

The Granite State Geologist

Newsletter of the New Hampshire Geological Society
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President's Message

Jack Jemsek

In preparing this parting shot to the 20th century, I realized that I was a wee bit short on experience to provide a statement of where geologic education and practice has been in New Hampshire, and where we should set our sights for the third millennium. But conversations with our State Geologist, Gene Boudette, and other elder geologists always provide inspiration and guidance. I am quite sure that New Hampshire's most valuable geologic resource is not its minerals, aggregate, groundwater, streams or beautiful vistas, but the wealth of knowledge harbored by our senior members. May they always have a strong voice in both the scientific and political aspects of geologic matters in New Hampshire.

The following is my wish list for NHGS objectives as we turn the corner to 2000:

- Licensure for the professional practice of geology will be readily approved by the Legislature in 2000, and that the mission of the New Hampshire Council of Professional Geologists (NHCPG) will be embraced by all concerned parties;
- Increased student involvement in the NHGS, particularly from the state's fine universities, and introduction of a one-day colloquium featuring undergraduate and graduate student presentations, similar to those conducted in Massachusetts, Maine and Vermont;
- Increased attendance at our dinner meetings, geology field trips and family outings; and more volunteers for NHGS committees;
- Revision of NHGS by-laws to better facilitate continuity of Board of Director members;
- Progress in involving the general public during Earth Science Week.

There have been many great accomplishments in this state over the years, and hopefully they will be summarized in a future article (see below). In the meanwhile, I have the following general requests regarding geology:

- Care in the publication and use of digitized topographic and geologic maps so that detail provided by earlier maps is not lost;
- Systematic large-scale surficial mapping of the state be conducted and/or mentored by seasoned geologists with timely publication of results;
- Continued commitment of the state to water resources research and publications, particularly with regard to arsenic, radon and wellhead protection;
- Implementation of an alternative to MTBE in gasoline to protect water resources; and
- Rebirth of economic geology activities in the state.

On these and other geologic matters, I hope that Gene Boudette will co-author a feature article or white paper for a future issue of *The Granite State Geologist*.

I encourage you to take the opportunity to commend this outstanding scientist and public servant in his final year as State Geologist.

See you at the January meeting!

Reminders

The NHGS's mailing address has changed! The new address is:

New Hampshire Geological Society
PMB 133
26 South Main St.
Concord, NH 03301

The Post Office will return to sender any mail sent to NHGS that does not follow the above address format.

The world-wide-web address remains unchanged:
<http://nhgs.org/NHGS/> or simply www.nhgs.org

Also, if your mailing label says "Membership Expired," please consider renewing now. You can download an application from from the web site. Questions about membership status should be directed to Steve Shope, 603-778-3988, e-mail: sshope@nh.ultranet.com.

Is Arsenic in Ground Water Tied to Regional Geology and Land-use Patterns?

Joseph D. Ayotte, U.S. Geological Survey

Analysis of arsenic in public-supply wells in eastern New England, by the U.S. Geological Survey, shows statistical relations between the presence of arsenic in bedrock public-supply wells and generalized bedrock geologic and land use data. Data from more than 800 bedrock public-supply wells, all of which meet the current drinking water standard of 0.050 mg/L, were used in the analysis. The abstract of the report is shown below. Contact Joseph Ayotte at (603) 226-7810 or at jayotte@usgs.gov for more information on the study and results. The report is due to be issued in January by the New Hampshire-Vermont District. The complete reference is:

Ayotte, J.D., Nielsen, M.G., Robinson, G.R., Jr., and Moore, R.B., 1999, *Relation of Arsenic, Iron, and Manganese in Ground Water to Aquifer Type, Bedrock Lithochemistry, and Land Use in the New England Coastal Basins*: U.S. Geological Survey Water-Resources Investigations Report 99-4162, 61 p.

Abstract

In a study of arsenic concentrations in public-supply wells in the New England Coastal Basins, concentrations at or above 0.005 mg/L (milligrams per liter) were detected in more samples of water from wells completed in bedrock (25 percent of all samples) than in water from wells completed in stratified drift (7.5 percent of all samples). Iron and manganese were detected (at concentrations of 0.05 and 0.03 mg/L, respectively) at approximately the same frequency in water from wells in both types of aquifers.

