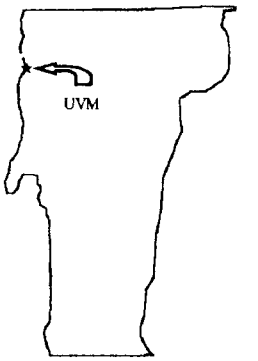
THE GREEN MOUNTAIN GEOLOGIST



QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

SPRING 1997 VOLUME 24 NUMBER 2

The Vermont Geological Society Spring Meeting for PRESENTATION OF STUDENT PAPERS

SATURDAY APRIL 26, 1996, 8:30 AM

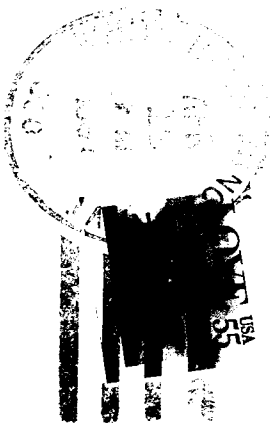
Room 1, Calkin Building,University of Vermont
Burlington, Vermont

See Inside For Details.

Inside This Issue

THE GREEN MOUNTAIN GEOLOGIST
VERMONT GEOLOGICAL SOCIETY
DEPARTMENT OF GEOLOGY
UNIVERSITY OF VERMONT
BURLINGTON, VERMONT 05405-0122

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



PRESIDENT'S LETTER

April 12, 1997

Dear Members,

Like most of you, my life is filled with a wide variety of activities, with plans underway for a busy summer. The geology department here at Norwich University is in the process of being packing into 40 trailers for the summer in order to complete the final stage of a $15 million renovation of the Science and Engineering complex by August. Teaching for the final three weeks will be conducted with our computers, a couple of milk crates and a handful of samples and maps we anticipate needing. After teaching a course on the connecticut River with Fred Larsen in late May, I'll be heading off to Italy for research while Fred begins his annual western U.S. swing. We can only hope that our renovation runs smoothly in our absence.

In the Winter GMG I mentioned several projects that I was hoping to see get underway soon. So far I have not had much response to these ideas, so I will mention them again in order to gage the interest level. If you have an interest in participating in one of these projects, please let me know.

- **"Best Field Trip Stops in Vermont"** We're exploring the idea of publishing a volume with a format similar to the Decade of North American Geology Centennial Field Guide Volumes, but with a shorter 2-page format per site, including figures and references. We need contributors.
- **"Geology of Vermont Slide Show"** We would like to collect a large number of documented slides taken at the best geology sites in Vermont. These would be organized and published as a CD, perhaps in coordination with the "Best Field Trip" ..... volume above. Again, we need contributors.

I'm looking forward to the annual Spring Meeting and hearing the student papers presented. Hope to see many of you at the meeting.

Ciao.

Dave Westerman

westy@norwich.edu

GUEST EDITORIAL

This issue of the *Green Mountain Geologist* is packed with great information for all our members. Larry Becker, our State Geologist has been very active over the past year. His report on *page 4* updates us on everything from new and ongoing STATEMAP activities, the advances of GIS technology, water in fractured bedrock studies in Rutland County, Act 250 quarry reviews, to the hydrodynamics of Missisquoi Bay.

We've received some excellent abstracts from the upcoming Spring Student Presentation Meeting at UVM on April 26. I know I'm looking forward to sitting in and refreshing my ties with current academics in geology; I hope to see many of you there as well! Check out our presentation program beginning on *page 8*.

As an added bonus to this issue, we've included a center pull-out containing the most recent VGS Membership Directory. This is a great reference to help us all keep in touch with each other, and it sure is interesting to see where some of our old friends have ended up over the years.

We've also tried to provide you with additional updates on current and upcoming regional and local activities, newly available environmental education materials, professional position openings, grant and research opportunities, and a short-list of some great web sites to browse on the internet. If you think anything is missing that should be in the GMG, we'll be looking to hear from you before the Summer issue goes to print in July.

As our society President, Dave Westerman, notes in his letter on *page 2*, we're still looking to hear from you regarding *"Best Field Trip Stops,"* and *"Vermont Geology Slides."* Your input on these projects is vital. The Vermont Geological Society is a volunteer organization run by members who share many of the same pressures, deadlines, and worries that you are going through. We know how difficult it is to take even the smallest amount of time away from our already very busy lives. We always welcome input and assistance from other members, so if you've got a suggestion, a comment, criticism, contribution, or a *stone* to grind, let us know!

We also welcome your nominations of prospective officers for the upcoming year (1997-98). If you would be interested in having a hand at the helm, or if you know of someone else who may be interested, drop us a line; all of the Executive Committee telephone numbers are listed on the back page of this issue, and... they're in your new Membership Directory!

In this issue's *Water News* column (*page 7*), I'll bring you up to speed with a few of the newsworthy items I picked up at the annual Northeast Rural Water Association meeting in Woodstock last month. I'll also let you know about the latest zebra mussel repellent actively in use in Vermont, and how you might be able to assist in maintaining a critical groundwater monitoring program in the state that is threatened with obsolecence due to the recent drastic budget cuts at the federal level (USGS).

So sit back and enjoy your GMG, and remember to...

...keep on rockin'

Kent S. Koptiuch
KSKGeoS@aol.com

STATE GEOLOGIST'S REPORT

Geologic Mapping: As the bill stalled along with many in the 104th Congress, the reauthorization for the National Geologic Mapping Act is again before the 105th Congress (HR704 and S317). For support, the State Geologist contacted Congressional staff from Senators Leahy, Jeffords and Rep. Sanders Washington offices. The National Geologic Mapping Act authorizes STATEMAP which is the grant that funds Vermont is mapping in the Northern part of the State. The USGS maps in Southern Vermont under FEDMAP. The University of Vermont has received EDMAP funds from this Act. Monies from this appropriation are crucial to maintaining a very productive cooperation between the State, academic community, and the Federal government. At present the administration budget has a shortfall in the STATEMAP and EDMAP appropriation. Vermont could be adversely affected. I would urge you to support this legislation with full funding, as information derived from this mapping can be used to address a variety of environmental issues and resource questions.

GIS Expo: The Vermont Survey participated in the GIS expo held in Montpelier on February 18th. Open-file and prototype digital geologic maps were displayed. Greg Walsh from the USGS in Reston was in attendance to highlight the cooperation between the State and Federal Government in producing digital geologic maps in conjunction with the Information Management Section of the Agency. As a Vermont Center for Geographic Information Board member representing the Agency, the State Geologist attended the kick off meeting of Vermont's grant to participate in the National Digital Geospatial Data Framework to improve coordination between creators and users of GIS data.

Water In Fractured Bedrock: The Vermont Survey is part of a developing cooperation with both the USGS Water Resources and Geologic Divisions and the Rutland Regional Planning Commission to study water in fractured bedrock. The proposed project intends to define the areas with the greatest potential to yield water to bedrock wells in the eastern part of Rutland County. The intent is to create a prototype regional study for planners and provide background information to consultants locating wells in a growth area. In a March 31, 1997 letter to Gordon Eaton, Director of the USGS - Vermont Agency of Natural Resources Secretary, Barbara Ripley, supported the search for funds for this project. She also designated the State Geologist as the point of contact between USGS representatives and other elements of the Agency.

Quarries and Act 250: The season for quarry reviews under Act 250 criteria 9E is upon us. At present, four are under review. An example is the State Geologist's visit to the OMYA, Middlebury crushed rock operation. An expansion is planned to the south along with the development of a private access road directly to route 7 to remove truck traffic from a residential neighborhood on Foote Street.

Stream Geomorphology: The first phase of a four phase project to study Watershed Hydrology Protection and Flood Hazard Mitigation is underway with the release of a request for proposal. A consultant will be asked to conduct a literature search that focuses on the nature of change in stream hydrology, morphology, water quality, and aquatic ecosystems. The consultant will then examine how land use change may contribute to changes in stream hydrology and morphology. As a link to phase II, the consultant will provide recommendations on how to determine *(Continued on Page 5)*

*(Continued from Page 4)*thresholds of watershed land use change which, when passed, result in an unacceptable reaction in a stream with accompanying affects on water quality and aquatic ecosystems. A study of flood damage reports from an August 5, 1995 event is also part of the RFP. Proposals are due by May 15, 1997.

