THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

WINTER 1998 VOLUME 25 NUMBER 1

The Vermont Geological Society's Winter Meeting

Johnson State College,
Johnson, Vermont

Saturday March 28th
Coffee 9:30, Meeting Starts at 10

See inside for details.

Directions: The Winter meeting will take place in the Bentley Building, Rm 207. Johnson State College is located on the hill immediately north of the Village of Johnson. Approaching from the east on Rt. 15 take the first right turn after the Woolen Mill, from the west, the first left after the Grand Union. A tiny green sign points the way to the College. Continue up the hill about 1/2 mile. A sign indicates a right turn into the college. Follow the entrance road to its end and park in the big parking lot at the end of the road. The Bentley building is adjacent to the parking lot. The entrance is on the 2nd floor, adjacent to the meeting room.

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

PRESIDENT'S LETTER

Dear Members,

New Years greetings from my home in the beautiful Sterling Mountains in what may yet turn out to be the year of "exceptional weather patterns." In our region, this year certainly started out dramatically with what many refer to as the "Storm of the Century." Very few of us will easily forget the images of thick, ice-coated tree branches, bent and broken trees, and toppled power lines and power poles. What made this event even more exceptional, especially to those of us who lived through it, was the scale and geographic area affected by the storm. But even as New Englanders slowly recover from the effects of the ice storm our attention must surely turn to folks out west who are at the mercy of one of the strongest El Nino events of recent times. Already this unfolding drama has left us with powerful images of widespread floods, landslides, and beach erosion with more yet to come. Who knows how these events will ultimately play themselves out but for now they should surely give us cause to ponder.

We have two important events in the VGS calendar coming soon. The Winter Meeting will be held here at Johnson State College on March 28. This year's focus for that meeting is environmental and applied geology and I am really looking forward to hosting this event. Coming up the Spring Meeting will be held at Middlebury College on April 25. At this event students from around the state will be giving presentations of their VGS sponsored research activities. I hope that I will see many of you at these events.

Best Regards
Tania Bacchus, Johnson State College
bacchust@badger.jsc.vsc.edu

WINTER MEETING PROGRAM

Johnson State College
Johnson, Vermont
March 28, 1998

9:30 Coffee

10:00 Don Maynard, Seth Frisbie, and Bilqis Hoque: *Overview of Arsenic in Bangladesh Groundwater*

10:20 Joseph Hayes: *An Innovative Groundwater Remediation Design in a Complex Hydrogeologic Setting*

10:40 Parminder Padgett and Nancy Hayden: *The Effect of Clay Contenet on Residual Tetrachloroethene (PCE) Saturation and Mobilization*

11:00 Chad Farrell, Nancy Hayden, John Diebold: *Enhanced Dissolution of Residual DNAPL Contamination Using Alcohol Flushing*

11:20 Poster Viewing
Stephen Van Horn, A. Jones, W. Stansfield, and Z. Markey: *Origin of en Echelon Segmented Mesozoic Dikes in North-Central Vermont: Evidence from the Outcrop Geometry of Small Lamprophyric Dikes*

Stephen Wright, S. David Shaw, Kyle Nichols:
Seismic Hazards map of the Burlington Vermont Quadrangle, Western Vermont

12:00 Lunch:

VGS Executive Committee Meeting: *All members are invited to attend!*

WINTER MEETING ABSTRACTS

ENHANCED DISSOLUTION OF RESIDUAL DNAPL CONTAMINATION USING ALCOHOL FLUSHING

Chad Farrell*, Nancy J. Hayden and John Diebold; Department of Civil and Environmental Engineering, University of Vermont, Burlington, Vermont 05405; * Now at ATC Associates, Inc., Richmond, VT; e-mail: Farrell63@mail.atc-enviro.com; nhayden@emba.uvm.edu

Alcohol flushing is an in-situ remedial technique that has shown promise for the remediation of immobile dense non-aqueous phase (DNAPL) contaminants such as tetrachloroethylene (PCE). Alcohols such as isopropyl alcohol (IPA) are cosolvents which enhance the dissolution of residual DNAPL into the aqueous flushing solution. Alcohols will also cause a reduction on the interfacial tension between the immiscible aqueous and organic phases which may result in mobilization of the trapped DNAPL blobs. In some cases, alcohols will also preferentially partition into the DNAPL, causing it to swell into a more easily recoverable continuous phase. As a result of the possible mobilization of DNAPL outside of an intended remediation capture zone, enhanced dissolution is often considered to be the mechanism of primary importance in the implementation of a remedial scheme based on alcohol flushing.

