foliation. Elmore Mountain region has no distinct pattern in the S2 foliation, while Stowe-Waterbury region shows a prominent trend of the S2 foliation to the northeast.

The metamorphism of the Stowe-Waterbury region is medium-high pressure facies series based on chemical evidence of zoned amphiboles from the Stowe Pinnacle and Waterbury trail area of Mt. Hunger (Laird, verbal comm.). The Elmore Mountain region has similar zoning of amphiboles, but the metamorphism is only medium pressure facies series.

The garnets in the Elmore Mountain region primarily show two stages of growth. This initial growth has been partially to completely replaced by chlorite, and the second growth of un-chloritized, small garnets are usually found within mica-rich layers. In the Stowe-Waterbury region, the garnets have little to no chlorite replacement, but a few locations appear to have two (different?) stages of garnet growth.

DEBRIS SLIDE PROCESSES AND FOREST RESPONSE IN THE ADIRONDACK MOUNTAINS, NEW YORK

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Debris slides are a common geomorphic process in the Adirondack Mountains of New York, where over 410 have been identified. Thin mats of soil, vegetation, and regolith typically slide off steep slopes (>30°) and leave the relatively smooth igneous bedrock exposed. Previous studies suggest that slope angle and rainfall intensity are the primary factors controlling debris slide location and initiation. Processes, recurrence intervals, and ecological effects of Adirondack debris slides, however, are poorly understood.

To date Adirondack debris slides, several methods of dendrogeomorphology were employed. These include identifying disturbance signals in radial growth patterns of edge trees, crossdating trees with slide related mortality to determine their death dates, and dating trees recolonizing slide surfaces. Qualitative and quantitative analyses were also performed to further understand soil-forming processes around Adirondack debris slides and the amount of area affected by the debris slide process in this region. To evaluate the effects of debris slides on trees growing on slide margins, radial growth patterns of edge and non-edge (>10m from edge) trees were compared. Age structures were also developed to gain an understanding of tree recruitment patterns on slide margins.

Tree radial growth patterns showed a high amount of intra-site variability, and disturbance signals in ring widths were indistinct. These results suggest that trees respond more to micro-site variations than to climate or debris slides, decreasing the potential for dating slides via disturbance signals. Crossdating trees with slide-related mortality can yield a more accurate and reliable date, but this method suffers from the highly variable growth patterns. It is also limited to dating younger slides where tree decay has yet to occur. Soils in areas with potential debris-slide activity are thin and highly organic, indicating that soil genesis relies primarily on the input of decaying plant material. Weathering of the underlying igneous bedrock (primarily anorthosite) is slow, and the relatively high quartz and silt content in these soils suggests that aeolian input may be significant. It is unclear whether thin soils are a result of slow soil-forming processes or frequent slide activity. Revegetation and soil development on slide tracks appears to be slow, limiting the frequency of this event in any one area. In the Adirondacks, debris slides are an important landscape-altering process, with approximately 15% of potential slide terrain on individual mountains showing evidence of both past and recent slide activity.

A GEOCHEMICAL ANALYSIS OF STOWE FORMATION METAVOLCANICS IN THE MT. ELMORE REGION OF VERMONT

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Mount Elmore is located within the Stowe Formation in north central Vermont, approximately 15 miles north of the town of Stowe. In this region, the Stowe Formation is comprised of metasediment and metavolcanic units of Ordovician age. The metavolcanics, greenstones and amphibolites, occur in discrete beds interspersed with metasediments which are primarily chlorite, garnet, and kyanite-grade schists. The metavolcanic units appear to be fault bounded as indicated by truncation of structures across contacts. In hand sample, greenstones often have quartz and epidote layered foliations with a relatively small amount of amphibole. In thin section, the greenstones contain abundant chlorite, epidote, and quartz grains with minimal amounts of brown mica, amphibole, sphene, and magnetite or ilmenite. Both coarse and fine grained amphibolites are present in hand sample. In thin section, the amphibolites contain large amounts of hornblende (>60%) and epidote with small amounts of quartz, chlorite, sphene, and magnetite or ilmenite.

