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Author Information

Wallace S. Broecker, Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y., E-mail: broecker@ldeo.columbia.edu; Thomas F. Stocker, Physics Institute, University of Bern, Switzerland, E-mail: stocker@climate.unibe.ch

NEWS

Studies Examine Bangladesh Arsenic Contamination Problem

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Between 35 and 77 million Bangladeshis (out of a population of 125 million) are at risk of drinking water contaminated with arsenic levels above the World Health Organization (WHO) guideline of 0.01 milligrams per liter (mg/l), according to the WHO. A British Geological Survey study in 1998 found that 35 percent of shallow tubewells sampled had arsenic levels above 0.05 mg/l (the maximum concentration allowed in Bangladesh) and 8.4 percent had levels above 0.3 mg/l.

Some recent research focusing on this problem could help Bangladesh provide clean water to these people.

Only a few thousand of the approximately 12 to 18 million tubewells in the country have been reliably tested for arsenic, according to Faisal Hossain, a native of Bangladesh who is a civil and environmental engineering professor at Tennessee Technological University, Cookeville. Hossain said that he ranks arsenic contamination—and its poisoning of millions of Bangladeshis—as one of the top problems facing the country.

Because dependable test results are rare, Hossain is developing a mapping scheme that he hopes could predict with this small amount of data where arsenic-contaminated wells are more likely to be found so that reliable testing may be optimized in those areas.

In a poster presentation at the December 2005 AGU fall meeting in San Francisco, Calif., Hossain and his colleagues proposed combining a more traditional geostatistical approach for spatial mapping with a nonlinear technique based on chaos theory that looks at patterns in the data. He argues that that because there are better-understood physical mechanisms behind the distribution of arsenic in the region, traditional spatial mapping methods that assume its distribution is random are inadequate.

A Natural Man-made Problem

Arsenic is found naturally in most basins derived from Himalayan sediment, explained Scott Fendorf, a biogeochemist at Stanford University, Calif. The arsenic is attached to iron oxide within the sediment. Under anaerobic conditions and in the presence of carbon, bacteria underground will respire on the iron oxide, releasing the arsenic into the water.

Until recently, it was thought that this process took place within the aquifers, that the arsenic-laced iron oxide was found there, and that the carbon had to be transported into the aquifer to start the process. However, Fendorf and his colleagues proposed in a December 2005 article in the *Proceedings of the National Academy of Sciences* that because the iron oxides in the aquifers appear to already have been reduced, this process must be taking place near to or at the surface. Under this scenario, the arsenic—and not carbon—is transported into the aquifer and is a continuous source of contamination.

By studying the hydrological cycle of the arsenic, "maybe we will decipher what the key mechanism is and where it resides, where the arsenic is coming off. Then we can do something about that," such as changing land use practices, Fendorf said.

Charles Harvey, a groundwater hydrologist at the Massachusetts Institute of Technology, Cambridge, and Fendorf's colleague, added, "If we understand how [arsenic] moves through the aquifers, then we can, with confidence, say where is it a good idea to put in a well and where it could conceivably be dangerous."

Arsenic contamination is a problem in many parts of Asia, but it is most widespread in Bangladesh. In the 1970s, the United Nations launched a program there to end reliance on microbially-contaminated surface waters by drilling shallow tubewells. However, none of the wells were checked for arsenic contamination. In the 1990s, health officials, first in West Bengal, India and then in Bangladesh, began finding an increasing number of cases of arsenic poisoning and arsenic-related diseases, including skin lesions and cancers.

Richard Wilson, a Harvard University physicist who is president of the Arsenic Foundation, said that "the right solution, of course, is to get good water to people."

However, getting good water to the Bangladeshis has proven problematic. For example, affordable methods to treat the arsenic-contaminated water, such as filtering it through iron-coated sand, tend not to be used for very long, as people find the filters to be too bothersome to use and clean, said Harvey.

Another solution may be digging deep wells, such as those that have served the city of Dhaka for ages. These wells, which are thought to be safer (when installed properly) than shallow tubewells, can be drilled for about US $200 to $300 each and serve around 300 people, said Wilson. He also advocated helping Bangladeshis move back to using surface waters, although he admits that, in this tropical setting, it is difficult to maintain bacteria-free wells.

—Sarah Zielinski, Staff Writer