Solubility, interfacial tension and density studies were initially performed for different DNAPL/alcohol/water systems to characterize the effect of alcohols on DNAPL. Column studies were then conducted using homogeneously packed and two-layered soil systems to investigate the use of alcohol flushing for the removal of residually entrapped PCE from saturated soils. Permeabilities and effluent PCE concentrations were monitored during the course of experimentation to illustrate the degree of PCE removal within the soil columns. Effective permeabilities were shown to increase due to the continuous removal of PCE by dissolution, and total clean-up times were observed to diminish by nearly two orders of magnitude when using an alcohol flush of 40% and 50% IPA by volume. While the overall experimental results illustrated the advantage of using alcohol flushing for the removal of DNAPL from the subsurface, results from the layered soil column experiments consistently indicated preferential clean- up of one layer and, thus, the need for continued research into the use of alcohol flushing for layered geologic environments containing residual DNAPL contamination.

AN INNOVATIVE GROUNDWATER REMEDIATION DESIGN IN A COMPLEX HYDROGEOLOGIC SETTING

Hayes, Joseph J., Senior Supervising Geologist, EMCON, 1 Mill Street, Burlington, Vermont

At industrial sites where chlorinated volatile organic compounds (CVOCs) are present in groundwater, dense nonaqueous-phase liquids (DNAPLs) may form on confining layers in the subsurface. Because of the low solubility of many CVOCs in groundwater, pump and treat remedies may not be effective in removing these compounds. The lack of effectiveness leads to the requirements of "pump and treat forever." To minimize the risk to receptors, the inherent objective of any remediation strategy is source control and containment of the groundwater plume to minimize impacts. This objective is difficult at sites with complex hydrogeology.

Passive in-situ groundwater remediation using Permeable Reactive Barriers (PRBs) is an innovative technology that fits in well with the strategy of containing and remediating CVOC impacted groundwater. At a site in Vermont, PRBs using zero valent iron reactive media, were designed to remediate groundwater impacted with CVOCs. The groundwater remediation system design consisted of four PRBs interconnected with low permeability groundwater cutoff walls. The iron which is contained in the PRBs breaks down the CVOCs through dechlorination to non-chlorinated byproducts and chlorine ions. Unlike groundwater pump and treat, this innovative technology does not transfer contaminants from one media to another, thereby reducing energy usage, water and/or carbon disposal costs.

Soil conditions at the site are fairly typical of the region resulting from the Pleistocene high stand of Lake Champlain, its deltas and alluvial tributaries. The aquifer is heterogeneous, consisting of a variable thick silt and sand zones overlying a clay confining layer at a depth of 8 to 20 feet below ground surface. The underlying clay, which forms an irregular surface across the site, acts as a barrier to downward groundwater flow and influences contaminant migration. The depth to groundwater is approximately 5 feet. Variable hydraulic conductivities exist across the site ranging from 0.10 to 1,200 cm/day.

A remedial design was selected that incorporated physical site features such as groundwater discharge areas and the underlying clay confining layer to direct CVOC impacted groundwater towards the PRBs. The PRBs and cutoff walls were keyed into the underlying clay and

strategically located upgradient of the groundwater discharge areas to intercept the CVOCs prior to discharge to surface water. Cutoff walls were incorporated into the design to maintain capture and assist in channeling the CVOC impacted groundwater to the PRBs.

OVERVIEW OF ARSENIC IN BANGLADESH GROUNDWATER

Maynard, Donald M., Frisbie, Seth H., and Hoque, Bilqis A.
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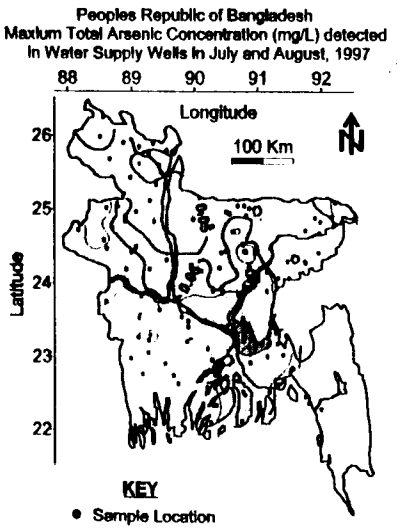
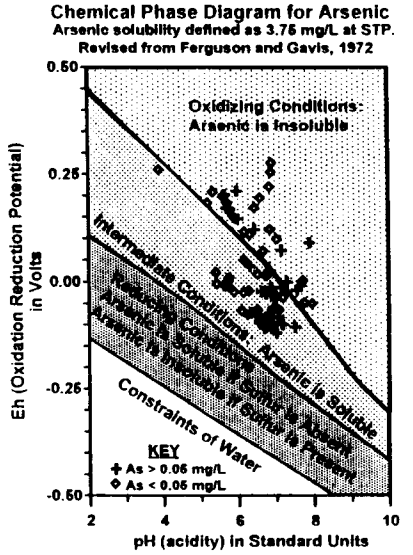
Since the 1970s approximately 2.5 million wells have been installed in Bangladesh as potable water supplies. The replacement of surface water with groundwater as a potable water source has greatly reduced deaths by dysentery, cholera, and other aqueous borne diseases. However, arsenic is present above World Health Organization recommended safe drinking water limits of 0.01 mg/L in many Bangladesh water supply wells. A two month study of Bangladesh groundwater quality was performed in 1997 by The Johnson Company of Montpelier, Vermont; the Environmental Health Program of the International Center for Diarrhoeal Disease Research, Bangladesh; and the National Rural Electrification Cooperative Association, Bangladesh Office. The study was funded by the US Agency of International Development through the Bangladesh Rural Electrification Board.