Geochemically, the metavolcanic rocks in the Mt. Elmore region are classified as tholeiitic basalts based on Al_2O_3/SiO_2 vs. $FeO+0.5(CaO+MgO)$ and Zr vs. P_2O_5 classification diagrams. Rare earth element analysis shows a flat to slightly depleted light rare earth element (LREE) pattern approximately 8 to 20 times that of chondrite values. This pattern is typical of modern mid-ocean ridge basalts. Magnesium variation diagrams imply an olivine, plagioclase, and clinopyroxene fractionation trend in the parent magma. Tectonic discriminant diagrams, such as the Y-Cr plot, indicate that the Mt. Elmore metavolcanics were formed in a spreading environment. These findings are consistent with earlier results from other greenstones in the Stowe Formation. The results thus support the interpretation that the Stowe Formation greenstones formed during early stages of Iapetan ocean spreading.

RELATIONSHIP BETWEEN THE OUTCROP GEOMETRY OF A SEGMENTED EN ECHELON MESOZOIC LAMPROPHYRIC DIKE AND LOCAL JOINT PATTERNS IN THE CAMBRIAN UNDERHILL FORMATION, JOHNSON, VERMONT

Jones, A., Stansfield, W., and Van Horn, S. R., Department of Environmental and Health Sciences, Johnson State College, Johnson, VT 05656

Mesozoic intrusions of the northern Appalachians were emplaced in complexly deformed and jointed Lower Paleozoic regionally metamorphosed rocks. Near the town of Johnson, Vermont, a lamprophyric dike crops out discontinuously along a 1.5 km section of a north flowing stream that exposes the Lower Cambrian Underhill Formation in the Green Mountain Anticlinorium. The Underhill Formation contains silvery gray-green schist (locally phyllite) with abundant lenticular segregations of granular white quartz and both a quartz-filled joint set that strikes N15W and a joint set that strikes N30E to N50E. The orientation of the foliation (N40E, 40SE) is parallel to the limbs of tight isoclinal folds.

A lamprophyric dike crops out as seven discrete dike segments, striking N31E to N48E, that are offset with respect to each other along strike. Individual dike segments are continuous but contain offsets of the dike contact perpendicular to strike. Horns, bridges and schist xenoliths are present at several of the contact offsets. There is no evidence of post-emplacement faulting near the offsets as foliation is continuous near the offsets. Adjacent dike-parallel joints are present in the wall-rocks near the dike segments.

Magma can create joints by a hydrofracture mechanism as it rises through the crust or it can use older joints as pathways. Eighty-five joints were measured in the local area in an attempt to determine their relationship to the dike. Sixty-three percent of the joints in the stream valley where the dike crops out strike N30E to N50E and these joints crosscut the N15W quartz-filled joints. Only fourteen percent of the joints in a east flowing stream due west of the dike outcrop follow this trend. The very localized distribution of the N30E to N50E joint set along with the outcrop geometry (contact offsets, horns, and bridges) of the dike segments is consistent with the creation and dilation of fractures during dike emplacement.

EFFECTS OF THE INTERNAL SEICHE SYSTEM IN THE SOUTH MAIN LAKE OF LAKE CHAMPLAIN, VERMONT

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The internal seiche has been found to have remarkable effects on the thermodynamics of Lake Champlain. Past studies at Valcour Island, on Lake Champlain, have shown the thermocline to intersect the sediment-water boundary during strongly non-linear periods. As the thermocline rapidly shallowed, high velocity currents scoured the lake floor, triggering sediment storms as well as the formation of sediment furrows. An additional non-linear response was the formation of an internal "surge" which traveled in the opposite direction of wind forcing.