Missisquoi Bay: The draft final report for phase II of the Missisquoi Bay Hydrodynamic Study is complete. The field study and a new six month computer simulation are the subject of the second phase. At an April 16th meeting in Swanton, the consultant will present the draft findings.

Respectfully Submitted,
Larry Becker
State Geologist

You can contact the State Geologist's Office by calling :

(802) 241-3608,

or writing to:

State Geologist
Agency of Natural Resources
103 South Main Street, Center Building
Waterbury, Vermont 05671-0301

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ENVIRONMENTAL EDUCATION RESOURCES

- *Hydroexplorer* computer games offer students interactive ways to learn about water issues in Colorado or California. For grades 4-6, comes with teacher's manual, student worksheet, and stickers. It is available for IBM or MacIntosh computers, for $25.00. Students board a fresh water submarine and travel down rivers in California and Colorado, exploring the fresh water ecosystems. To order contact: Water Education Foundation, 717 K Street, Suite 517, Sacramento, CA 95814, or call (916) 444-6240, fax (916)448-7699.
- A *Groundwater Study Guide* is available from the Wisconsin Dept. of Natural Resources. The guide is useful for students grade 6-9 anywhere in the country. It contains a teacher's guide, copy-ready student activity sheets, overhead projector masters, a 24" x 36" water cycle poster, and a groundwater magazine. Students can learn about the water cycle, groundwater movement, septic systems operation, hazardous chemicals, groundwater contamination, community impacts and conflict, and water conservation. The study guide comes in two parts; the poster and the information packet. Cost for non-Wisconsin residents $10.00. Contact: Document Sales, Dept. of Administration, P.O. B. 7840, Madison, WI 53704-7840. Request Study Guide #1701. Make checks payable to Wisconsin Dept. of Administration. Credit card orders can call 1-800-363-7253.

THE GREEN MOUNTAIN GEOLOGIST Volume 24, Number 2, Spring 1997

Research Grants/Scholarships/Graduate Positions Available

- **Vermont Geological SocietyStudent Research Grants** are designed to aid our future geologists investigate Vermont's geo-history. Awards are presented semi-annually to the student(s) with the best research topic(s) and associated method(s) in Vermont Geology. Students receiving assistance through the program will present their research results at the VGS Spring Meetings. Spring application deadline is May 15, 1997. For applications contact VGS Student Research Grants, Dept of Geology, UVM, Burlington, VT 05405-0122

- The Geography Department at the University of Arkansas at Fayetteville is pleased to be able to announce that it has lucrative **research assistantship support** available for outstanding MA students interested in working in the area of Middle Eastern geography. We are looking for prospective students with interests in the broad area of physical geography and who have interest in and some experience with GIS applications in Physical geography.

  This opportunity has just appeared so we will need to to proceed promptly with graduate school admission and department evaluations. If you have any graduating seniors interested in this opportunity to work with strong physical geography faculty and with access to outstanding GIS facilities, please contact:

  Dr John C. Dixon, Chair
  Department of Geography
  University of Arkansas
  Fayetteville, Arkansas
  Ph: (501) 575 3159
  e-mail: jcdixon@comp.uark.edu

- **Fellowship - Graduate Study in Environmental Geosciences - Women**
  Purdue University is continuing its program of offering an annual Fellowship for a female student interested in starting graduate work in the Department of Earth and Atmospheric Sciences, in any area of Environmental Geosciences. This 1 year fellowship has no teaching or research service requirements, and provides a fast-start for the graduate program (MS or PhD). Previous recipients have taken part in writing successful proposals to fund continuation of their research and graduate program.

  For more information on the Department, our homepage is http://meteor.atms.purdue.edu. More information on the geomorphology and environmental hydrology group can be found at http://uval.geo.purdue.edu

  Purdue University excels in Science, Engineering and Agriculture, and is home to PRIME Lab (AMS facility for cosmogenic isotopes) and the USDA National Soil Erosion Laboratory.

  Previous recipients have worked on subjects as varied as: applications of cosmogenic isotopes to determining glacial erosion patterns (subsequently funded by the National Science Foundation); evaluation of an economic incentive for erosion control (subsequently funded by the Great Lakes Basin Program), and; assessment of the long term hydrologic impact of urbanization (proposal pending with the National Science Foundation).

  For more information, and to apply, please contact:

  Jon Harbor
  Department of Earth and Atmospheric Sciences
  Purdue University
  jharbor@uval.geo.purdue.edu

WATER NEWS

Kent S. Koptiuch, CGWP

The *Northeast Rural Water Association (NeRWA)* held their annual conference, tradeshow, and training program at the Woodstock Inn in Woodstock last month. As one of perhaps 200 attendees, I enjoyed a day filled with a comfortable mix of equipment and vendor services propoganda (I use the term affectionately in this instance); comraderie with other scientists, customers, and regulators; and a useful blend of well-presented educational training. Not to mention an excellent lunch! The program included training sessions on confined space entry, distribution system water quality evaluation, comparative cost-effectiveness and methodologies for disinfection of water supply systems, corrosion control, and a regulatory update on the Safe Drinking Water Act (SDWA) as it affects the availability of funding for well-head protection areas presented by representatives from the VT DEC, NH DES, MA DEP, and New England EPA.

One effect of the SDWA 1996 Amendments is that a State Revolving Fund (SRF) program has been established to provide a potential of $12.4 million in 1997, and $7.1 million in 1998 to be directed towards source protection (10%); water systems certification, state capacity determination, and technical assistance programs (15%); small water system upgrades (2%); and 4% is earmarked for State administrative costs (the fate of the remaining 69% of the SRF was no discussed).

That's the bait; if Vermont swallows it, we'll have to take the hook too! To qualify for the federal monies, the State must provide a 20% match (about $2.5 million in 1997). This has got the State regulators and legistlators scrambing to find some funding; as of March 25, the end result looked favorable. Access to SRF funds will enable many small public water supply systems throughout Vermont to upgrade their treatment, protection, and distribution systems to meet current standards.

Also of primary importance in the newly authorized SDWA, is the repeal of the former requirement for EPA to identify and regulate 25 new contaminants every 3 years; they've never succeeded at this anyway. In its stead, EPA must now select and regulate contaminants that pose the greatest risk to public health. This will be achieved through risk assessments and cost/benefit analysis. This is a much saner approach to contaminant regulation in that it is based upon at least some form of scientific documentation, as opposed to merely picking 25 new contaminants every third year due to a legal requirement. EPA must produce its *Contaminant Candidate List* through a seven-step process by February 6, 1998; it will be interesting to see if the wheels of EPA can meet this requirement considering that they've never been able to meet their previous mandates.

The Champlain Water District (CWD)in South Burlington, the Tri-Town Water District (Addison), and the Vergennes-Panton Water District made the front page of the March issue of *Water World* for their experimental pilot applications of Plasma Sparker technology as a zebra mussel controler on their raw water intake lines in Lake Champlain. CWD General Manger, Jim Fay is quoted as saying "*...we're optimistic that this electrotechnology is going to revolutionize the way we purify water*

SPRING MEETING PROGRAM

University of Vermont Saturday, April 26, 1997

8:30 **Registration,** ***Refreshments (provided)***

8:50 **Call to Order**

9:00 **Markowski, Matthew S.,** *Zebra Mussels as Biomonitors of Metal Pollution in Lake Champlain*

9:15 **Carolan, Gregory F.,** *Distribution and Geochemistry of Tailings Contaminated Floodplain Sediments Along Soda Butte Creek, Yellowstone National Park, Montana, Wyoming*

9:30 **Landis, Joshua D.,** *Recent Debris-flow and Flash-flood History of Northeastern Yellowstone National Park*

9:45 **Epstein, Jessica L.,** *Hydraulic Aspects of the McLaren Mine Tailings Dam-Break Flood on Soda Butte Creek, Yellowstone National park*

10:00 **Ewing, Tracy T.,** *Particle Size Variations and Metals in Flood-deposited Mine Tailings Along Soda Butte Creek, Yellowstone National Park*

10:15 **Escowitz, Ethan.,** *Geochemistry of Amphibolitic Greenstones Southwest of Jericho Center, Vermont*