During the study 570 groundwater samples were collected and analyzed for total arsenic and ferrous iron. Field parameters such as pH, oxidation-reduction potential, and dissolved oxygen were also measured. In addition, 90 samples were analyzed for other inorganics. The conclusions of the study included the following:

- Natural phosphate mineral sediments deposited in a estuarine environment is suggested as the source of dissolved arsenic by general correlations between arsenic, phosphorous, and chloride concentrations.
- The weight of scientific evidence from many tests demonstrates that arsenic treated wooden power poles are not the source of the widespread arsenic contaminated groundwater observed in Bangladesh.
- Chemical interference during analysis for iron indicates the widespread presence of additional toxic heavy metals (other than arsenic) in Bangladesh groundwater.
- Arsenic was detected at concentrations above 0.05 mg/L in more than 30% of drinking water wells tested.

THE EFFECT OF CLAY CONTENT ON RESIDUAL TETRACHLOROETHENE (PCE) SATURATION AND MOBILIZATION

Parminder K. Padgett and Nancy J. Hayden Department of Civil and Environmental Engineering, University of Vermont, Burlington, Vermont 05405

The widespread use of chlorinated cleaning solvents has led to their release to the environment. Many of these cleaning solvents are more dense than water and are, therefore, called dense non-aqueous phase liquids (DNAPLs) when present in the subsurface. Gravitational forces cause DNAPLs to migrate down through the vadose zone and into the saturated zone of an aquifer. As the DNAPL moves through the saturated zone it leaves behind a residual DNAPL saturation, or trail of discontinuous trapped blobs that are held by capillary forces within the pore spaces. The residual DNAPL saturation acts as a long- term continuing source of groundwater contamination that is difficult, if not impossible, to remediate with currently accepted pump and treat technologies.

A promising in-situ remediation technology for residual DNAPL removal is enhanced dissolution using alcohol or surfactant flushing. One concern with these technologies is the potential to mobilize the residual DNAPL in a downward direction. The objective of this research was to investigate the effects of clay fines on the residual saturation of

tetrachloroethene (PCE), a DNAPL, and mobilization of the trapped PCE during flushing with isopropyl alcohol solutions. Column experiments were conducted with soils containing 0% to 20% clay completely mixed within a well-sorted Ottawa sand. Column characterization included pressure-saturation relationships, pore size distribution, residual PCE saturation, and PCE mobilization during alcohol flushing. Higher percentages of clay resulted in a higher residual PCE saturation and the onset of PCE mobilization at lower alcohol concentrations. The increases in residual saturation and mobilization may be explained by differences in PCE blob sizes and shapes in the clay-containing media versus those in a more homogeneous media. Relationships noted between mobilization and residual saturation and permeability may aid in our ability to determine the applicability of alcohol flushing technology to different hydrogeologic environments.

ORIGIN OF *EN ECHELON* SEGMENTED MESOZOIC DIKES IN NORTH-CENTRAL VERMONT: EVIDENCE FROM THE OUTCROP GEOMETRY OF SMALL LAMPROPHYRIC DIKES

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Four Mesozoic lamprophyric dikes (0.25-1.7 m thick) located in Albany, Johnson, and Jericho, VT, have a strikingly similar outcrop geometry. The four dikes were emplaced in complexly deformed and jointed Lower Paleozoic regional metamorphic rocks. The dikes crop out in the Lower Cambrian Pinnacle and Underhill Formations and in the Devonian Northfield Formation. Each dike studied crosscuts the foliation of the country rock suggesting that the orientation of the foliation did not affect the emplacement of the dikes.

All four dikes crop out as two or more discrete *en echelon* segments that are offset with respect to one another along strike. Where exposed the termination of the dike segments pinch out and are not truncated by shear zones or faults. Foliation in the country rock near the offsets is continuous. These observations suggest that the offsetting of the dike segments is not related to any post-emplacement deformation.