One region of Lake Champlain that has had very little hydrodynamic research is the area South of Thompson's Point. From May 16, 1997 to October 13, 1997, eight sub-surface moorings (from Thompson's Point to Crown Point) equipped with temperature sensors, current meters, sediment traps, and one stereo camera system were emplaced at different depths throughout the water column. The nominal recording interval for the equipment was one hour. Upon retrieval of these instruments, the information was downloaded onto computers and then processed for quality control. Rock Island and Potash Point moorings malfunctioned and released prematurely, but were later redeployed at the same sites. Data between the retrieval and redeployment of these locations were discarded. Additionally, a failure of Snake Den's temperature chain occurred after the first sixty days of operation. The last recorded failure was Owls Head's upper temperature probe, which retrieved no data for the duration of the deployment period. All other equipment including, temperature chains, sediment traps, temperature probes, and current profilers were successfully retrieved. The stereo camera system, located at 122 meters, recorded no evidence of furrows or sediment storms. It did, however, show shifts in bottom bed form and freshly uprooted growth of the plant *Potamogeton robbinsii*, which is present in waters no deeper than 17 meters.

Results show that there was an internal seiche acting within the studied region. During strongly stratified periods (mainly summer and fall) the thermocline exhibited linear as well as non-linear behavior. During linear events, the thermocline would slowly rise up the shallowing bathymetry to the south, while during non-linear periods the thermocline was found to have a more wall-like (steeper vertical face) appearance. While it is not possible to state that the thermocline reached the atmosphere interface due to lack of surface instrumentation, it can be strongly inferred from the data. Another inferred possibility is

that the internal seiche could form a breaking wave under strong non-linear conditions. While there is no concrete proof that the internal breaking wave occurs, there is some evidence that this phenomenon might exist.

THE EFFECTS OF DOWNSLOPE PROCESSES ON THE CONTINENTAL SHELF AND SLOPE OFF OF THE COAST OF CAPE HUDSON, ANTARCTICA.

L. Ward Lyles, Dept. of Geology, Middlebury College, Middlebury, VT 05753

Multichannel seismic reflection data, side-scan sonar, and swath bathymetry data collected on the 97-02 cruise of the *R/V Nathaniel B. Palmer* were used to investigate the bathymetry and morphological features along the little-studied continental margin off of the Cape Hudson coast of Antarctica. Four lines ran from the continental shelf edge to the base of the continental rise and each line showed similar morphological features. At the continental break, a linear system of feeder channels coalesce downslope. These channels carry sediment-laden flows to the continental rise where the sediment is deposited in large asymmetrical sediment mounds, ranging from 18 to 62 kilometers long and 300 to 700 meters thick. At the base of the continental slope, between the feeder system of channels and the sediment mounds, an erosional channel exists parallel to the margin. This erosional channel was found to range from 3 to 7.5 kilometers in width and 50 to 150 meters in depth. These features are similar to those observed along the Pacific side of the Antarctic Peninsula suggesting that the processes governing their formation are consistent along the western Antarctic margin.

MAPPING AND ANALYSIS OF THE STABILITY OF SEDIMENT FURROW FIELD IN THE BUFFALO RIVER, BUFFALO, NEW YORK USING GEOGRAPHIC INFORMATION SYSTEM TECHNOLOGIES

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From 1990 to 1996, dual frequency side-scan sonar profiles were obtained annually on the Buffalo River, Buffalo New York to assess changes in the bottom morphology. These profiles show the presence of a sedimentary furrow field that lies between Army Corps of Engineers (COE) markers 614 to 644. The side-scan sonar images were collected in analog form and consist of a straight orientation. To spatially correct these images for a meander of the river, Geographic Information Systems

(GIS) were used to rubbersheet the furrow field. After accurately locating and comparing the placement of furrows for each year of the data, inferences can be made about the stability of this furrow field.

Overall, the furrow field is relatively stable throughout the seven year period, especially between COE markers 631 to 622, though minor lateral and downstream migration is observed. Throughout the Area of Concern, some new furrows formed while others eroded away. These temporary features show evidence of bi-directional stream flow as their "tuning fork" patterns open in both the upstream and downstream directions.