10:30 **Break for Questions, Coffee Break**

10:45 **Nadeau, Beth M.,** *Holocene Wetland Evolution in Response to Long-term Lake-level Rise in Lake Champlain*

11:00 **Baggish, Aaron L.,** *A Gelbstoff Budget for Lake Champlain*

11:15 **North, Nicole S.,** *Pockmark Fields in Cumberland Bay, Lake Champlain*

11:30 **Tierney, Shawn R.,** *Seasonal Turbidity in South Lake Champlain*

11:45 **Valin, Chris,** *A Relative Chronology of River Terraces in the Mad River Valley*

12:00 **Questions & Lunch Break,** *Feel free to join the 'brown baggin' Executive Committee Members while we hold our Spring business meeting, or patronize a local deli or restauraunt (a listing will be provided).*

1:00 **Haines, Seth S.,** *The Effects of Ice Loading on Near Surface Sedimentary Seismic Velocities, With Implications for Ice Volume Interpretation*

1:15 **Wertheim, Jill A.,** *A Study of the Metamorphism and Deformation Within the Sillimanite Zone East of the Victory Pluton, Miles Pond, Vermont*

1:30 **Onasch, Emily H.,** *Analysis of Structures and Metamorphism Across the Monroe Line Northeast of the Victory Pluton, Branby, Vermont*

1:45 **Lackey, Jade Star,** *Garnet Zone P-T-Deformation History in the Contact Aureole of the Victory Pluton: Implications for the Age of the Monroe Fault*

2:00 **Adams, Angela L.,** *Experimental Determination of the Melting Curve of $NaMg(0.5)Si(2.5)O_6$ Between >12-16.5 GPa*

2:15 **Applegate, G. Scot,** *Geochemical Characteristics of Slab-Derived Melts and Phase Equilibria: Experimental Constraints at 4 GPa*

2:30 **Mallard, Laura,** *BEDROCK GEOLOGIC MAPPING IN THE RICHMOND 7.5' QUADRANGLE*

2:45 **LANGER, Katherine E.,** *PETROGRAPHY AND GEOCHEMISTRY OF GRANITIC ROCKS FROM THE BICKFORD QUARRY, MARSHFIELD, VERMONT*

3:00 **Questions & Answers**

3:15 **Awards Presentation**

3:30 **Meeting Adjourns**

Abstracts Follow in Alphabetical Order

Experimental Determination of the Melting Curve of $NaMg(0.5)Si(2.5)O_6$ Between >12-16.5 GPa

Adams, Angela L., Department of Geology, Norwich University, Northfield, Vermont, 05663, and GASPARIK, Tibor, Center for High Pressure Research, Department of Earth and Space Sciences, SUNY at Stony Brook, Stony Brook, New York 11794

Phase relations for the composition $NaMg_{(0.5)}Si_{(2.5)}O_6$, an orthorhombic pyroxene (NaPx), have been determined experimentally between 120-165 kbar and 1650-1800°C with a split-sphere anvil apparatus (USSA-2000). NaPx melts incongruently to enstatite and liquid; below the liquidus is a mixture of primary enstatite, sodium-rich melt and stishovite, the high pressure phase of SiO_2. Previous work by Gasparik (1989) found NaPx to be stable at pressures above 150 kbar. NaPx is also the first high-pressure pyroxene known to contain Si in both four ([4]Si) and six ([6]Si) coordination with oxygen (Angel, 1988). This work refined a portion of the melting curve for NaPx, and expanded understanding of the phase relations of NaPx and majorite garnet, both of which have six-coordinated silica. This research studied the pyroxene transformation to garnet which occurs at depths in the transition zone between approximately 400 and 670 km where seismic wave velocities increase rapidly with depth. It is possible that the transition zone discontinuities at ~410km and ~670km are caused by a phase transition between pyroxene and garnet, an alternative explanation to the olivine-to-beta phase transition. As a result of this work, a new triple point at the join between garnet, stishovite and NaPx has been located at approximately 165 kbar and 1850°C, and a new NaPx field has been described.

GEOCHEMICAL CHARACTERISTICS OF SLAB-DERIVED MELTS AND PHASE EQUILIBRIA: EXPERIMENTAL CONSTRAINTS AT 4 GPa

Applegate, G. Scot, Department of Geology, Middlebury College, Middlebury, VT 05753, and Robert P. Rapp, Center for High Pressure Research and Mineral Physics Institute, Earth and Space Sciences Department, State University of New York at Stony Brook, Stony Brook, NY 11794-2100

Basalt melting and peridotite assimilation experiments were performed at 4 GPa (40 kbar) using the USCA-1000 multi-anvil apparatus at the S.U.N.Y. at Stony Brook. With 5 - 15 % melting of basalt, eclogitic (gt + cpx +/- opx) residues are in equilibrium with high-silica, alkali-rich, hydrous melts enriched in LILE and depleted in HFSE relative to primitive mantle. The compositions for basalt melting experiments compare closely geochemically to natural examples of tonalite-trondhjemite-granodiorite (TTG) suites and adakites. The presence of rutile in one run suggests that this accessory phase may play a significant role in controlling trace and REE distribution in slab-derived melts.

Peridotite assimilation experiments were performed by adding about 10 - 15 % depleted peridotite to sample capsules with basalt. These high-silica, alkali-rich, hydrous liquids in equilibrium with eclogitic residues are distinguished by significantly higher Mg* (Mg/Mg+Fe) and higher Cr contents which resemble natural examples of high-magnesian andesites (HMA). However, plots of extended REE for peridotite assimilation experiments do not adequately resemble natural examples of adakites, TTG, or HMA suites. These results help to explain the observed geochemical characteristics of arc magmatism for cases in which there are thought to be differing degrees of interaction between slab-derived melts and the sub-arc mantle wedge.

A GELBSTOFF BUDGET FOR LAKE CHAMPLAIN

Baggish, Aaron L., Department of Geology, Middlebury College, Middlebury, VT 05753

Lake gelbstoff is generated primarily from the watershed by the decomposition of biological tissues such lignin and tanin in surface soils. Gelbstoff is a high molecular mass organic polymer that attenuates light and produces a yellow color in lake water. The Lake Champlain drainage basin has experienced considerable industrial use and population growth during the past two centuries. The primary goal of this study is to determine if the concentration of gelbstoff in Lake Champlain is "natural" or has been affected by human development.

To answer this question I employ a mass-balance approach analogous to those historically used to study phosphorous loading. This method includes sampling the lake's major tributaries, absorbance vs. depth profiles from the Broad Lake, laboratory evaluation of the relative levels of gelbstoff produced from various organic materials, and assesments of gelbstoff photo-degradation rates. All gelbstoff concentrations are assessed spectrophotometrically. I calculate that the mean absorbance in Lake Champlain is 0.8 m^{-1}. This value appears to be natural. Consequently, we conclude that drainage basin agriculture, lake shore industrialization, and lake front urbanization are not significant sources of Lake Champlain's gelbstoff.

DISTRIBUTION AND GEOCHEMISTRY OF TAILINGS CONTAMINATED FLOODPLAIN SEDIMENTS ALONG SODA BUTTE CREEK, YELLOWSTONE NATIONAL PARK, MONTANA-WYOMING

Carolan, Gregory F., Geology Department, Middlebury College, Middlebury, VT 05753

The McLaren tailings impoundment lies on upper Soda Butte Creek near Cooke City, Montana, 8 km above the Yellowstone NP boundary. It stores pyrite-rich waste from an open pit gold mine in the New World district. In June 1950, the impoundment failed, resulting in a major flood that deposited pyrite-rich tailings as overbank and slackwater sediments along the floodplain as much as 30 km downstream. The impoundment is a significant source of acid drainage containing metals (e.g., Fe, Cu, As,
and Pb). Dissolved Cu is highest in Soda Butte water during spring runoff, when dilution of this acid drainage by uncontaminated stream water is greatest (Nimmo and Willox, 1996). Therefore, the floodplain tailings may be another significant source of trace metal pollution.