Individual dike segments in all four dikes are continuous but contain offsets of the dike contact by as much as 0.5 m perpendicular to strike. In

some cases a small horn of lamporphyre continues a short distance in front of the contact offset along a dike parallel joint. Country rock bridges and xenoliths are present at several of the contact offsets. Xenoliths represent part or all of a country rock bridge that has been removed by continued magma flow in the dike. These features are well developed along the contacts of a 1.6 m thick dike emplaced in the Northfield Formation. The contact offsets represent locations where *en echelon* fractures overlapped during horizontal growth of the dike segments and were joined by dilation of the fracture.

The similar outcrop geometry (offset dike segments, contact offsets along segments, horns, and bridges) of the dikes studied is consistent with dilation of an *en echelon* fracture array. Hydrofracturing of the crust by rising magma in conjunction with a continually changing stress field with depth can result in the development of an *en echelon* fracture array.

SEISMIC HAZARDS MAP OF THE BURLINGTON VERMONT QUADRANGLE, WESTERN VERMONT

Wright, Stephen F., Shaw, S. David, and Nichols, Kyle. Department of Geology, University of Vermont, Burlington VT 05405, swright@zoo.uvm.edu

While earthquakes in Vermont and the rest of New England are much less frequent than those occurring in many parts of the western United States, large earthquakes have occurred and the ground shaking and ensuing damage typically extend over a much larger area than earthquakes in the western United States (Scharnberger, 1997). Burlington and its surrounding communities constitute the largest metropolitan area in Vermont and lies within an area that would experience significant lateral accelerations during an earthquake similar to the estimated 5.8 magnitude earthquake located near Montreal, Quebec area in 1732 (Ebel et al., 1995). We have created a seismic hazard map of the Burlington 7.5-minute Quadrangle using the following data: (1) Vertical thickness of low-velocity surficial materials, (2) Seismic velocities of these materials, and (3) Estimated lateral accelerations from an earthquake of similar magnitude and distance as the 1732 Montreal earthquake (Ebel et al., 1995). We have compiled information on the vertical distribution of surficial materials from (1) water well logs, (2) bridge and road construction borings, (3) borings around building construction projects, (4) borings associated with hazardous waste sites (usually leaking underground storage tanks), and (5) field observations from stream channels, roadside excavations, and gravels pits. These data

have been compiled, using GIS techniques, to create an isopach map of clay-rich surficial materials. The degree of enhanced seismic shaking is derived from these isopach data.

East–West cross-sections reveal N–S-trending, gently east-dipping ridges of sedimentary rocks, resistant to weathering and mantled by till. The intervening N–S-trending areas contain thick sections of surficial material generally consisting of very clay-rich glacial till, overlain by rhythmically bedded silt and clay deposited in Lake Vermont, that is in turn overlain by massively bedded mixed silt and clay deposited in the Champlain Sea. These clay-rich sediments are generally mantled by deltaic or beach sands. Areas of enhanced seismic risk occur in the N–S-trending areas overlying low-standing rocks and thick sections of clay-rich and seismically slow surficial materials.

STATE GEOLOGIST'S REPORT

Laurence R. Becker
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VGS Move and Personnel

The Vermont Geological Survey moved to new quarters in September, 1997. Look for us by the rock sculpture outside of the refurbished old Laundry Building in the Waterbury Complex. The location is improved for visitors who come to obtain geological information, so please stop by the next time you are in Waterbury to see our new surroundings. In addition to Marjorie Gale, the full time geologist/information specialist, a 3/4 time GIS Data Base Specialist began working for the Vermont Survey in Nov., 1997. Dr. Jonathon Kim has been hired to complete a number of tasks funded through Federal grants. They include: the testing of a GIS approach that presents the nature of seismic risk in Vermont through a computer application known as HAZUS; the use of GIS outputs in the schools to present the science and nature of geologic hazards in Vermont; the placement of bedrock maps in digital format; and the use of a GIS data base on minerals to plan for the identification and balanced use of industrial minerals such as crushed rock, sand and gravel, and dimension stone.