Concentrations of arsenic in public-supply wells drilled in bedrock (in the National Water-Quality Assessment Program New England Coastal Basins study unit) vary with the bedrock lithology. Broad groups of lithochemical units generalized from bedrock lithologic units shown on state geologic maps were used in the statistical analyses. Concentrations of arsenic in water from public-supply wells in metasedimentary bedrock units that contain slightly to moderately calcareous and calc-silicate rocks (lithochemical group M_C) were significantly higher than the concentrations in five other groups of bedrock units in the study unit. Arsenic was detected, at or above 0.005 mg/L, in water from 44 per-

cent of the wells in the lithochemical group M_C and in water from less than 28 percent of wells in the five other groups. Additionally, arsenic concentrations in ground water were the lowest in the metasedimentary rocks that are characterized as variably sulfidic (group M_S). Generally, concentrations of arsenic were low in water from bedrock wells in the felsic igneous rocks (group If) though locally some bedrock wells in granitic rocks are known to have ground water with high arsenic concentrations, especially in New Hampshire.

The concentrations of arsenic in ground water also correlate with land-use data; significantly higher concentrations are found in areas identified as agricultural land use than in undeveloped areas. There is, however, more agricultural land in areas overlying the metasedimentary rocks of lithochemical groups M_C and the minimally deformed clastic sediments of group M_{Md} than in areas overlying other lithochemical groups. This correlation complicates the interpretation of sources of arsenic to ground water in bedrock. A test of this association revealed that relations between arsenic concentrations and the metasedimentary rocks of group M_C are not weakened when data associated with agricultural land use is removed; the reverse is true, however, if the data associated with the group M_C are removed from the analysis.

The occurrence and variability of arsenic in water from bedrock public-supply wells could be related to several factors. These include (1) the distribution and chemical form of arsenic in soils and rocks that are part of the ground-water-flow system, (2) the characteristics that influence the solubility and transport of arsenic in ground water, (3) the differing degrees of vulnerability of ground-water supplies to surface contamination, and (4) the spatial associations between land use, geology, and ground-water-flow patterns. Strong relations between agricultural land use and the metasedimentary rocks of group M_C complicate the interpretation of arsenic source to water in these bedrock aquifers. This is due in part to the past use of arsenical pesticides; additionally, few whole-rock geochemical data are available for the rock types in the lithochemical groups of aquifers that contain ground water with elevated concentrations of arsenic. Without such data, identifying specific bedrock types as arsenic sources is not possible. In southern Maine and south-central New Hampshire, and in northern Massachusetts, the few available whole-rock analyses suggest, at least for these local areas, a connection between known bedrock chemistry and ground-water arsenic levels.

Although the litho-geochemical group and land-use category variables individually describe much of the variance in the concentrations of arsenic in ground water, the litho-geochemical relation is statistically stronger than the land-use relation. Low concentrations of arsenic in water from bedrock public-supply wells are associated with the metasedimentary rocks of group M_s (characterized as variably sulfidic). This association could reflect a variety of factors and suggests that simple dissolution of arsenic-bearing iron phases, such as sulfides, may not explain concentrations of arsenic in water in this bedrock aquifer group. Whole-rock geochemical data and more complete water-chemistry data, as well as studies of historical variation of arsenic concentrations (time-line studies), and site-specific studies, will be critical in addressing the arsenic source issue.

Other New Publications from the USGS

Stratified-drift Aquifers of New Hampshire Poster

A compilation of the statewide stratified-drift aquifer mapping that was done by the U.S. Geological Survey (USGS), in cooperation with the New Hampshire Department of Environmental Services (NHDES), is now available in a colorful glossy poster showing major sand and gravel aquifers overlying a relief map of the state at a scale of 1:250,000. The poster is 38 by 49 inches and is available at no charge either in a flat or folded version. Please specify which version you want when requesting the poster.