Five major areas of tailings deposition were mapped in 1996, and 133 samples of floodplain tailings were analyzed by ICP-AES on aqua regia leachates for 32 trace metals. Stratigraphic sections of thicker tailings deposits were analyzed for sediment and water extractable (both soluble and colloidal) trace metal content as well. Floodplain tailings are highly enriched in Cu, Fe, Pb, As, and Mn over background levels in pre-mining overbank sediments (e.g., Cu ranges up to ~1200 µg/g, whereas background levels are 15-30 µg/g) but have lower concentrations than the tailings in the

impoundment, where Cu averages 3130 µg/g. The Cu, Fe, As, and Pb content of floodplain tailings decreases exponentially with distance from the impoundment (r^2 = 0.77, 0.78, 0.95, 0.96, respectively). Tailings deposits are up to 60 cm thick, and thicker sections typically display a zone of strong oxidation overlying a mottled, variably oxidized zone and/or reduced zone with gleyed appearance. Manganese accumulates in the mottled or reduced zone, indicating translocation presumably as Mn^2+. Cu, Fe, As, and Pb are more often concentrated in the upper zone suggesting lesser translocation of these metals compared to Mn. Analysis of water extractable metals, however, shows that Mn, Fe, and to a lesser extent Cu can be readily mobilized by percolating precipitation or groundwater. Overall, metals concentrations in most of the tailings deposits are controlled primarily by dilution with uncontaminated sediment during the flood event, and to a lesser extent by in situ translocation. High levels of water extractable metals, translocation of Mn, Fe, and Cu, and streambank erosion of the floodplain tailings all suggest that they are a significant source of trace metals pollution in Soda Butte Creek. Samples of modern (1990-1996) overbank sediments show ~two-fold enrichment of Cu and Pb compared to pre-mining overbank sediments from stream terraces, indicating widespread low-level contamination of the fluvial system.

HYDRAULIC ASPECTS OF THE McLAREN MINE TAILINGS DAM-BREAK FLOOD ON SODA BUTTE CREEK, YELLOWSTONE NATIONAL PARK

Epstein, Jessica L., Department of Geology, Middlebury College, Middlebury, VT 05753

Mine tailings impoundment failures are not uncommon on a worldwide basis and have caused serious environmental damage and human disaster. The McLaren mine tailings impoundment was operated on Soda Butte Creek from 1933 to 1953 at Cooke City, Montana, about 7 km above the Yellowstone National Park boundary. In June 1950, the impoundment failed, flushing pyritic tailings down the Soda Butte floodplain 30 km to the confluence with the Lamar River, a tributary of the Yellowstone River. The acidic tailings were deposited as overbank sediments up to 60 cm thick, and contain high concentrations of heavy metals which now impact the river ecosystem through degradation of water quality and floodplain soils.

The purpose of this study was to evaluate the hydraulic aspects of the 1950 tailings flood through indirect estimation of peak discharge, flood duration, and stream power. USGS stream gaging began much later on Soda Butte Creek in 1989. Several cross-sections were surveyed at each of five sites. Flood stages were constrained by the upper limit of tailings deposits, bank geomorphology, and bars deposited during the flood (dated with tree-ring methods). The slope-area method produced peak discharge estimates of 9400 ft^3/s (estimated uncertainty ~+108%, -36%) in the impoundment channel just below the dam, 4900 ft^3/s (uncertainty ~40%) 9.5 km below the impoundment at Landslide Narrows, 3800 ft3/s (uncertainty ~70%) 17 km downstream in Hollywood Meadow, 3600 ft3/s (uncertainty ~18%) 20 km downstream in Round Prairie, and 3200 ft^3/s (uncertainty ~30%) 24 km downstream at Cottonwood Bars. The impoundment channel discharge estimate is probably too high due to enlargement of the channel during the flood given the dam-break model estimate of 7000 ft^3/s (uncertainty ~40%). Provisional USGS discharge records indicate that the

1996 snowmelt peak discharge was only about 10% lower than the estimated peak of the dam-break flood at Cottonwood Bars. The 1996 flood was the largest since gaging began and deposited overbank sediments up to a few decimeters below the highest tailings deposits, consistent with the discharge relationship. Channels formed during large natural floods over the last few hundred years acted as slackwater areas for the McLaren dam-break flood, accumulating thick, concentrated tailings sediments 25 km or more below the impoundment. Reconstructed flood hydrographs estimate attenuation of the flood wave downstream, and show the relatively short duration of the flood, from about 7 to 13 minutes at the failure site to 18 to 32 minutes in Cottonwood Bars. Preflood airphotos and field observations show that the flood had little geomorphic impact on the floodplain. Stream power graphs indicate this lack of erosion was probably due to the short duration and rapid decrease in energy expended downstream. Despite the short duration of the flood, a large volume of tailings were deposited as overbank sediments.

GEOCHEMISTRY OF AMPHIBOLITIC GREENSTONES SOUTHWEST OF JERICO CENTER, VERMONT

Escowitz, Ethan, Department of Geology, University of Vermont, Burlington, VT 05405

Geochemical analyses were performed for three previously unanalyzed amphibolitic greenstones west of Jerico Center in the Underhill formation. The outcrops from which the samples came are among the westernmost exposures of greenstone, lying east of likely associated Brome Thrust. Porphyroblasts of dark green amphibole distinguish these metavolcanics which make up distinct discontinuous layers in the Pinnacle and Underhill formations.

Tectonic discriminant diagrams showed the Jerico greenstones to be rift volcanics and within plate basalts similar to the Group A Vermont rocks (Tibbit Hill and Huntington greenstones) defined by Coish et. al (1985), and the greenstones of Quebec (Oak Hill group of the Tibbit Hill, Mansville Complex, and Sutton metamorphic Suite) analyzed by Colpron (1990). Concentrations of Zr and TiO_2 in all three groups generally conformed to the decreasing west to east trends identified by Coish (1987). The Jerico samples, however, had considerably lower Zr concentrations (143 ppm), than the relatively north/northeast located Mansfield Complex (179 ppm) and Tibbit Hill of both Quebec (196 ppm) and Vermont (219 ppm). Additionally, the Huntington greenstones had considerably higher TiO_2 concentrations (3.6 wt %) than the samples to the north/northeast: Mansfield (2.51 wt %), Jerico (2.6 wt %), and the Tibbit Hill of Quebec (2.67 wt %), and Vermont (3.17 wt %).

There appears to be a significant variation in greenstone compositions within the Tibbit Hill formation. The Quebec Tibbit Hill lies to the west of the Brome Thrust and is compositionally similar to the Mansfield Complex further to the east. The Mansfield Complex composition also resembles that of the Jerico greenstones which lie well to the south and east of the Brome Thrust. The Vermont Tibbit Hill lies to the east of the Brome Thrust and is considerably more enriched in Zr and TiO_2 than the Quebec Tibbit Hill, Mansfield Complex, and Jerico greenstones. This differing is probably due to faulting associated with the Fletcher anticline near Wintergreen Mountain. Despite this post-rifting explanation it is still yet to be worked out if the variation in the primary greenstone compositions reflect volcanic variations in time or space.

PARTICLE SIZE VARIATIONS AND METALS IN FLOOD-DEPOSITED MINE TAILINGS ALONG SODA BUTTE CREEK, YELLOWSTONE NATIONAL PARK

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The McLaren mine tailings impoundment is situated on upper Soda Butte Creek above the Northeast Entrance of Yellowstone National Park. In June 1950, the impoundment failed, releasing a large volume of tailings in a brief flood of high peak discharge. Tailings were deposited as overbank sediments for at least 30 kilometers along the Soda Butte Creek floodplain. The purpose of the study was to define the stratigraphy of the deposits and variations in particle size with depth, examine changes in particle size of tailings deposits with distance of transport, and examine the relation of texture to metals concentrations. Tailings deposits in five study areas along the floodplain were mapped in detail and 107 samples were analyzed for metal concentrations and particle size distribution. Sediments finer than 4ϕ (silt and clay) were analyzed using laser diffraction instrumental methods. Sieve analysis was used on sediments coarser than 4ϕ. Grain size variations within sample sites and between the five sites were examined, along with correlations to metal concentrations.

Textures of the tailings deposits range from silty sand to sandy silt, with a few silt-size samples (Folk classification). There is no significant change in mean particle size downstream. There is a greater range in clay content at downstream sites, however, and the standard deviation of clay content for each of the five study areas increases downstream. Regression analysis shows no significant overall change in sorting downstream, but the range of sorting values also increases downstream. This may result from the greater range of depositional sites and flow velocities on the broad floodplains of the lower valley. Stratigraphic sections show a variety of vertical trends in particle size, but upward-fining trends are most common.

