Editorial

Beyond BTEX

by Michael J. Barcelona

"It's definitely not a time to become complacent with our current understanding of contaminant fate and transport processes."

I recently have been contacted by several colleagues from Europe and South America who wonder what all the fuss is about MTBE (methyl tertiary butyl ether) in ground water. This caused me to reflect on our collective history and understanding of problem definition in the subsurface environment. Let me share some thoughts.

We have come a long way in the past 25 years of active water resource quality monitoring and remediation. Sophisticated sampling and analytical methods for inorganic and organic environmental contaminants have been developed in support of a variety of regulatory compliance programs. Professional practice in the field and office has improved significantly since the "gold-rush" of the late '80s traveled through the ground water industry. Real gains have been made in balancing costs and benefits in subsurface remediation programs. However, more in-depth understanding of the behavior of contaminant mixtures even in "simple" hydrogeologic systems is needed to minimize long-term environmental or human health risk.

It's definitely not a time to become complacent with our current understanding of contaminant fate and transport processes, particularly with the usual two-dimensional depictions of plumes in reports. Consider how obsolete our training and experience in problem-solving would be if the plumes were really planar objects containing only regulated compounds.

We also have to guard against historical myopia in addition to complacency where complex mixtures of organic, radiological, or inorganic contaminants are involved. This is true for two main reasons:

- **Approved analytical methods for organic contaminants mainly detect volatile or sparingly soluble compounds.** Rarely has more than 10% of the dissolved organic content of ground water been identified. Very soluble compounds (e.g. acids, alcohols, aldehydes, amines, ketones, etc.) with considerable biological and chemical reactivity are almost never reported or considered in risk estimates for their impact on possible remedial options. Numerous observations of MTBE in ground water associated with dissolved fuel components should alert us to the presence of unreported compounds that influence: oxygen, iron III, nitrate and other electron acceptor concentrations, sorption and source release terms, and overall biological activity or biomass within plumes. These compounds may be responsible for synergistic or agonistic effects in exposures. Either effect would render meaningless our estimates of reference dosages or cancer slope factors for risk estimation. We should be clear in our qualified definition of and solutions to problems where BTEX compounds (or TPH for

(cont. on page 6)

(cont. from page 4)

that matter) alone have been documented.

The second reason is also related to contaminant mixture complexity.

- **There are always unforeseen hydrogeologic, chemical, or biological consequences of active treatment processes**. Consider the example of chlorination of drinking water to disinfect supplies and protect us from exposure to pathogens. This treatment alone has probably saved more lives from water-borne disease than medicine has cured. However, previously unidentified natural organic compounds in raw waters react with aqueous chlorine to form disinfection by-products, many of which have significant human biological effects (e.g., chloroform, trihalocetonitriles, chlorophenols, etc.). Alternative water treatment methods: permanganate oxidation or ozonation yield other by-products with distinct toxicological properties.

Given the complexity of petroleum products, industrial formulations, or landfill leachate mixtures in sediments or ground water, we should all be well advised to keep up with the literature in other fields which may alert us to unintended treatment consequences. For example, in the petroleum hydrocarbon area, the growing use of forsenic analysis methods to supplement "approved" methods has been quite fruitful in source estimation and product differentiation.

In the coming year, we are going to solicit short one- to two-page field Innovation Notes in *GWMR* to allow our readership to share timely new investigative tools, approaches, methods, or interpretations of monitoring and remediation results. I hope you will think back on some of your past projects and participate in the effort. Happy New Year.

Michael Barcelona directs the National Center for Integrated Bioremediation Research and Development of the Department of Civil and Environmental Engineering at the University of Michigan, Ann Arbor, Michigan. He is editor of GWMR.

"In the coming year, we are going to solicit short one- to two-page field Innovation Notes in GWMR."