Bedrock Mapping

In 1997, STATEMAP deliverables included a first draft compilation of the bedrock geology of Northern Vermont from six one-degree sheets at 1:100,000 scale (Lake Champlain North, Lake Champlain South, Mt. Mansfield, Montpelier, Groveton, and Mt. Washington) with rock descriptions, preliminary stratigraphic columns, cross-sections, and references. The Vermont Survey's package also contained detailed geology for eleven 1:24,000 quadrangles. The package included 7.5 minute quads mapped by contractor's to the Vermont Survey in the summer of 1996 and other digitized maps developed in cooperation with the USGS from their work in Southern Vermont. In the summer of 1997, to fill gaps in the first draft compilation, fourteen geologists, including professors, students and professionals, mapped under STATEMAP and State funds. The following are acknowledged for their excellent mapping and compilation work in 1996 & 97: Compilers and Mappers -Drs. Barry Doolan, Charlotte Mehrtens, and Rolfe Stanley; Working Professionals - Dr. Peter Thompson and Thelma Thompson, Dr. Jonathan Kim, Dr. Eric Rosencrantz, Dr. Helen Mango, George Springston, Ron Parker, Adam Schoonmaker; and Students - Scott Applegate, Kim Brooks, Ben Copans,

Carey Hengstenberg, Tim Cronin, Kurt Haier, Jonathan Holt, Jeff Fredericks, Dave Sonenberg, Jimmy Talcott, and Shawn Wolfe . Also Laura Mallard mapped under EDMAP funds. Thanks continue to go the Information Management Section of the Agency of Natural Resources, John Dudley and Tom Merrifield in particular, for their highly valued cooperation in producing digital geologic maps. Laura Cadmus and Dave Dreher, as contractors, served well by producing quality digital products.

Of course, the invaluable cooperative work of Dr. Nick Ratcliffe as leader of the USGS team, Greg Walsh as geologist and GIS specialist, Dr. Tom Armstrong and Dr. Bill Burton, allowed detailed geologic work to be rapidly brought to open-file and published status.

The first compilation of Northern Vermont is a necessary step to begin the process of bringing the USGS work completed in the South together with geology to the North. The first cut to compile the North and South will take place in the winter of 1997/98. The cooperative relationship between the Vermont Survey and the USGS continues to be a strong one as we work together to bring forth a new State bedrock geologic map.. Marjorie Gale provided much assistance with compilation and the logistics of bringing the deliverables together. In the fall of 1997, The Vermont Survey was successful in putting forth proposals for State monies to assist with publication costs and field work to fill in gaps.

Surficial Mapping

As supported by the Vermont STATEMAP advisory committee, the summer of 1997 was the last big push on STATEMAP funds to map bedrock geology . The committee supported the use of STATEMAP for surficial mapping. On November 4th the Division submitted the Federal funding application for the Montpelier, Barre West, and St. Johnsbury quadrangles. We received letters of support from the respective planning commissions that cover Central and Northeastern Vermont. These are areas that are expected to grow. The surficial geologic information can be applied to water supply issues, spill response, siting of infrastructure projects and location of sand and gravel deposits. In the summer of 1997, for the purposes of creating a seismic hazard map, well log data from the Burlington, Vermont quadrangle were compiled, contoured, and presented in GIS format by Stephen Wright and two students David Shaw and Kyle Nichols.

In 1998, we were notified that Vermont is one of 13 states out of 43 state geological surveys submitting that received the full funding amount requested for geologic mapping in the summer of 1998. The Division

received - "Congratulations on preparing a clear and concise STATEMAP proposal with cogent arguments for the societal value of the mapping." The review panel also complimented the Division on the "strategic planning" represented by the surficial geologic mapping proposal.

Mineral Assessment

The Vermont Survey has been awarded a grant by the Eastern Mineral Resource Team of the USGS. The initial overture is to study metallic commodities, but the long range cooperation will focus on industrial minerals. The money will be used to bring the mid 1980's Mineral Resources Data System up to date, define mineral deposit types for a group of entries and define a role for the State Survey in providing information that will help locate and plan for the future use of industrial minerals. F. M. Beck, Inc. of Yarmouth, Maine is updating the data base and defining deposit types for metallic commodities. The industrial minerals plan is being drafted in-house.

GIS

The work of the Vermont Survey in cooperation with the USGS is discussed in an article on GIS in the October 1997 issue of Geo Info Systems. Geo Info Systems is a nationally distributed magazine that presents information on all aspects of GIS technology. The article entitled *"GIS: The Bedrock of Geologic Mapping"* discusses Vermont's geologic mapping project that produces geologic maps in digital format through the cooperation of the Vermont Survey, USGS, and the Information Management Section of the Vermont Agency of Natural Resources. Also, the Vermont Survey participated in a GIS expo held in Montpelier in February. Open-file and prototype digital geologic maps were displayed.

Missisquoi Bay:

The Final Report for Phase II - Missisquoi Bay Field Study and Hydrodynamic Verification is complete and delivered. A Project Advisory Committee (PAC) of citizens and public officials assisted a study that looked at whether the causeway, built in the 1930's, contributes to increased sedimentation in the Bay. The most significant finding is that for sediment and phosphorus the simulations indicate a 1% or less concentration change between the with and without causeway cases. The Vermont Survey believes that this project represents a model for public involvement in the development of a scientific study that informs public policy issues. The PAC took the study from the development of a request for proposal, through interviewing and choosing a consultant to review of important steps towards completion of the work.