Linear regressions indicate that a weak positive correlation exists between the clay fraction and As ($r = 0.28$), Cu ($r = 0.35$), Fe ($r = 0.33$), and Pb ($r = 0.27$) concentrations. Correlations between the five metals and the coarser fractions are very low. This suggests that the metals are enriched in the clay fraction, but that the coarser grain sizes also contain significant metals, probably in primary sulfide ore minerals and in grain coatings. The decrease in metal concentration downstream shows dilution by uncontaminated sediment entrained along the flood path, but sediment added below the dam break and impoundment outlet channel apparently had little effect on the overall particle size distribution. Particle size characteristics of the tailings deposits are consistent with a flood that deposited medium sand and finer material during a brief overbank surge of high sediment concentration, with little sorting or fining downstream.

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THE EFFECTS OF ICE LOADING ON NEAR SURFACE SEDIMENTARY SEISMIC VELOCITIES, WITH IMPLICATIONS FOR ICE VOLUME INTERPRETATION

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Wide-angle seismic reflection data from sonobuoys deployed from the R/V *Nathaniel B. Palmer* cruise 94-7 were used to explore the effects of glacial activity on Pleio-Pleistocene sediments in the Ross Sea of Antarctica. Previous workers propose that deposits subjected to the advance of an ice sheet will experience overcompaction and associated changes in their physical properties. New glacial models suggest that it is possible for an ice sheet to advance and retreat without generating a change in the physical properties of the sediment. This occurs because ice sheets which advance on a layer of water and cannibalized sediments may not overcompact the sediments because the pore pressure of the water will prevent compaction.

We examined the velocity character of sediments to determine whether or not loading by ice sheets causes changes in physical properties such as velocity. Coincident sonobuoy seismic data and single channel seismic data from the Ross Sea were used to examine the relationship between seismic velocity and glacial activity. Depositional conditions of Pleio-Pleistocene sediments were interpreted from single channel profiles. Buoys were reduced using the software JDseis (copyright Columbia University) and velocity structures were determined for the upper 120 m of sediment. Considering only the near-surface sediments we determined seismic velocities of glacially overrun units. Velocities of sediments which were not overrun by ice were found in two locations to be 1.7 and 1.8 km/s. Glacially overrun sediments in one location showed a velocity of 1.8 km/s and in two others velocities of 1.9 km/s. These velocities are similar to those of non-overrun sediments. Other glacially overrun sediments had velocities of 2.2 and 2.3 km/s, distinctly greater than non-overrun sediments. This indicates that glacial overrunning can, but does not always, result in overcompaction of sediments. Low velocities in three subglacial deposits suggest that ice can advance over areas and leave a relatively uncompacted, normal velocity, deposit which would be difficult to recognize without seismic stratigraphic data.

GARNET ZONE P-T-DEFORMATION HISTORY IN THE CONTACT AUREOLE OF THE VICTORY PLUTON: IMPLICATIONS FOR THE AGE OF THE MONROE FAULT

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The Monroe Fault in eastern Vermont separates the New Hampshire and Vermont stratigraphic sequences, and is believed to be an Acadian thrust fault. In northeastern Vermont, the Devonian Victory pluton and its contact aureole appear to cut the fault; however, the fault-pluton contact is not exposed. Two regionally occurring foliations, S_1 and S_2, change little in orientation across the fault or near the pluton. S_1 strikes NE with a nearly vertical SE dip. S_2 strikes N-NE and dips moderately E-SE. A variably developed intersection lineation L_{2X1} is defined by crenulation of aligned S_1 micas. Vergence of the fault could not be determined from shear sense indications on porphyroblasts.

Timing of regional deformations D_1 and D_2 is demonstrated by the relationship between porphyroblast growth due to plutonic heating, and development of S_1 and S_2, petrofabrics. Timing of deformation and metamorphism varies with distance from the fault. Further than 4.5 km from the fault, post-deformational biotite and garnet cut across both S_1 and S_2,. Garnet growth appears pre- to syn-deformational within 1-2 km of the fault. Within 500 m of the fault, a single intense foliation (S_2,?), post-dates biotite and garnet growth and garnets contain S-shaped mineral inclusion trails. A retrograde metamorphic event postdates all deformation is noted by replacement of post-tectonic garnet and biotite by fibrous chlorite, and growth of muscovite laths across all foliations.

Geothermobarometry shows maximum P-T conditions in the garnet zone west of the fault were 4.5 kb, 460° C. A Gibbs method P-T path for a Vermont sequence sample near the fault suggests that garnet grew during a 1kb increase in pressure followed by a 50° C increase in temperature. This P-T path and microstructures near the fault are consistent with syn-tectonic metamorphism.

RECENT DEBRIS-FLOW AND FLASH-FLOOD HISTORY OF NORTHEASTERN YELLOWSTONE NATIONAL PARK

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The glacial trough valleys of northeastern Yellowstone National Park (YNP) are characterized by active Holocene sedimentation on tributary alluvial fans, in part due to forest fire devegetation during warmer periods (Meyer et al., 1995). Most steep, low-order basins of northeastern YNP have weathering-limited slopes of friable andesitic bedrock that lack substantial colluvium. Thus, most debris flows are generated through progressive entrainment of sediment during surface runoff and channel incision during brief heavy rainfalls, rather than from regolith failures following saturation. Flash-flood deposits result in basins where discharge dominates over available sediment, but have similar meteorological implications; both events have similar climatic implications. Lichenometric and tree-ring dating methods were employed to investigate changes in the frequency of these major hydrologic events in the absence of fire over the last ~250 years on the fans of Soda Butte Creek. Averages of the five largest lichens on known-age and tree-ring dated deposits were used to establish a growth curve for Genus Rhizocarpon Section Rhizocarpon lichens. Growth rate between 30 and 200 years before present is nearly linear (age in years = 0.172[diameter in mm] + 4.177; r2 = 0.987; n = 12).

Dating of 156 debris-flow and flash-flood deposits shows an apparent increase in activity from 1750 to 1930, but this trend is probably due to poor preservation of older deposits. Relative peaks of activity at ~1810-1818, ~1858-1866, ~1910-1914, ~1926-1930, ~1934-1938, and ~1942-1946, and a general decrease in activity from ~1940 to 1974 are more likely to be real. Comparison with high-resolution dendroclimatic reconstructions suggests that times of increased debris flow activity correlate with periods of regional drought. Warm summers in this area are often associated with intense convective storm precipitation; in 1988, a single, brief thunderstorm during the driest summer on record produced major debris flows and flash floods in the middle Soda Butte Creek. Debris flows are less common during some periods of unusually cool, wet spring and winter seasons (e.g., 1760-1775 and 1872-1890). The climatic transition from Little Ice Age to present has included an overall warming and drying trend over the

last 100 years in Yellowstone (Balling et al., 1992). If regional or global warming continues, debris flow activity may increase from greater convective-storm intensity as well as from heightened forest fire magnitude.

PETROGRAPHY AND GEOCHEMISTRY OF GRANITIC ROCKS FROM THE BICKFORD QUARRY, MARSHFIELD, VERMONT

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Biotite-rich subporphyritic granite/granodiorite of the Knox Mountain Pluton is exposed in the Bickford Quarry located approximately 5.6 km south of Marshfield, Vermont, along Route 2. Five granite, six aplite and three pegmatite samples were collected and analyzed using petrographic microscope, ion coupled plasma (ICP) and x-ray fluorescence (XRF) techniques. Modal analyses of one granite sample showed 40% quartz, 37% oligoclase, 10% microcline and 10% biotite. Accessory minerals included muscovite, chlorite, apatite, and zircon. Two types of aplites were distinguished based on color and accessory minerals. The gray aplite is dominated by biotite; the white aplite is dominated by almandine garnet and tourmaline. The aplites occur as dikes 4 to 10 cm thick and as pods up to 20 cm in diameter. Modal analysis of a white aplite showed 40% quartz, 30% oligoclase and 27% microcline. Two types of pegmatites were also distinguished as gray and white, similar to their associated aplites. The pegmatites are simple, with little or no zonation. Common accessory minerals of the white pegmatite are garnet and tourmaline; common accessory minerals of the gray pegmatite are biotite, apatite, muscovite, and pyrite. The pegmatites occur as dikes 5 to 20 cm thick, with crystals in the center portion up to 4 cm in length. Modal analysis of a pegmatite showed 28% quartz, 4% oligoclase and 63% microcline. Major element geochemistry showed an enrichment in TiO_2, Fe_2O_3, MgO and CaO in the granites relative to the aplites and pegmatites. Al_2O_3 was most abundant in the granites and decreased in concentration from aplites to pegmatites. K_2O was most abundant in the pegmatites and decreased from aplites to pegmatites. Trace element concentrations varied significantly between granites, aplites and pegmatites.