Both the poster and the arsenic report are available through the USGS by contacting Debra Foster, Outreach Coordinator, at (603) 226-7837 or through E-mail at dhfoster@usgs.gov. Visit the New Hampshire/Vermont District web page for additional products and information about the USGS at <http://nh.water.usgs.gov> or the USGS web page at <http://www.usgs.gov/>

Also of interest:

“Tectonic lithofacies, geophysical, and mineral-resource appraisal maps of the Sherbrooke-Lewiston area, Maine, New Hampshire, and Vermont, United States, and Quebec, Canada,” compiled by R. H. Moench, E. L. Boudette, and W. A. Bothner, has been published by the USGS as Miscellaneous Investigations Series Map I-1898-E.

Field Trip Report—The Ossipee Ring-Dike Complex

Nelson Eby and Lee Wilder

After the assembly of Pangea, two periods of extensional magmatism occurred in New England. These are represented by the Older White Mountain Igneous Province (ca. 180 Ma) and the Younger White Mountain Igneous Province (ca. 120 Ma). The younger period of igneous activity occurred shortly before the opening of the North Atlantic Ocean ca. 100 Ma. The Ossipee ring-dike complex of central New Hampshire is an example of this younger period of igneous activity.

The Ossipee complex is of interest for several reasons.

(1) It is the only intrusion in the Younger White Mountain Province that has substantial amounts of both basaltic and rhyolitic volcanics. (2) The outer ring dike, consisting of sub porphyritic granites and quartz syenites, is almost complete. (3) Due to the work of Marland Billings and his students this structure is regarded as the type locality for this type of igneous structure.

Ring dikes develop during periods of extensional tectonics. Circular fractures are formed and magma is extruded along the fractures while the central block subsides. At Ossipee the basalts and rhyolites were erupted at the beginning of ring-dike formation and subsidence. Subsequently a thin granite sheet was emplaced beneath the volcanic pile. Geophysical evidence tells us that at depth the conduit is largely filled with mafic igneous rocks.

Friday night was wet and rainy, but Saturday morning, August 14, 1999, cleared to a beautiful summer day, as a small but hardy band of NHGS members met near the Junction. of NH 113 and 25 in South Tamworth. After the exchange of cheerful greetings, Nelson Eby trooped us off to “ground truth” the Ossipee ring dike complex. A guide for the field trip, and a more complete description of the Ossipee complex, can be found on the NHGS web site (<http://nhgs.org/NHGS/>). For the afternoon, we reconvened on the Weir’s Beach boardwalk for a delicious lunch, more conversation, and a ride aboard the **MV Mount Washington** on picturesque Lake Winnepesaukee. A hearty thank you to Greg Kirby and Nelson Eby for another great NHGS Summer Field Trip/Family Picnic. Mark your Y2K calendar now, so that you will not miss out on next summer’s event!

Data is not information is not knowledge is not wisdom.

Lance Norskog

An Update on NHCPG Activities

The New Hampshire Council of Professional Geologists (NHCPG) will be providing a newsletter this month updating current and future events. Walter Carlson has provided some much needed relief to NHCPG President Dorothy Richter as he is now editor of the NHCPG newsletter.

Senate Bill 181-FN to establish licensure for professional geologists will be presented to the New Hampshire Senate in January 2000. Support letters from the Joint Working Group on Proposed Licensing of Professional Geologists (includes members of the NHCPG, NHGS, Consulting Engineers of NH, the NH Society of Professional Engineers, and the American Society of Civil Engineers), Robert Varney and Phil O'Brien of the NH Department of Environmental Services, Gene Boudette (NH State Geologist), the NHGS, and others played an important role in the Senate Committee approval in October 1999.

Upon Senate approval of the bill, a House Committee will review and vote on the bill, hopefully in the Spring of 2000. After final approval, the bill becomes law. The next steps include formation of a NH Board of Professional Geologists to work on the regulations for licensing professional geologists, and the eventual purchase of a standardized test from ASBOG. To achieve the above goals, NHCPG will be seeking membership renewals and additional corporate contributions for the upcoming year. Please assist the NHCPG with your financial support so that we can successfully establish licensure for professional geologists.

The next NHCPG meeting will be January 5, 2000 at 5:30 pm at the NH-DES offices on Hazen Drive in Concord (please arrive on time, because the building will be locked).

