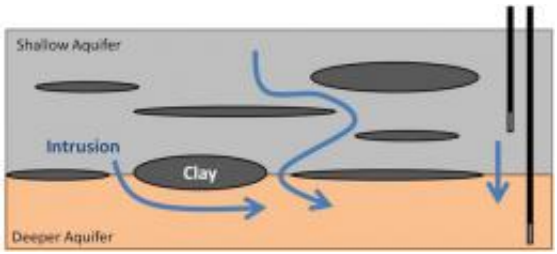
Natural processes can limit spread of arsenic in water, study says

October 11 2011



Shallow arsenic-contaminated water can penetrate deep aquifers when water is pumped from lower levels. Credit: Kathleen Radloff

(PhysOrg.com) -- Many people in Bangladesh and other parts of Asia have been poisoned by drinking groundwater laced with arsenic—not introduced by humans, but leached naturally from sediments, and now being tapped by shallow drinking wells. In recent years, to avoid the problem, deeper wells have been sunk 500 feet or more to purer waters—but fears have remained that when deep water is pumped out, contaminated water might filter down to replace it. Now, a study has shown that deep sediments can grab the arsenic and take it out of circulation—a finding that may help to keep wells safe elsewhere, including in the United States. The study, led by researchers at Columbia University's Department of Earth and Environmental Engineering and the Lamont-Doherty Earth Observatory, appears in the current online edition of the journal *Nature Geoscience*.

Lead author Kathleen Radloff and her colleagues injected arsenic-rich water into a deep aquifer in Bangladesh, then monitored arsenic levels over nine days. They found that arsenic fell by 70 percent after 24 hours, and continued to decline over the monitoring period. They attributed this to the arsenic sticking to the surfaces of deep sediment particles, in a process called adsorption.

However, the process may have limits. The results were applied to a hydrological model of the Bengal Basin, the aquifer that serves most of Bangladesh and the neighboring Indian state of West Bengal. Using the model, the team found that the risk of arsenic contamination is limited when wells are restricted to household use, but increases significantly if they are also used for irrigation, even if much arsenic adsorbs to the sediment.

Elevated arsenic is common in shallow drinking wells across much of South and Southeast Asia, but the problem has been most apparent in Bangladesh. The World Health Organization has called it the largest mass poisoning in history. Researchers from Columbia's Mailman School of Public Health, Lamont-Doherty and other university divisions have studied the problem for years, along with scientists from many other institutions. The current study, funded by the U.S. National Institute of Environmental Health Sciences' Superfund Research Program, also included researchers from Queens College, the University of Delaware and the University of Dhaka.

A Bangladeshi worker drills a sampling well. Local crews have been working with researchers for over a decade. Credit: Kathleen Radloff

William Suk, director of the Superfund Research Program, said the research “carries far-reaching public health significance, not just for the people of Bangladesh but for those affected globally by arsenic exposure, including Americans.” According to the U.S. Geological Survey, some 43 million Americans depend on unregulated private wells, and at least a quarter of wells have at least one contaminant exceeding levels considered safe by the Environmental Protection Agency. The EPA reports arsenic as the second-most common contaminant at Superfund sites. Like aquifers in parts of Asia, several large U.S. aquifers are also threated by overuse.

Radloff, now an environmental engineer for a private consulting company, said that the study could be applied to areas where geochemical conditions are similar. “In situations where water demands are increasing, monitoring of water supplies needs to also increase--not

only in Bangladesh, but also in the U.S.," she said. She cited the Mahomet aquifer in central Illinois. "The overall aquifer geochemistry is very similar to that of Bangladesh," she said. "Farming demands have drastically altered water flow conditions and there are good reasons to expect arsenic concentrations might change more than they have in the past."

Radloff said that estimates of how much arsenic can be taken up by sediments and the potential effects of pumping may also help improve remediation at U.S. Superfund sites, where intensive pumping is often used to remove contaminants from groundwater.

Provided by Columbia University