BEDROCK GEOLOGIC MAPPING IN THE RICHMOND 7.5' QUADRANGLE

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As part of a joint project between the USGS and the Vermont Geologic Survey the bedrock geology of Vermont is being remapped. In order to link previous mapping done in northern Vermont to work done in central and southern Vermont the bedrock geology of the Richmond 7.5' Quadrangle needed to be mapped. Faults found in northern Vermont are being traced through the quadrangle, and stratigraphic changes within the Camels Hump Group are being investigated. In the 1996 field season much of the map was completed and will be finished during the summer 1997. The geology in this area is more complex than what has been interpreted by previous investigations. The rocks in the Richmond area are dominantly schist, phyllites and greenstones of the Pinnacle and Underhill Formations (late Proterozoic to early Cambrian age). The western edge of the Richmond 7.5' Quadrangle is bordered by the Brome Fault Complex (BFC). The eastern edge of the Richmond 7.5' Quadrangle was mapped by Thompson and Thompson

and is dominated by structures related to the Honey Hollow Fault (HHF). The structural geology between these two faults is complex and the stratigraphy is no walk in the park either. The area has experienced three phases of Taconic deformation each having it's own associated folds, faults and cleavages. The second phase of deformation caused a cleavage fan to form as the major structure between the BFC and HHF.

ZEBRA MUSSELS AS BIOMONITORS OF METAL POLLUTION IN LAKE CHAMPLAIN

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Zebra mussels (Dreissena polymorpha) are filter-feeding bivalve molluscs recently introduced into Lake Champlain. Like all aquatic filter feeders, zebra mussels concentrate in their bodies not only nutrients, but also contaminants such as hydrophobic organics and metals. For each contaminant, there exists a quantitative relationship between concentration in the water and concentration in soft tissues of individual mussels. Along with other important traits, this characteristic makes zebra mussels very useful as a biomonitor species.

Specimens were collected along the shoreline of the lake at 30 sites in New York and Vermont between September 17 and October 29, 1996. Soft tissues of specimens between 1.7 and 2.3 cm in length were analyzed for 18 metals (Na, Mg, Al, Si, P, K, Ca, V, Cr, Mn, Fe, Ni, Cu, Zn, Cd, Ag, Sr, and Ba) by argon plasma spectrometry. Where possible, the data is compared to metals in the sediment and in the soft tissue of the native unionoid mussels. Also, the zebra mussel soft tissue data is compared to metals in the shells of the same specimens.

The zebra mussel soft tissue data indicates that Lake Champlain is relatively clean in terms of bioavailable metals, although some metals display greater variability than others. Because continual biomonitoring of metals and other contaminants will help provide an assessment of the lake's ecological health, it is hoped that similar studies will continue to monitor the lake in the future.

HOLOCENE WETLAND EVOLUTION IN RESPONSE TO LONG-TERM LAKE-LEVEL RISE IN LAKE CHAMPLAIN

Nadeau, Beth M., Department of Geology, University of Vermont, Burlington, Vermont 05405

This study examines the development and up-slope migration of wetlands in Lake Champlain in order to determine the rate and magnitude of Holocene lake-level rise. During the summer of 1996, sediment cores were collected using several techniques in transects across the Alburg Dunes Wetland, in Alburg, VT. The base of the wetland sediments in selected cores was radiocarbon dated in order to obtain time constraints on wetland development and up-slope migration. A lake-level curve for the northern end of the lake has been produced using radiocarbon dating of wetland basal peat as a proxy for lake-level rise. The curve indicates that lake-level has risen approximately 8 meters in the north lake during the last 9,500 years (fig. 1).

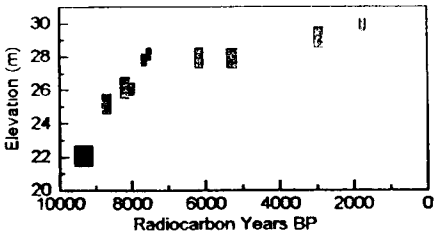

Figure 1. This plot shows a positive relationship between age and elevation of the basal peat from Alburg Dunes Wetland. The rate of lake-level rise after the close of the Champlain Sea Stage (10,200 y BP) was rapid, then decreased by 7,500 years ago in northern Lake Champlain. The grey boxes represent bulk radiocarbon dates including calculated error.

Isostatic rebound generally progresses rapidly after ice retreat, then slows down through time. The lake-level curve produced for the northern end of Lake Champlain follows this trend. If isostatic rebound is responsible for lake-level rise, then the southern end of the lake must have undergone a greater magnitude of submergence due to rebound of the Richilieu Sill and differential tilting of the Champlain Basin. To test this hypothesis, a lake-level curve will be developed for the southern part of the lake using the same techniques employed to produce the northern lake curve. By comparing the two curves using tilted water planes, Holocene differential rebound between the north and south lake will be determined.

POCKMARK FIELDS IN CUMBERLAND BAY, LAKE CHAMPLAIN

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Side scan sonar profiles (100 and 500 kHz) imaging the bottom of Lake Champlain were obtained during the 1996 summer Lake Champlain Shipwreck Survey. Profiles off the Cumberland Head, near Plattsburg, NY, revealed two fields of pockmarks. One field is 0.75 km2 in areal distribution and the second field is 1.75 km^2. The pockmarks within the fields are on average 20 m in diameter and a few meters deep. The pockmarks are arranged along a linear trend that run southeast to northwest which matches the region tectonic fabric of the bedrock geology. Three cores (7.62 cm in diameter and ranging in length from 167 cm to 204 cm) were taken in the smaller pockmark field to investigate the formation of these pockmarks. The cores were positioned to obtain samples directly inside a pockmark (core 3), close to the edge of a pockmark (core 1) and within the intervening pockmark-free field (core 2). A comparison core, core B, (209 cm in length) was taken in Thompson's Point Bay, an area without pockmarks, to be used as background.

Physical properties, magnetic susceptibility, conductivity, pore water chemistry and grain size of the cores were measured. The core taken inside the pockmark show distinctly different results that those taken outside of it. Cores 1 and 2 exhibit different ranges than core 3 for all of the measurements. The comparison core, core B, is distinctly different from all three of the cores taken in the Cumberland Head area, as is expected. Core 3 has higher porosity and lower density than cores 1 and 2. Cores 1 and 2 have patterns of distribution that are very similar to one another while core three has a different

distribution of depth dependent values. Magnetic susceptibility for core 3 is much lower, almost half that of the values for cores 1 and 2. Conductivity and anisotropy are different in all three cores. Core 1 is consistently anisotropic, it is more conductive in the transverse direction. Core 2 is similar to core 1 in that it is anisotropic in the transverse direction but not as strongly so. Core 3 displays a section of anisotropy that is comparable in strength to core 1. The pore water profiles are all quite similar between cores. The sodium and potassium depth profiles behave in the expected advection-diffusion manner. Silicon exhibits a random scatter interpreted as caused by the saturation point being reached. The depth profiles for magnesium and calcium are unusual. They show a systematic removal of the calcium and magnesium ions from the water. Linear distribution aligned with basement faults, core physical properties and pore water chemistry suggest that the pockmarks were created by ground water migrating upward and through the lake sediment.