Significant changes of the furrow field occurred between the 1995 and 1996. During this time, there was a decrease in the number of furrows within the COE markers 638 to 634 and minor downstream migration of furrows between COE markers 622 and 614.

Strong river flows have kept the furrows active causing moderate changes within the furrow field. The observations suggest that polluted sediments from industrial activity, are being re-suspended. This re-suspension of sediment is of concern for water quality, putting recreational areas and natural habitats for fish and wildlife in jeopardy.

VEGETATION AND CHANNEL CHANGES ON SODA BUTTE CREEK, YELLOWSTONE NATIONAL PARK

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The "natural regulation" policy in Yellowstone National Park dictates that no large ungulates will be killed within the park as a means of population control. There is some concern that the resulting increase in the size of elk herds has caused ecosystem stress due to overbrowsing of willows in the Park's northern winter range. Increased stream erosion could be one indicator of declining tall willow communities in northern Yellowstone riparian areas.

Soda Butte Creek, a major tributary of the Lamar River in northeastern Yellowstone, was used as the study area to document lateral channel changes over time. Soda Butte Creek is a mountain alluvial stream with local basin relief of up to 1,000 m, high bedload and suspended sediment supply, and a variable braided to locally meandering channel pattern. The banks of the stream were surveyed within five study reaches in the summers of 1996 and 1997 in order to measure erosion and accretion over the course of a single year. Two upstream study reaches are outside the elk winter range, and have more and higher willows on the banks. The middle reach has mixed grass, conifer, and willow banks.

The lower two reaches have grass and fewer willows, although the upper of these has denser grass, which may increase resistance to erosion. Survey data were plotted along with vegetation and bank material in order to view relations between these factors and erosion rates. In addition, aerial photographs from 1954, 1971 and 1987 were analyzed in order to quantify channel changes over longer intervals. Measurements were made of bank erosion and accretion that occurred during each interval. The reaches along which changes occurred were grouped according to general channel morphology. Mean distances of erosion and accretion per length of channel were calculated, and mean bankfull width was measured.

Mean bankfull width decreased at 4 of the 5 study sites between the years 1954 and 1987. From 1987 to 1997, width generally increased at all sites. The increased erosion over this second time period may have largely occurred because of prolonged high discharges in 1996 and 1997, however, and may not be indicative of a continuing trend. These were the two years of highest runoff on the Lamar River since gauging began in 1924. Snowmelt runoff in 1997 caused substantial local erosion along a number of bank segments. The most downstream study reach has sparse grass and few willows, and experienced channel narrowing between 1987 and 1996 as well as between 1954 and 1987. Also, the only reach at which net widening occurred over the entire period of record was the farthest upstream, outside the winter range and where willow cover on banks was the most dense. The most significant long-term change appeared to be channel narrowing between 1954 and 1987. These findings would seem to oppose the popular opinion that bank erosion has become more rapid over the study period due to overgrazing.

ESTIMATES OF VOLUME AND MASS FOR FLOOD-DEPOSITED MINE TAILINGS ALONG SODA BUTTE CREEK, YELLOWSTONE NATIONAL PARK

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Soda Butte Creek near the Northeast Entrance of Yellowstone National Park was subjected to severe mine waste pollution when a tailings impoundment failed in June, 1950. This impoundment, located 8 km above the park boundary, presently contains approximately 174,000 m³ of pyrite-rich tailings extracted from the New World mining district from 1933 to 1953. The flood from the impoundment failure deposited tailings on the Soda Butte floodplain as much as 32 km downstream, to the Lamar River confluence. Most deposits are located in abandoned and

flood channels, flood bar drapes and mantles, overbank sheets, and slackwater eddies, and vary in thickness (2-60 cm) and metals concentration (e.g. Cu ~100-1220 µg/g). Typically the deposits lie under 0-30 cm of younger sediment. They are mixed with uncontaminated fine overbank sediments and generally decrease in Cu, As, Pb, and other heavy metal concentrations downstream due to dilution.

