

Arsenic and Old Sandstone

We think of pollution as a human phenomenon, when in fact natural pollution from the break-down of minerals is also important, and can come from unexpected sources.

The bedrock Wisconsin and Minnesota contains lots of sandstone beds. One of the purest is the St. Peter Sandstone, which consists almost entirely of well-rounded quartz grains. This is the rock that forms the white cliffs along the Mississippi River in St. Paul, the lower layer at Minnehaha Falls, and the steep road cuts around River Falls, Wisconsin. Where this formation is below the surface, it forms an important aquifer. Water moves readily through the spaces between the sand grains. Think of how fast a spilled soda soaks into the sand on a beach and you'll get the idea.

Imagine the horror of people in east-central Wisconsin who have drilled wells into this rock and find themselves drinking water with hazardous quantities of arsenic! Measurements in Outagamie and Winnebago Counties find some wells with arsenic concentrations up to 2,000,000 micrograms per liter. (The U.S. E.P.A.'s recommended maximum is 50 micrograms per liter). A homeowner's first reaction, after going to get bottled water will be to look around to sue whoever it was who has been dumping arsenic. The problem is that the arsenic is coming from the sandstone itself.

If one looks at the St. Peter sandstone, one sees scattered rusty red zones. This is the result of the weathering of pyrite. By the time the sandstone is exposed at the surface, the pyrite has decomposed to hematite. Below the surface, some zones of St. Peter sandstone is peppered with bright brassy pyrite. Pyrite is ideally made of iron and sulfur, but minerals in nature are rarely pure. Pyrite has a nasty habit of picking up arsenic and including it in its structure in the place of some of the sulfur. As the pyrite begins to break down, it releases the arsenic into the surrounding ground water. This was what was happening in eastern Wisconsin. The arsenic may have gotten into the rocks at the time of formation of the lead and zinc ores in southwestern Wisconsin when metal-bearing fluids were moving through the area. Indeed, the pyrites found in some of the old mines is an arsenic-bearing variety known as bravoite.

A similar problem occurs in southeastern Michigan, this time with a different formation called the Marshall sandstone. In one county 30% of the well tested in this formation yielded arsenic contamination, at times reaching concentrations as high as 350 micro-grams per liter. Investigation again showed that the Marshall Formation contained pyrite and that the pyrite had trace amounts of arsenic.

In the play, "Arsenic and Old Lace" part of the comedy comes from the idea of sweet old ladies poisoning their guests. Who would think danger could come from such an innocent-looking source? Our sandstones look like nice clean sand. Who would have thought that some of them release arsenic to our drinking water?

- Dr. Bill Cordua, University of Wisconsin-River Falls

References:

Cannon, W., A. Kolker and D. Westjohn, 1998, "The Geological Source of Arsenic in Ground Water in Southeastern Michigan", Institute on Lake Superior Geology, 44th Session, Abstracts with Programs, p. 50 -51.

Dutch, S., J. Moran and R. Stieglitz, 1998, Geologic Traverse of East-Central Wisconsin, in Guidebook to Field Trips in Wisconsin and Adjacent areas of Minnesota, ed. of M.G. Mudrey Jr., for 31st Annual Meeting of the North Central Section of the Geological Society of America, p. 3 - 11.