ANALYSIS OF STRUCTURES AND METAMORPHISM ACROSS THE MONROE LINE NORTHEAST OF THE VICTORY PLUTON, GRANBY, VERMONT

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The Monroe line of northeastern Vermont separates the Ordovician (?) -Devonian metasedimentary and metaigneous rocks of the New Hampshire sequence to the east from the Silurian-Devonian metasediments of the Vermont sequence to the west. In the past, this boundary has been interpreted as either an unconformity or a thrust fault. Contact metamorphism of both sequences occurred during the Devonian due to the intrusion of the New Hampshire series plutons throughout northeastern Vermont and New Hampshire.

The Monroe line is well-exposed within Buzzell Gap, northeast of the Victory Pluton in Granby, Vermont. Mesoscopic evidence for faulting includes an increase in the concentration of quartz veins and a general reduction in grain size near the fault. Two main foliations of the Vermont sequence rocks are visible in thin section. S_1, defined by fine-grained muscovite and quartz, appears as inclusions within garnet and biotite porphyroblasts. S_2, along which biotite porphyroblasts and garnet pressure shadows are aligned, is a crenulation cleavage of the tight-to-isoclinally folded S_1 foliation. S_2 becomes increasingly well-developed towards the Monroe line, where S_1 is preserved only as rootless isoclines. At the fault, S_2 is the dominant foliation which wraps around garnet porphyroblasts indicating synmetamorphic faulting.

To the east, the amphibolites also exhibit a stronger foliation closer to the fault. The amphiboles are zoned, with actinolitic cores and hornblende rims.

Both field and microstructural data suggest that the Monroe line is a thrust fault which caused the juxtaposition of older New Hampshire sequence rocks with younger Vermont sequence rocks. Further evidence shows that this thrusting occurred during the Acadian Orogeny concomitantly with the contact metamorphism of the New Hampshire series plutons.

SEASONAL TURBIDITY IN SOUTH LAKE CHAMPLAIN

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In Southern Lake Champlain, high turbidity levels have depressed economic values of lake shore homes and property. Blame for this high turbidity and associated aesthetic problems, has been ascribed to the International Paper Company (IPC). Two lawsuits against IPC have resulted.

In two articles, *Distribution of Pollutants from a New Plant in Southern Lake Champlain, Vermont and New York*, and *Paper Plant Effluent revisited-southern Lake Champlain, Vermont and New York*, David Folger and R.S. Haupt made some hypotheses about turbidity in Southern Lake Champlain which I have tested.

David Folger, R.S. Haupt, and others concluded that the summer wind and waves stir up the lake bottom causing suspended solids to make the water turbid. In the winter months, they hypothesized that the ice prevented the wind and waves from stirring up the lake floor. They predicted that the turbidity levels would drop because the suspended solids would settle to the lake floor under the ice. This being the case, IPC effluent would be the dominant cause of winter turbidity levels. Further, the suspended solids in the effluent may account for much of the total suspended solids in the water during warm months of the year. However, most of the suspended solids from the effluent are hidden because of the naturally high turbidity levels in the South Lake this time of year. My observation proves otherwise.

Water samples from the Crown Point Reservation dock taken, before, during, and after the ice season, suggest that the results of David Folger, R.S. Haupt, and others' are incorrect. Samples have also been taken South of Crown Point, down through, and past, the paper plant owned by IPC. The turbidity levels turned out to be relatively high near Crown Point, high below the paper plant, and lower near the plant. This has led me to believe that the paper plant does not have as much an affect as Folger and Haupt had hypothesized. Under further investigation, samples were filtered and examined using a Scanning Electron Microscope (SEM). The particulates were mainly made up of aluminum potassium silicates, leading me to believe that of these samples consisted mainly of clay minerals and feldspar grains.

The turbidity has shown to be higher during the winter months in Southern Lake Champlain. The SEM work has demonstrated that the IPC is not responsible for the majority of the lakes high turbidity.

A Relative Chronology of River Terraces in the Mad River Valley

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Previous study of the de-glacial history of the Winooski Valley (Larsen, 1972) has identified a series of glacially-dammed, high level lakes. As the laurentide ice sheet retreated through the valleys, the lakes served as reservoirs for the ice sheet's sediment and water volumes, as well as for input from the subaerial valley. The land that would have surrounded these lakes would be unstable owing to the combination of a considerably steeper terrain and less protection from vegetative cover. With ice retreat, the lakes dropped to newly exposed spillways followed by the rivers which necessarily cut through the valley-fill grading to the new base-level. The resulting river terraces in

the Mad River Valley record these events and have been used to contstuct a relative chronology of river terraces. Additionally, the relative incision resulting from each lake drop can be used to characterize the response of rivers to the spatial magnitudes of base level drop, and to an emptying valley.

A STUDY OF THE METAMORPHISM AND DEFORMATION WITHIN THE SILLIMANITE ZONE EAST OF THE VICTORY PLUTON, MILES POND, VERMONT

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The Victory Pluton of northeastern Vermont is a member of a series of Devonian granitic intrusions. The pluton appears to cross cut the Monroe Line, which divides the distinct Vermont and New Hampshire sequences of metasedimentary rock. The aureole of contact metamorphosed country rock around the Victory Pluton represents P-T conditions up to sillimanite + K-feldspar grade. Research on the west side of the pluton indicates that metamorphism may have occurred during an increase in pressure. This study focuses on the contact aureole on the east side of the Monroe Line, examining the metamorphic and structural evolution of the highest grade metamorphic rocks.

The peak metamorphic assemblage on the east side of the aureole includes biotite+quartz+garnet+sillimanite+k-feldspar with melt, showing that metamorphic temperatures reached approximately 775-825°C . Pressures of 6-6.6 kbars recorded on the east side are significantly greater than on the west side, indicating a deeper origin. Retrograde textures such as muscovite replacing sillimanite and biotite and chlorite replacing garnet record cooling after peak temperatures. Biotite and sillimanite define a steeply dipping ENE to ESE striking dominant foliation. Aligned sillimanite grains and sillimanite pressure shadows wrapping around garnets define a down-dip stretching lineation. Biotite and sillimanite are folded into hand sample scale, steeply plunging kink folds. Quartz veins are boudinaged and some granitoid dikes are weakly foliated, while others are folded. The asymmetry of the pressure shadows, internal foliation of garnets oriented at angles to the external foliation, and the foliation and folding of the dikes suggest that deformation occurred at high temperatures, either by the intrusion of the pluton or by movement along the Monroe Line.

SEMINARS, MEETINGS, and FIELD TRIPS

April 26: **Vermont Geological Society Spring Meeting for the presentation of Student Papers**, University of Vermont, Burlington, Vermont (see front cover for details).

April 26: **Vermont Wetlands Association 7th Annual Meeting**, *"Wetland Protection Strategies in Vermont."* 9:00 A.M., Kirk Alumni Center, Middlebury College, Middlebury, Vermont. Contact: Peter Williams, VWA PPOB 433, Montpelier, VT 05602; (802)482-2028.

April 29, 30, & May 1: **9th Annual EnviroExpo-New England** *World Trade Conference Center*, 164 Northern Ave. Boston, MA. Contact: EnvirExpo, 33 Trapelo Rd., Belmont, MA 02178; (617) 489-2302.

July 22: **Soil & Water Conservation Society 52nd Annual Conference** *"Human Dimensions and Managing Ecosystems on a Watershed Basis."* Toronto, Ontorio. Contact; SWCS @ (800) THE-SOIL, ext 18, e-mail; jenp@swcs.org.

CAREER OPPORTUNITIES

- The Department of Geography at the University of Southern California has an open position for **a Postdoctoral Fellow**. We are seeking a scientist to investigate levee bank erosion induced by wind waves, boat wakes, and fluvial currents in the delta region of the Sacramento and San Joaquin Rivers. The successful applicant will have Ph.D. in hand (hence postdoc!) and will assist in the development of a field oriented research agenda on this general topic in consultation with project managers. Candidates with a doctoral degree in Engineering, Geography, Geology, Oceanography, or a closely related discipline are encourgaed to apply. The position is for one year, beginning as soon as possible, with the possibility of renewal for up to two years. Apply to:

  Douglas J. Sherman
  Dept. of Geography
  University of Southern California
  Los Angeles, CA. 90089-0255

  Send application letter, statement of relevant experience, CV, and the names and addresses (including e-mail) of three references. Review of applications will begin May 7, 1997, and continue until a suitable candidate is found.