Airphotos were used to map the tailings and were joined with maps produced by total station surveys. Depths for individual tailings deposits were averaged and multiplied by area to obtain volume estimates. Summation of these values approximated the total amount of tailings sediment on the Soda Butte Creek floodplain to be 29,400 m³, ~1/6 of the volume of tailings in the impoundment; however, floodplain deposits are diluted tailings. To acquire a value for the total mass of tailings, bulk density analyses performed on 14 samples yielded a value of 1.22 g/cm³, and 144 samples were analyzed for metals concentration. Copper concentrations were estimated for unanalyzed tailings deposits by an equation describing Cu concentration as a function of distance downstream from the impoundment. The potential impact of these tailings on Soda Butte Creek is significant, as they are chemically mobile and physically reworked by bank erosion. Increases in metal concentrations during high discharge (Nimmo and Willox, 1996) may signify that metals from floodplain tailings deposits are being leached and reworked into the stream water, and that acid drainage from the impoundment is not the only source of pollution. The tailings will have long-term effects on the Soda Butte Creek system due to their high concentration, quantity, and proximity to the stream.

GEOCHEMICAL AND MINERALOGICAL ANALYSIS OF A SILURO-DEVONIAN SHEETED DIKE SUITE LOCATED NEAR EAST BARNET, NORTH EASTERN VERMONT

Rouff, Ashaki A., Geology Department, Middlebury College, Middlebury, VT 05753

The geologic history of Vermont is marked by two significant tectonic events; the Taconian and Acadian Orogenies, dated at 460-440 and 400-360 Ma, respectively. A Siluro-Devonian dike complex of the New Hampshire sequence, northeastern Vermont, has been dated at 420 Ma. Geochemical and mineralogical analysis of this intrusive feature can be utilized to describe magmatic events occurring between the two major orogenic episodes.

The intrusive suite is exposed near the town of East Barnet at the Frank D. Comerford Dam along the Connecticut River, and Frank D.

Comerford Quarry 1 kilometer northeast of the Dam. The dikes at the Dam intrude slates and are coarse grained with feldspar phenocrysts, whilst those at the Quarry intrude coarse-grained pegmatitic diorites, and are fine grained, dark colored basaltic rocks. Dam dikes have slightly higher silica content, and lower iron and titanium wt % relative to quarry dikes. Low grade minerals such as amphibole, epidote and sphene, altered from pyroxene, plagioclase and titanomagnetite respectively, were observed in thin sections from both dikes. Diorites are characterized by their low titanium wt %, and the presence of amphibole and epidote altered from pyroxene and plagioclase.

Triangular, binary, and rare earth element (REE) diagrams produced from trace and major element analysis indicate that the dikes are chemically similar to mid ocean ridge basalts (MORB), or some back arc basin basalts. The approximate REE abundance is 20-30 times that of chondrite for the dikes, and 7-10 times that of chondrite for the diorites. The dikes exhibit flat REE patterns with small negative europium anomalies, whilst those of the diorites have a positive europium anomaly indicative of accumulation of plagioclase.

The geochemistry of the dikes indicates that the interval between the Taconian and Acadian orogenies marked a period of extension. During that time, asthenospheric mantle was partially melted to form depleted tholeiites that intruded the crust as the Comerford igneous complex.

DETERMINING THE MECHANISM OF MAGMA FLOW IN A SEGMENTED EN ECHELON LAMPROPHYRIC DIKE, JOHNSON, VERMONT: EVIDENCE FROM PHENOCRYSTS

Stansfield, W., Jones, A., and Van Horn, S. R., Department of Environmental and Health Sciences, Johnson State College, Johnson, VT 05656

The emplacement of thin lamprophyric dikes, primarily camptonite and monchiquite, in the northern Appalachians occurred during the Mesozoic Era. The majority of these dikes contain phenocrysts, megacrysts and xenoliths that may be useful in determining the mechanism of magma flow (laminar or turbulent) during dike emplacement. Within the town of Johnson, VT, a lamprophyric dike discontinuously crops out along a stream valley for approximately 1.5 km. The dike occurs as seven discrete en echelon segments having a maximum thickness of 1.74 m. The lamprophyric dike is compositionally a monchiquite which contains phenocrysts of salite (clinopyroxene) and kaersutite (amphibole), megacrysts and rarely xenoliths. The groundmass contains salite, kaersutite, analcite, magnetite and ocelli.