Stream Geomorphology:

The State Geologist is the project manager for a four phase study that covers watershed hydrology protection and flood hazard mitigation. Phase I is a literature search that focuses on the nature of change in stream hydrology, morphology, water quality, and aquatic ecosystems. A consultant was hired to examine how land use change may contribute to changes in stream hydrology and morphology. As a link to phase II, the consultant provided recommendations on how to determine 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. Stone Environmental Inc. of Montpelier with Peter Gale as project manager for the consultant using several Dartmouth professors (Drs. Frank Magilligan and Keith Nislow) as subcontractors completed phase I in January 1998 . Based on empirical studies largely from localities outside Vermont, development alters the hydrologic regime such that the magnitude and frequency of floods typical of undisturbed streams changes to produce more frequently occurring large floods and bankfull floods. Increased surface runoff can then produce changes in the morphology of a stream with sediment releases that have a potential to impact aquatic biota. The final phase I report is has been distributed for public review and comment on all aspects of the study plan.

Lake Champlain Atlas

The Vermont Survey in cooperation with the Lake Champlain Basin Program and the Agency's Information Management Section created GIS data layers, a home page, and arcviews for a paper atlas. A homepage is posted, GIS layers are complete, and the arcviews have been submitted to a printing contractor.

National Earthquake Hazard Reduction Program

A memorandum of understanding is complete between The Vermont Survey and the Vermont Department of Public Safety. The Vermont Survey is developing a program that includes the development of educational materials to schools, government, and businesses about the risk of damage from earthquakes and other geologic hazards in Vermont and the mitigation measures that are appropriate for Vermont conditions. A recent study funded by Division of Emergency Management indicates that the risk of damage to buildings is greater than previously thought for Northwestern Vermont. The education program will also address the science of earthquakes which includes the geological component and Vermont's geological history. A coordinator is under

contract, George Springston, to help plan the program and perform educational outreach.

The Vermont Survey home page now has a section covering the FEMA - National Earthquake Hazard Reduction Program. Mapping of the surficial materials in the Burlington quadrangle was conducted in summer 1997 to better understand the potential for amplification of seismic waves in "soft soils" underlying Vermont's largest city.

Geology and Biology

As geology is part of the physical attributes that support ecosystems, the States' Elements of Biodiversity document finalized in April includes sections on geology, soils, and climate written by the State Geologist. A test of the applicability of the elements document is in the planning stages. Using the elements, an assessment of the Pine Mountain Wildlife Management Area in Topsham is underway. The State Geologist chairs a subcommittee on geology, soils, and climate. The Vermont Survey conducted a reconnaissance field visit to the property.

The intent is to begin to define categories of geology/soils that support a variety of natural communities. The work combining the geology/soils and the natural community locations would hope to find firm correlations between the physical and chemical attributes of particular sites and the natural communities that reside there.

Educational Outreach

The State Geologist spoke before the Vermont Association of Planning and Development Agencies to discuss new bedrock geology maps in digital format. Potential cooperation exists to create derivative maps from the digital data that address specific geological issues that face the Commissions. Sources of aggregate precluded from extraction because of other development is a concern.

The Vermont Survey ran a field trip for the American Association of Petroleum Geologists Foundation meeting in Woodstock. Contacts were made with a geologic organization that represents 30,000 geologists nationwide with expertise in the search for natural gas—the focus of exploration in Vermont in the early 1980's.

The State Geologist is working with the Vermont Conservation Districts providing technical assistance to the developing Farm-a-Syst program. Farm-a-Syst uses assessments to determine what practices and structure may pose a risk to a farm's drinking water. A system that rates the vulnerability of a water supply to contamination in part employs geological information after a Wisconsin model. In addition to reviewing

the rating system, a test field application of the method was conducted at Fairmont Farms in East Montpelier in September . The State Geologist provided training on how to view the geology and water well issues at the test site and discussed the variability of Vermont's geology as it may be encountered when other sites are assessed.

The State Geologist spoke at a conference for District Conservationists sponsored by the Natural Resource Conservation Service (the former USDA Soil Conservation Service). Geological issues were discussed as they relate to in-ground manure storage and its influence on ground water. Techniques for judging an aquifer or a wells' vulnerability to contamination were compared from the NRCS SEEPAGE method and the FARM-A-SYST project. A real example of well contamination possibly linked to in-ground storage was used as an illustration. The example had been brought to the Geologic Division by the Vermont Department of Agriculture for interpretation of the geologic conditions. The District Conservationists were in need of better information on depth to ground water and the nature of the unsaturated zone and aquifers below proposed in-ground storage. Use of the geological information available from the Division was encouraged and methods to fill information gaps were discussed.

