

Guest Editor's Note

In this issue of the *GMG*, I have attempted to focus on selected topics concerned with environmental and groundwater geology. I selected this theme because of the significance of environmental work to geologists in Vermont. Virtually all of the geologists that have graduated from post-secondary schools in Vermont in the past ten years have (or will) work in environmentally related disciplines. This fact is a manifestation of the accelerated growth of hydrogeology and environmental geology. In the May 1991 *GSA Today* article entitled "Hydrogeology: It Is," Stephenson, Cutright, and Woessner state that "Hydrogeology is currently the fastest growing discipline in the geosciences." This accelerated growth is the result of a societal awakening to the limited nature and the value of uncontaminated ground and surface water. The trend of increasing opportunities for geologists in environmental fields is not likely to abate by the end of this millenia.

One concern in regard to the expanding need for hydrogeologists and environmental geologists is the paucity of educational opportunities that are available in Vermont. Few courses are available beyond the introductory level that focus on the more complex and interdisciplinary aspects of hydrogeology. This may stem from a perception by educators that these disciplines are best taught in an engineering format or that practical applications "cheapen" the science. It is certainly true that hydrogeology is an eclectic science (as is geology) that draws strength from many disciplines. Hydrogeologists today face problems that require some knowledge of chemistry, physics, mathematics, computer science, statistics, microbiology, soil science, and law as well as engineering principles. It is undeniable, however, that hydrogeology requires an understanding of the nature, fabric, structure, history, and origins of earth crustal materials: soils, sediments, and rocks. Hydrogeology requires trained geologists. As Stephenson, Cutright, and Woessner (1991) have observed, studies for hydrogeologists should "emphasize the processes that create the geologic framework through which fluid moves (e.g. depositional environments and structural character). Without such a basis, links between complex theory and application are poorly grounded."

In the July, 1992 issue of *Geology*, John Bredehoeft writes a letter that highlights the significance of fluids (dominantly water) in crustal processes. He points out the fact that fluid migration is the dominant process by which energy and mass are transported through the crust; that many ore deposits are the "products of extinct geothermal systems," and that pore fluids play a dominant role in the deformational and tectonic history of rock masses. Mr. Bredehoeft's purpose is to emphasize that hydrogeology is a rigorous and quantitative science that poses intellectual challenges to all geologists. Stephenson, Cutright, and Woessner (1991) add that there is a "paucity of bona fide hydrogeology candidates for employment at virtually all levels. Those employers facing staff shortages are turning to persons who have little or no actual hydrogeological

education or training." In a water-rich state like Vermont, in which almost all geology graduates go on to professions in the environmental field, it is imperative that additional educational resources be allocated to buttress course offerings in hydrogeology.

The 1992 Summer VGS field trip is intended to provide an educational opportunity that will permit attendees to witness the processes and technologies involved with active groundwater remediation. The field trip will visit three sites that are contaminated by petroleum products. (A description of the nature and distribution of contaminants and the remedial strategies employed for clean-up at each site are presented as short articles in this issue of the *GMG*). The trip will conclude with a demonstration of the techniques that are employed in order to install an analytical quality groundwater monitoring well. This is sure to be an opportunity not soon repeated so please plan on attending.

Sincerely,

Ronald L. Parker

SUMMER FIELD TRIP

Hydrogeology and Remediation Technology at Three Hazardous Sites in Central Vermont

plus

A Groundwater Monitoring Well Installation Demonstration

This field trip is designed to illustrate three contaminated sites in the central Vermont region and to show how these sites are being cleaned up. The sites are located in the middle of downtown Barre, immediately south of the Norwich University campus in Northfield and in the village center in Waitsfield. The sites will progress from a relatively simple site to a relatively complex site in order that field trip participants can gain a better perspective of the range of groundwater contamination problems.

The field trip will start at 9:30 AM. on August 22, 1992 (rain or shine). The trip will meet at the Park & Ride parking lot on the north side of Route 62 at the Berlin-Barre exit (across from Town and Country Honda). From there the trip will proceed down the hill on Route 62 to the Barre City intersection of Route 14. At this intersection take a right. The site is a closed gas station on the left (northeast) side of the road next to Mr. Z's Pizza. Park in the shopping center parking lot adjacent to the site. The field trip will plan on being at this location for 30-45 minutes. A description of the site by Kent Koptiuch is included in this issue of the *GMG*.