The monchiquite contains abundant vesicles filled with secondary calcite which suggests that the nucleation of gas bubbles by exsolution and expansion occurred during magma ascent.

The presence of hydrous minerals and vesicles within the dike indicates that a volatile phase was present during dike emplacement that could possibly cause turbulent flow. However, mafic dikes that are less than 5 m thick normally record evidence of laminar flow. The distribution and orientation of the phenocrysts that were present during magma ascent should suggest the flow mechanism. Samples collected across two of the seven dike segments indicate: (1) a low modal kaersutite (phenocrysts plus groundmass) zone located 0.2 m from both contacts, (2) a symmetrical modal distribution of phenocrysts and (3) a preferential alignment of the phenocrysts. Seventy-six percent of the phenocrysts measured in samples from the contact and the center of the dike segments lie within 30 degrees of the mean orientation of the phenocrysts. Although a period of laminar flow before cessation of magma flow could align the phenocrysts, the symmetrical modal distribution of the phenocrysts suggests that laminar flow was the predominate flow mechanism during emplacement of the dike.

GEOCHEMISTRY OF THE NEWARK PLUTON, NORTHEAST KINGDOM, VERMONT

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The Newark pluton intrudes the impure recrystallized limestone, calcareous-quartzose phyllites, and staurolite-garnet schists of the early Devonian Waits River Formation and the phyllitic quartzites, quartzose phyllites and quartz-mica schists of the early Devonian Gile Mountain Formation. The Newark pluton has modal compositions of mostly granite proper with minor granodiorite. Two feldspars, plagioclase and microcline, occur in all compositions. Biotite is ubiquitous whereas muscovite occurs in some samples only. Hornblende occurs in one sample of granodiorite. Accessory minerals include chlorite, ilmenite, and sphene.

Major and REE analysis of the stock corresponds with the chemistry of the granodiorites and granites of the nearby Echo Pond pluton, which is included in the Northeast Kingdom batholith. Thus, the Newark pluton can be included in the batholith. The main stock is LREE enriched and has weak or absent negative Eu anomalies. Dikes near the pluton have a relatively higher silica content than the main stock and negative Eu anomalies and are assumed to be related to the pluton. A K_2O-SiO_2 diagram plotted for the pluton places the stock in the high-K calc-

alkaline series. Molar calculations show that the stock is metaluminous. The presence of two micas indicate that vapor was present in the melt.

Tectonic discrimination diagrams show that the pluton was developed in a syn-collisional environment. High K content indicates that magmatic evolution likely involved crustal assimilation.

WATER NEWS

Kent S. Koptiuch, CGWP

Now that mud season is almost over (I hope) here in my little part of Vermont, I'm looking forward to the opportunity of driving a clean truck once more; I live on a dirt road and for 7 months out of 12, I'd have to wash it every day. If I really wanted that luxury! The rivers seem to be subsiding from flood stage (although they've fooled us with that ploy several times this late Winter/early Spring), and even the level of Lake Champlain has dropped imperceptibly in the last couple of days from its near-record high. I still have to drive up, rather than down the ramp to get on the ferry to Plattsburgh, so I know the canoeing on the rivers will be good for a while yet! Also, for those of you who are two-bit farmers like me, now's the time to set your fence posts in new pastures; the soil is so saturated, you can drive them in with a sledge quite easily without using a post-hole digger at all. Of course, that isn't helping a lot of folks with older, and/or poorly designed septic systems; excavators specializing in wastewater disposal systems renovations can line up a whole season's work right now just by driving the roads and sniffing out new jobs!