- **Assistant Extension Professor.** Nine-month, annual reappointment Assistant Extension Professor position in Watershed Management/Water Quality beginning September 1, 1997. A Ph.D. in natural resources management or related discipline is required. Applicant should have experience in extension and research that assesses effects of land management activities on water quality and quantity. Experience in working with nonindustrial private landowners and expertise in quantitative aspects of watershed management decision making (including GIS) is preferred, as is evidence of extramural grant success and university-level teaching experience. Salary is commensurate with experience and qualifications. Reappointment is dependent on availability of funds and on performance. Applications should be received by MAy 15, 1997 to receive priority consideration. The position will remain open until filled. Send a letter of application stating personal extension, teaching, and research goals, official transcripts, curriculum vitae, and the names and addresses of three references to Dr. Michael Ross, Chair, Search Committee, Department of Forestry and Wildlife Management, University of Massachusetts, Amherst, MA 01003-4210. Phone (413) 545-2940.

CAREER OPPORTUNITIES *(Continued)*

- **Hydrologist/Geomorphologist** for river restoration firm. Min 6 yrs exp in fluvial processes, sediment transport, open channel hydraulics, and project management. Construction supervision experience a plus. Some travel. Salary dependent upon experience. Contact: Inter-Fluve, 25 N. Willson, Bozeman, MT 59715 (www.interfluve.com)
- **Faculty Research Associate**, Dept. of Geosciences, Oregon State University, Corvallis, OR. The Department of Geosciences at Oregon State University seeks to fill a faculty research associate position. This person will conduct a study of the geomorphic effects of a hydroelectric dam complex on sediment transport and channel morphology in the Deschutes River, central Oregon, in the context of a dam relicensing application. Develop models of water and sediment transport, paleohydraulic analyses, and sediment budgets linked to streamflow, channel cross-section, historic, and geologic information. Qualifications include Ph.D. or equivalent in geomorphology, geology, hydrology, or related field; experience with analysis of historical streamflow records, paleohydraulic reconstruction, and sediment transport models; field experience with stratigraphic analysis, channel mapping, aerial photograph interpretation, and channel cross-section measurement; knowledge of UNIX and DOS system hardware and software. Proficiency in GIS and digital terrain modeling desirable. Position is full-time, fixed-term, with reappointment at discretion of Department Chair and Dean. Salary commensurate with experience. Send letter of application, resume, transcripts of university work, and three letters of reference to Julia Jones, FRA Search Committee, Department of Geosciences, 104 Wilkinson Hall, Oregon State University, Corvallis, OR 97331-5506, Telephone: (541) 737-1224, FAX: (541)737-1200, e-mail: jonesj@ccmail.orst.edu. Review of applications will begin May 1, 1997 and continue until position is filled. Oregon State University is an Affirmative Action/Equal Employment Opportunity employer, and has a policy of being responsive to the needs of dual-career couples. For more inforamtion on this position, contact Gordon Grant (grant@fsl.orst.edu; fax: 541-750-7329; phone: 541-750-7328)
- **National Program Leader for Soil Management**, USDA, ARS, National Program Staff, Natural Resources and Sustainable Agricultural Systems, Beltsville, MD seeking soil scientist. Salary Commensurate with experience ($75,935 to $98,714). Permanent, full-time position requires U.S. Citizenship. National Program Leader is responsible for leading and coordinating the Agency's agricultural research programs relating to agricultural soil management research. A bachelor's degree in soil science or closely related discipline is required. A Ph.D. is desirable. Contact: Jerry Hatfield at (301) 344-4638 or (301) 344-2288 and request vacancy announcement #ARS-A7B-051. Applications must be marked B709 and postmarked by 5/12/97.

Water News *(Continued from page 7)*

supplies." The Plasma Sparker successfully repels zebra mussels by creating a plasma cloud of ions through high voltage current induction. The high temperature plasma cloud effectively creates a shock-type wave that can reduce organics to simple molecules. It also causes physical damage to aquatic organisms at the cellular level; the mussels get annoyed to the point where they search elsewhere for suitable feeding stations. Fay indicated that by switching from chlorine treatment to plasma sparking, he could potentially save the district $15,000 a year. The pilot programs were funded by grants from Green Mountain Power Corp. and the Electric Power Research Institute.

Long-time VGS member and former Vermont ANR DEC Water Supply geologist Jim Ashley is looking for volunteers to assist in maintaining the statewide groundwater monitoring well elevation gaging program that is no longer USGS funded. For information on how you can help to keep this critical data base functioning, give Jim a call at (802) 684-3491.

Make Your Opinion Count! To call or Write Your Voice in Government:

U.S. Senate:

The Honorable Patrick J. Leahy
433 Russel
Senate Office Building
Washington, D.C. 20510-4502

The Honorable James M. Jeffords
513 Hart
Senate Office Building
Washington, D.C. 20510-4503

U.S. Congress:

The Honorable Bernard Sanders
213 Cannon
House Office Building
Washington, D.C. 20515-4501

State of Vermont:

Governor Howard Dean, M.D.
Office of the Governor
Montpelier, VT. 05609
(800)649-6825

State Senate or House:
(800) 322-5616; Call and leave a message for your local representative.

"Abstracts From a Dictionary of Useful Research Phrases".

Forwarded from Jeff Lee, Dept. of Economics & Geography, Texas Tech University Lubbock, Texas 79409-1014 USA Phone: 1-806-742-3838 Fax: 1-806-742-1137 e-mail: adgjl@pop.ttu.edu or j.lee@ttu.edu

1 *"It has long been known that..."* I didn't look up the original reference.
2 *"A definite trend is evident..."* These data are practically meaningless.
3 *"Of great theoretical and practical importance..."* Interesting to me.
4 *"While it has not been possible to provide definite answers to these questions..."* An unsuccessful experiment, but I still hope to get it published.
5 *"Typical results are shown..."* The best results are shown.
6 *"These results will be shown in a subsequent report..."* I might get around to this sometime if I am pushed.
7 *"The most reliable results are those obtained by Jones..."* He was my graduate assistant.
8 *"It is believed that..."* I think.
9 *"It is generally believed that..."* A couple of other guys think so too.
10 *"It is clear that additional work will be required before a complete understanding of the phenomenon occurs..."* I don't understand it.
11 *"Correct within an order of magnitude..."* Wrong.
12 *"It is hoped that this study will stimulate further investigation in this field..."* This is a lousy paper, but so are all others on this miserable topic.
13 *"Thanks are due to Joe Blotz for assistance with the experiment and to George Frick for valuable discussions..."* Blotz did all the work and Frick explained to me what it meant.
14 *"A careful analysis of the obtainable data..."* Three pages of original notes were obliterated when I knocked over a beer.
15 *"A statistically oriented projection of the significance of the findings..."* Wild guess.
16 *"A highly significant area for exploratory study..."* A totally useless topic selected by my committee.
17 *"Three of the samples were chosen for detailed study..."* The results of the others didn't make any sense.

- **Vermont Geological Survey:** http://www.state.vt.us/anr/
- **Geological Society of America:** http://www.geosociety.org
- **Soil & Water Conservation Society:** http://www.swcs.org
- **Water Environment Federation:** http://www.wef.org
- **National Ground Water Association:** http://www.h2o-ngwa.org
- **Vermont Agency of Natural Resources:** http://www.state.vt.us/anr/waste.htm
- **New York Dept. of Environmental Conservation:** http://www.dec.state.ny.us.
- **Vermiculite :** http://www.mcn.net/' vermiculite/welcome.htn

Vermont Geological Society Student Research Grants

are designed to aid our future geologists investigate Vermont's geo-history.

Help the VGS to promote a deeper insight into Vermont Geology.

Students receiving assistance through the program will present their research results at the VGS Spring Meetings. Your generosity will help cover a lot of terrane!

To contribute to the **VGS Student Research Grant Program**, clip or copy this form and send it, along with your check or money order made payable to VGS, to:

Allen Carpenter, Treasurer, Vermont Geological Society
Department of Geology, University of Vermont
Burlington, Vermont 05405-0122

- *I'VE ENCLOSED MY TAX-DEDUCTIBLE CONTRIBUTION TO BE DEDICATED TO THE **VGS STUDENT RESEARCH GRANT PROGRAM.***

TOTAL GIFT: **$**_____

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