The State Geologist gave a presentation to the Vermont Junior Mineral Symposium in Springfield, Vermont entitled "Pieces of the Puzzle, Vermont's Geologic History through its Rocks and Minerals." The event drew students and parents with hands on study of minerals and specimen displays.

Radioactive Waste

On October 7, 1997, the House of Representatives approved the Texas Low-Level Radioactive Waste Compact by a vote of 309 to 107. The State Geologist was in Washington D.C. to assist with passage and worked with Vermont Congressman Bernard Sanders on his floor testimony. Questions were answered on the strength of arid hydrologic systems for waste isolation.

WATER NEWS

Kent S. Koptiuch, CGWP

It seems that all the advances of our modern society and its associated infrastructure can't keep at bay the constant and repetitive impacts of water, in all its forms. Last Summer, it was the flooding in Montgomery Center. In January, it was the "Ice Storm of '98." Right now it's unusually warm, late Winter weather causing an early mud season, swollen rivers, and an early end to the season for hardwater fisherman on Lake Champlain (speaking of Lake Champlain, no matter how much I love it, I never will be able to lump it in with the five Great Lakes, even if our dear old Uncle Bill did make it official. After all, I've rarely seen a weather system that would keep me and my 20 -foot boat off Champlain - Lake Ontario, on the other hand, has given me pause more than a few times!). And for the past year, it seems everyone's blaming everything on el Nino, warranted or not.

The Pacific coast has been hammered by major storms; the news is constantly reminding us of each little piece of California that seems to slip, inexplicably, into the ocean carrying yet another forlorn homeowner's real estate into Davy Jone's locker.

The south central states and the southeastern states are getting their share of flooding now. It almost seems as if each state is vying for the doubtful distinction of having the most residents swept downriver.

I'm not trying to make light of the plight of any of the folks affected by these so-called disasters; my heart is wrenched every time I hear another of these news flashes. I am just trying to point out how ignorant most people are of the power of water. Many of these incidents wouldn't even be classified as disasters if only we, as a people were more cognizant of how water and weather interact with and upon the land.

There really are places (like flood plains, and shorelines) where permanent development should be seriously reconsidered; but of course we'd end up with a lot of screaming from insurance companies who wouldn't like to give up their revenues from flood and disaster insurance premiums! And think of all the lost waterfront-tax revenues for municipalities nationwide. Not to mention all of the government employees who would have to redirect the focus of their work efforts if there were no more shoreline stabilization or flood control projects to work on.

Why, after all, should we continue to fool ourselves into thinking that we can tame nature. For millions of years, man has survived and evolved by adapting to a changing environment. In this microsecond of geologic time, man seems to believe that our survival is dependent upon overcoming that which can not be overcome. In another microsecond of geologic time, water and wind will wear away even the Great Wall of China; we just won't be able to see it from the space shuttle anymore!

For practicing professionals, water as a major force has become instinctively second nature. Yet, we all too often forget that as scientists, a part of our ethical duty is to provide the general public with information that they can utilize to protect themselves and their possessions from the ravages of the demon "diHydrogen-Oxide."

No, I'm not saying it should be our daily duty to go out and save the world from water. I am saying, however, that every once in a while, we need to make it a point to get out and talk to someone besides other scientists. I know that I've brought this up before in this forum, but we all need a little reminder once in a while.

So get out there and talk to your child's class in school. Become a mentor through the GSA. Send a letter to your local newspaper when you see something reported with a less than articulate knowledge of hydraulics. Volunteer on a town planning board. Talk to people (especially that local farmer who's spreading manure twenty feet upgradient from your site's upgradient monitoring well)! No matter how much we know about the power of water (which is nowhere near as much as that which we don't know), it doesn't do the layman any good if he or she can't get the information and put it to practical use!

As a profession, hydrogeology has much to offer in helping mankind; but first we have to continuously let mankind know that we're here to help and that we're not just out waving our arms about so that we can land another grant award, or increase our profit margin. Remember, the most prominent of earth's features that our astronauts do see from space are those of water and weather systems; that's a mighty big pot, and our little fire will never boil it, but some how, some way, no matter how seemingly inconsequential, we can sure use our knowledge to make things a little easier for everyone.

VERMONT GEOLOGICAL SOCIETY BUSINESS & NEWS

Vermont Geological Society Research Grant Awards

Research Grants/Scholarships/Graduate Positions Available Vermont Geological Society Student 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 March 31. For applications contact VGS Student Research Grants, Dept of Geology, UVM, Burlington, VT 05405-0122 (swright@zoo.uvm.edu).