I think we'll have to wait a bit before a lot of folk's "lake-bottom" property returns to "lake-front" property once more, but the calls for dealing with basements flooded with contaminated groundwater at some of my hazardous sites have subsided. The flurry of sump pump and water treatment installations has abated, but it looks like indoor air quality in affected residences will continue to require addressing for a while yet.

The March 2 edition of the Federal Register includes the EPA's new list of contaminants to be considered as priorities in developing drinking water guidance and regulation values over the next few years. The list includes 10 microbiological contaminants (or contaminant groups) and 50 chemicals that are currently not subject to regulation under the Safe Drinking Water Act (SDWA), but are frequently found in public water supply systems.

The EPA has divided the list into categories that includes contaminants/pathogens requiring additional occurrence data to evaluate, priority contaminants/pathogens for future drinking water research, and priority contaminants/pathogens to be evaluated for the development of future drinking water regulations and guidance values. For the full list, you can contact the EPA's SDW Hotline at 1-800-426-4791.

Two chemicals on the list that many of us here in Vermont deal with fairly regularly are MTBE and sodium. On the microbial list, they have targeted acanthamoeba for the development of guidance values specifically due to its impact upon users of contact lenses.

Uncle Bill recently asked Congress to approve the Clean Water Action Plan as part of their move to reauthorize the Clean Water Act. The plan, promulgated by EPA, includes 100 action items to be targeted through increasing aid (\$2.3 billion over the next five years) to state and local governments that is funneled through pre-existing programs.

Of primary concern is the impact of nonpoint-source pollution on wetlands, coastal waterways, and inland waterbodies. Under the plan, by the year 2,000, EPA will develop criteria for phosphorous and nitrogen in surface waters. The plan also calls for providing financial compensation and incentives to participating landowners who agree to implement agricultural and stormwater control practices that will better protect surface water quality. Full details on the Clean Water Initiative and the Clean Water Action Plan can be accessed on the internet at <http://www.epa.gov/cleanwater>.

New Water Web Site

The United Nations Development Program and the World Bank now co-sponsor a new web site developed by the Stockholm Environmental Institute. "The Global Water Partnership Forum" (GWP) address is [<http://www.gwpforum.org>]. The site provides links to water organizations world-wide, discussion forums, and bulletin boards.

SEMINARS, MEETINGS, AND FIELD TRIPS

April 24: Geological Society of Maine Spring Meeting, University of Maine, Orono; Presentations of Student Papers beginning at 1 PM. Dinner followed by Keynote Presentation at 7 PM: Dr. Brenda Hall, University of Maine: "*Abrupt climate change, from a southern hemispheric perspective*" Contact Daniel Belknap for details (Dept. of Geol. Sciences, University of Maine, belknap@maine.maine.edu)

April 25: Vermont Geological Society Spring Meeting: Presentation of Student Papers, Middlebury; See this issue for details.

May 2: *By the Shores of Lake Pigwacket*: A workshop on glacial geology in the Mount Washington Valley with Woody Thompson, sponsored by the Mount Washington Observatory. Course Fee: \$25. Call 603-356-8345 for details

May 15-17: Maine Mineral Symposium, Augusta. Features talks and field trips. Contact Woody Thompson at the Maine Geological Survey (287-7178) or Robert Hinkley (207-657-3732) for details and registration.

July 18: New Hampshire Geological Society Summer Field Trip, Glacial Lake Souhegan and Glacial Lake Contoocook deposits, south-central New Hampshire. Leader: Carol Hildreth; Contact Tim Allen for details (tallen@keene.edu or <http://kilburn.keene.keene.edu/>).

October 9-11: NEIGC Meeting sponsored by the University of Rhode Island.

October 26-29: Geological Society of America 1998 Annual Meeting "Assembly of a Continent" Toronto, Ontario, Canada. Abstracts due July 13, pre-registration due September 18. Call: 1-800-472-1988; Fax: 303-447-0648; E-mail: meetings@geosociety.org; Web: www.geosociety.org/meetings/98.