News from the NH Department of Environmental Services (DES)

This column highlights items selected from various desktops at DES. Readers interested in receiving additional information may contact the Public Information and Permitting (PIP) office at (603) 271-8013.

- DES has submitted a proposal to the U.S. Geological Survey under the STATEMAP-00 program for continued, systematic surficial geologic mapping of 7 1/2 minute quadrangles. If approved, funding will be avail-

able to complete five additional tiles during the 2000 field season. About 20 percent of the 213 tiles that cover the state are presently mapped and are available in various formats ranging from formal publications in full color to manuscript maps.

Three proposals have also been submitted to USGS for continued, detailed (1:24,000 scale or larger) bedrock geologic mapping under the EDMAP-00 program. A major thrust of this program is to support development of field mapping skills of students with guidance and supervision of colleges or universities. The first proposal would allow the Department of Earth Sciences at UNH to continue bedrock mapping within the Massabesic Gneiss Belt in central NH. The second proposal would provide for continued mapping in the Mt. Washington area under the guidance of the Department of Geology at Bates College. The third proposal would initiate bedrock mapping in the Lake Sunapee area through the Department of Geology at Keene State College.

- The New Hampshire Department of Environmental Services provides a bimonthly newsletter "Environmental News." This news letter provides highlights of DES's environmental goals and achievements throughout the state. Call (603) 271-3503 to obtain the free publication.
- The New Hampshire Department of Environmental Services-Drinking Water Source Protection Program provides a quarterly newsletter "The Source," which highlights drinking water protection programs. Call (603) 271-4071 to obtain the free publication.
- DES Waste Management Division is developing a Y2K Consultants Day, scheduled for March 16, 2000. The Consultant Day provides outreach and education to the environmental community regarding DES's rules and policies.
- Some new changes in reimbursement of cost related to soil excavation and disposal during UST closure are in place. In general, preapproval of any soil excavation and disposal is required and can be obtained through the DES' Emergency Response staff during the UST closure. One key element for approval is that the soil excavation and disposal will result in Site Closure. If these criteria cannot be met, soil remediation will take place during the Remedial Action Implementation phase of the Site's corrective action program.
- DES implements a program dedicated to assuring proper management of asbestos disposal sites. Program

elements include: investigation/confirmation of newly reported sites; periodic inspection of known sites; technical assistance for developing/implementing emergency response and remedial action plans for sites which need to be covered; activities pertaining to long-term maintenance of sites; and coordination of activities with the U.S. Environmental Protection Agency (US-EPA), which has remediated several sites through the federal Superfund-Emergency Removal Program. DES is currently developing a comprehensive site inventory including detailed maps of sites. This inventory also provides a basis for predicting the location of potentially undiscovered sites. In addition, DES is currently working with US-EPA to develop regulatory options for alternative site cover systems.

Earth Science Week 1999

Lee Wilder

Here's what happened: Governor Shaheen signed a proclamation for Earth Science Week 1999 at a ceremony in the executive council chambers. Chuck Knox of DES, who arranged the Governor's signing of the Proclamation, also sent photos of the signing and an Earth Science Week announcement to local papers. NHGS members Lee Wilder and Bob Whitmore helped Rundlett Middle School students setup and remove and Earth Science Week Display at the NH State House. The display included the new Bedrock Geologic Map of New Hampshire as well as some beautiful NH mineral and rock samples donated by Bob Whitmore. During Earth Science Week, Lee also took the Loudon Webelos Den to Palermo Mine to collect and identify minerals for their Webelo Geology Badge, and worked with 8th grade teacher Sue Bracy at Mountain Middle School in Goffstown, and with Terry Grady, a teacher at Harold Martin School. Several other NHGS members also volunteered to speak in schools. Earth Science Week was promoted in both the NHGS and the NHSTA newsletters, and many NH teachers of science requested the free Earth Science Week Packet from AGI. Earth Science Week 2000 is again slated for October. What can you do to help? <http://www.earthsciweek.org/>

“When soldiers form lines or hollow squares, you call it reason. When wild geese in flight take the form of a letter V, you say instinct. When the homogeneous atoms of a mineral arrange themselves into shapes mathematically perfect you have nothing to say. You have not even invented a name to conceal your heroic unreason.”