From this site the trip will travel back up Route 62 and will get on interstate 89 heading south. The caravan will leave the interstate at the Northfield-

Williamstown exit (Exit 5) and will proceed west on Route 64 to Route 12 and thence, north on 12 to Northfield. The site is situated immediately to the south of the Cabot Science Annex (the building that houses the Norwich University Geology Department). The Cabot Science Annex is the southernmost building on the Norwich campus along Route 12. Estimated time of arrival at the second stop is 11:00 to 11:15 AM. The field trip will plan on being at the second stop for 45 minutes to an hour. Participants should plan on eating lunch at this stop. A description of this site by Ron Miller and Pete Murray appears in this issue of the *GMG*.

From this location the field trip will travel to Waitsfield via the Roxbury Gap passage over the mountains. From the second field trip stop, head south on Route 12. Almost immediately veer to the right (west) onto Route 12A. Follow Route 12A to Roxbury (the next town). In the center of Roxbury take a right and head west on Warren Road over Roxbury Gap through the Northfield mountains, pass through East Warren and onward to Warren. At Warren, get on Route 100 and proceed north through Irasville to Waitsfield. The Village Grocery is on the left (west) side of the road. The estimated time of arrival at this location is approximately 12:45 to 1:00 PM. The site will be visited for approximately one hour. Descriptions of the site by Haslam and Amadon appears in this issue of the *GMG*.

Immediately following the tour of the village grocery site, a demonstration of the methods and techniques used to install a groundwater sampling quality monitoring well will be given. This demonstration will be performed by Neal Faulkner of Tri-States Drilling and Boring of West Burke, Vermont. The estimated start time for the demonstration is 2:00 to 2:15 p.m. The demonstration should take 1 to 2 hours to complete.

In order to return to the starting point of the field trip, participants need only drive north on Route 100, veer right on Route 100B and then get on interstate 89 at the Middlesex-Moretown exit (Exit 9). Proceed south on the interstate highway to the Berlin-Barre exit (Exit 7) to the place of the field trip origin.

Stop 1: Application of Soil Vapor Extraction Techniques at a Site Contaminated by Gasoline, Barre Vermont

Kent S. Koptiuch, Senior Geologist
Matrix Environmental Technologies, Inc.
4 Kellogg Road, Essex Jct, Vermont, 05452
(802) 878-9310.

In November 1990 a phase II subsurface investigation at a former gas station in Barre Vermont confirmed that overburden soils and groundwater were affected, respectively, by adsorbed and dissolved petroleum hydrocarbons. In October 1991 a soil vapor survey and ancillary investigations revealed that hydrocarbon impact was limited to the perched, unconsolidated aquifer and its associated vadose zone. Groundwater flow in this aquifer trends to the south with a gradient of approximately 1%. The potentiometric surface fluctuates seasonally between four and seven feet below grade.

The bedrock underlying the site consists of highly metamorphosed Paleozoic metasedimentary rocks (the Barton River Member of the Waits River Formation) and granitic intrusive rocks. Overburden at the site consists of poorly sorted sands and gravels of deposited by the Stevens Branch River and well sorted glaciolacustrine silts and clays.

Potential receptors of subsurface hydrocarbons from the gas station include trenchlines containing underground utilities along Main Street (water, sewer, gas), down-gradient residences and businesses, and the Stevens Branch itself. In cooperation with the Petroleum Sites Management Section of the Vermont Department of Environmental Conservation (DEC), a Remedial Action Plan (RAP) was developed and approved in December, 1991 to mitigate environmental impacts.

The RAP called for the installation of a five (5) point soil vapor extraction system to address both the adsorbed and the dissolved petroleum hydrocarbon plumes. The locations of the vapor extraction points were chosen using computer models that were based on a soil vent test. Recovered vapors are treated through a series of two (2) granular activated carbon (GAC) vessels prior to atmospheric discharge. A maximum discharge threshold of 5 parts per million total volatiles was imposed by the DEC. When vapor emissions meet or exceed this level, rotation of the GAC vessels is required.

The remedial system installation was completed during the early Winter months of 1992 and system startup occurred on April 8, 1992. The system is monitored and balanced on a monthly basis. The vapor extraction system utilizes a two (2) horsepower vacuum blower pulling an average of 2,800 cfm. Current recovery rates, with a system influent of 214 parts per million total volatiles, have been calculated to yield 70.44 lbs./hr total gasoline vapors. With continuous operation at the current extraction rate, removal of 95% of the contaminant has been projected to take a period of one year from the date of system startup.