Deadline for Spring GMG:

Members wishing to submit something to be published in the Spring issue of the GMG should do so by April 6, 1998.

VGS Sponsored Talk

"Creation Scientists' Geologic Time Scale" by Dr. Donald U. Wise
Professor Emeritus, University of Massachusetts Research Associate,
Franklin and Marshall College

March 19, 1998, 8:00 pm
Norwich University
Cabot Science Room 085

Dr. Donald Wise, internationally respected geologist and author of "Creationism's Geologic Time Scale" which appeared in the 1998 March-April issue of American Scientist, will give a presentation comparing and contrasting the "Young Earther's" view of history with one based on the results of scientific inquiry. This presentation is open to the public, and should be of particular interest to students and faculty in the Natural Sciences and to others concerned with the true nature of time.

Sponsored by:
Vermont Chapter of Sigma Xi
Vermont Geological Society
Biology and Geology Departments of Norwich University

Treasurer's Report

The financial condition of the Society remains strong. Please see attached financial reports as of December 31, 1997. A summary of these reports follows:

Checking Balance @12/31/97	$3,842.03
Excess of Income over Expense 01/01/97 - 12/31/97	$ 153.81

All new applications for membership were processed by Stephen Wright and, to my knowledge, were added to the membership data base.

All major bills currently known to me have been paid and all of the dues payments forwarded to me have been included in above numbers.

It is a pleasure to serve you as Treasurer. As always, suggestions and comments are welcome.

Respectfully submitted,

Al Carpenter
Treasurer

Farewells

Charles L. Drake 1924 - 1997

Charles Drake passed away at his home in Norwich on July 8, 1997. He was best known for his postulation that a period of widespread volcanic eruptions was the primary cause of the great dinosaur extinctions, as opposed to meteorite impact. Mr. Drake was a former GSA president (1977), GSA Fellow, and emeritus professor at Dartmouth College. In 1985 he was the recipient of the George P. Woollard Award from GSA's Goephysics Division.

NELD (NORTHEAST LITHIC DATABASE) WORKGROUP MEETING

The goal of NELD is to build a lithic identification and sourcing database for northeastern North America. We meet periodically to work out formatting, funding, and policy issues for the database. Our Website, hosted by Uconn's ArchNet, holds information on our goals, membership, and pilot projects.

Our next working meeting is scheduled for Saturday, March 21, 1998, 8:00 am to noon. This meeting will be held in conjunction with the 33rd Annual Meeting of the Northeastern Section of the Geological Society of America Annual Meeting (March 19-21, 1998) in Portland, Maine, USA.

http://www.lib.uconn.edu/NELD

For your information, the Northeast Section of the GSA's will feature at least two symposia of interest to geoarchaeologists on Friday March 20:

T3 Geoarchaeology:
Using geological techniques to model past environments. T10 Archaeological Stone Artifacts:
Contributions to sources, petrology, and distribution.

NELD representatives will make some introductory remarks about the project during the T10 session, and then on Saturday we will meet as a group to address specific issues (such as access security, nomenclature, graphics & mapping, and web & database design) as well as general policy and long term goals such as funding.

We invite new participants and input into our project. Please visit our Website for more information.

If you think you might be coming to Maine, please let us know so we can arrange for sufficient work space and handouts!

Kathleen E. Callum/Robert A. Sloma
GEOARCH, Inc.
Camp 62, Indian Trail; RR 2 Box 2429-1; Brandon VT 05733
TEL: (802) 247-8127; FAX: (802) 247-0107; geoach@sover.net

Check Out the Vermont Archaeological Society Web Page
http://www.uvm.edu/~vhnet/hpres/org/vas/vas.htm

SEMINARS, MEETINGS, AND FIELD TRIPS

March 19: Norwich University Lecture *"Creation Scientists' Geologic Time Scale"* by Dr. Donald U. Wise, Professor Emeritus, University of Massachusetts Research Associate, Franklin and Marshall College. Lecture @ 8 PM, Room 085 Cabot Science Building, Norwich University, Northfield, Vermont.

March 19–21: **Northeastern Section Geological Society of America Annual Meeting,** Portland, ME. Info: see December 1997 issue of *GSA Today* or www.geosociety.org

March 30: University of Vermont Spring Geology Seminar Series (4:30 P.M) *"Tectonics of Venus"* John Suppe, Princeton University.

March 28: Vermont Geological Society Winter Meeting, See this issue for details.

April 6: University of Vermont Spring Geology Seminar Series (4:30 P.M) *"Exhumation of the Sambagawa Blueschist Belt, SW Japan"* Bob Wintsch, University of Indiana.

April 25: Vermont Geological Society Spring Meeting: Presentation of Student Papers, Middlebury.