Brendan Mahony

Lincoln R. Page Scholarship

The Lincoln Page Scholarship program provides up to \$300 for expenses related to the recipient's continuing education in the earth sciences. The scholarship is open to any and all individuals who seek to continue their earth-science education in a manner consistent with the purposes of the New Hampshire Geological Society. K-12 teachers are especially encouraged to apply. Appropriate expenses would include travel to regional or national earth-science related conferences, course tuition, etc... Applications should consist of a one-page letter explaining the purposes for which funds are sought, and how an award would benefit the individual and meet the purposes of the NHGS. The application should be accompanied by a letter of endorsement from the applicant's school principal, faculty advisor, or employer as appropriate. Applications are accepted at anytime, although we anticipate that only one award will be made per year.

The Society also offers a Classroom Enhancement Grant. Teachers from across the state are invited to submit proposals for a grant of funds (up to \$300) to support the purchase of earth-science related teaching materials (equipment or supplies) for use in their classroom.

Applications and proposals will be considered as they are received, and should be sent to: The New Hampshire Geological Society, Scholarship Requests, Suite 133, 26 South Main St., Concord, NH 03301.

Please help spread the word about these programs by talking with the teachers in your local school district!

Authors Wanted

Nelson Eby has already contributed a short note (in this newsletter) and field trip guide (on the NHGS website) to the Ossipee Ring Dike Complex. Lee Wilder and Dick Lane are doing some research for an article(s) on some of New Hampshire's granite quarries. Peter Thompson has promised a piece for the newsletter on the geology of Mount Monadnock.

We need more. What about descriptive articles on the geology of other mountains or features in the state? Articles on mining and quarrying history? What kind of research are you working on now? What was your most recent consulting project? We need to hear from you! To contribute your thoughts, or articles, contact Tim Allen by e-mail: tallen@keene.edu, or v-mail: (603) 358-2571



New Hampshire Geological Society
PMB133
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Concord, NH 03301

The broad purpose of the New Hampshire Geological Society is to advance the science of geology in New Hampshire.

We hope to pursue this goal by contributing to public education, strengthening the role of geology in environmental concerns, and disseminating knowledge about the geology of the Granite State.

Membership in the society is open to all, including professional geologists in all areas and interested lay people.

NHGS News and Events

The **2000 Winter Meeting** of the NHGS will be held Thursday, January 13 at the Wayfarer Inn in Bedford, New Hampshire.

The NHGS is honored to host Mr. David E. Thompson, P.E. as the featured guest speaker. Mr. Thompson is the Chairman/CEO of Haley & Aldrich, Inc., the 350-person Boston-based engineering and science firm. His presentation is entitled "Geotechnical Perspectives of the Big Dig". As you are probably aware, the Big Dig refers to Boston's Central Artery/Harbor Tunnel project, which is the largest public transportation infrastructure project ever undertaken within the United States. The project involves the construction of a major below grade extension of Interstate 93 and Interstate 95 through the most heavily populated portion of Boston. Mr. Thompson's talk will provide an overview of the project and focuses on the design and construction of below grade structures with emphasis on the innovative construction methods being employed. Geology plays an important part in the design and con-

struction methods, as the Big Dig traverses the Colonial shoreline of Beantown.

The festivities will be begin at 6:00 PM with a social hour and cash bar, followed by dinner at 7:00 PM. **Reservations are necessary** and will be accepted until Wednesday afternoon, January 12, 2000. Please use the enclosed form to pre-pay and make your dinner selection. The cost is \$17 for NHGS Members and \$19 for non-members paid in advance. An additional \$2 surcharge will be collected from those paying at the door. For more information, contact Charlie Balyeat at (603) 763-7402 or Gretchen Rich at (603) 679-6775.

Additional Meetings of the Society for the **Year 2000** have been set for Thursday, April 13, and Thursday, October 12. A **Field Trip** is tentatively scheduled for July 15, with the **Family Outing** tentatively August 12. The Board of Directors is scheduled to meet next on February 24. The submission deadline for the next issue of this newsletter is March 10. Don't forget the NHCPG meeting on January 5, or the NH-DES Consultant's Day on March 16.