Arsenic in Ground Water in the Cow Island Area, Louisiana

Gresham, Dean M., and Duex, Timothy W.

Geology Department, the University of Louisiana at Lafayette; Lafayette, LA 70504, TDuex@louisiana.edu

ABSTRACT

Water quality in and around the towns of Cow Island and Forked Island, Louisiana has been a major issue in recent years. Intense media attention occurred in 2004, when the Louisiana Department of Environmental Quality (LDEQ) conducted tests of total arsenic (As) content in groundwater from 21 domestic water wells. The LDEQ found four wells to have levels of arsenic ranging from 10 parts per billion (ppb) to 60 ppb. The United States Environmental Protection Agency (USEPA) standard for total arsenic in public drinking water systems is 10 ppb, but private wells are unregulated.

The As source in the contaminated wells is currently unknown. Many residents of Cow Island and Forked Island theorize that As-rich insecticides formerly used in cattle dipping vats have migrated to the water table. Another potential contamination source is historic cemeteries which contain bodies that may have been embalmed with As prior to 1910. Both of these potential sources are found near the contaminated wells. It is also possible that the As in the area may be naturally occurring, due to physical and chemical interactions of the groundwater with As-rich sediments. Dissolved As in groundwater is controlled in part by natural factors such as As content of the aquifer, reduction/oxidation reactions, competing anions, and solid-phase structural changes at the atomic level. Examination of surface and subsurface data coupled with the LDEQ data can help provide clues related to the potential source, movement, and possible remediation of the affected ground water.

INTRODUCTION

Water quality has become an increasingly important point of concern for many parts of Louisiana including the towns of Cow Island and Forked Island in the southern part of the state. In that area, elevated levels of arsenic have been detected in wells that are the source of water for domestic use. This has sparked a debate about the origin, movement, availability, and possible remediation of arsenic in waters of south Louisiana. This paper will attempt to answer some of those questions by examining what has been discovered about arsenic in this area.

GEOLOGIC SETTING

The area of concern is located in the coastal plain of southern Louisiana where relatively young Quaternary sediments have been deposited in an area of minimal elevation and relief. The primary materials present are clays and silts with lesser sand and gravel that were deposited in alluvial and related environments. The sedimentary units generally dip and get thicker to the south where younger material is being actively deposited. Specifically, the thickness and extent of the material depends on the exact type of deposit and how it was
formed. The different depositional environments include channel sands, natural levees, floodplain, and marsh deposits. The materials form the southern extent of the Chicot Aquifer which elsewhere has over 1500 feet of fresh water. In this area the fresh water lens thins and ultimately disappears toward the coast. Because of the relatively flat topography there is not a large hydraulic gradient and the local movement of ground water is largely controlled by variations in the stratigraphy at the site as well as the geometry of surface water bodies.

ARSENIC IN GROUND WATER

In 2004 the Louisiana Department of Environmental Quality (LDEQ) found high levels arsenic in water samples from wells in the Cow Island area. Subsequent analyses by The Daily Advertiser through an independent laboratory found similar elevated values. The LDEQ data are given in micrograms per liter (ug/L) whereas The Advertiser data are listed as parts per billion (ppb); for all practical purposes the two methods of presentation are equivalent at these levels and they will be used interchangeably. The LDEQ tested 24 wells and found five to be at or above the maximum acceptable level of 10 ppb mandated by the U.S. Environmental Protection Agency (EPA) for public water supplies. Private wells are not regulated by the EPA but the same standards are generally applied as acceptable for all drinking water. The Advertiser tested slightly fewer wells (21) but found nine that were above the maximum limit. The highest level found in each study was from the same well and registered 60 ppb in the LDEQ study whereas it was 50.8 ppb in The Advertiser data. Such variability is not uncommon in separate sampling and analysis events and other duplicates exhibited similar spread. Most of the wells tested had relatively low levels of arsenic (<6 ppb). However, clearly there are elevated areas of high arsenic in drinking water from the area.

DISCUSSION

The source of the arsenic in the well water has not been identified positively at the present time. One source suggested in The Advertiser was arsenic pesticides used in cattle dips prior to the 1950’s to 1960’s. Other anthropogenic sources include old oil well sites, historic cemetery sites, and treated wood. It is also possible that the arsenic in the area could be naturally occurring and be part of the originally deposited material or be reworked from nearby sources. In the first case, arsenic pesticides were used as a control for ticks and other insects on cattle that were grazed in the area. Troughs were used as dipping vats and evidently used pesticides were dumped nearby. Several former cattle dips have been identified in the vicinity. Arsenic based insecticides also were used to control fire ants. It is not completely clear how old oil wells could be responsible for pollution but some were used as injection wells and possible contamination could have come from the injected waste. Another potential source is old cemeteries in the area where arsenic was used as an embalming agent that could escape as caskets deteriorate with age. At least two cemeteries are located in the region. Arsenic is also used as a preservative in treated lumber products that have numerous applications in the construction industry. However, this has not been suggested as a cause of high arsenic in ground water in the Cow Island area and no excess concentration of this material has been noted in the areas of high arsenic levels.

Arsenic is known to be naturally occurring and is found in a wide variety of rock types and environments (e.g., Welch et al., 2000). It can be found in hydrothermal water
(Stauffer and Thompson, 1984), in evaporitic situations (Swartz et al., 1996), and in certain minerals like sulfides (Kolker et al., 1998). Additionally, arsenic has been shown to vary seasonally in natural waters (Nadakavukaren et al., 1984). The most common cause of elevated levels of arsenic in ground water is apparently due to its release from iron oxides because of variable geochemical conditions, such as reaction with organic carbon (Welch et al., 1999). A number of other special circumstances can also contribute to high levels of arsenic in ground water, but these are relatively rare and not seen commonly in southern Louisiana. In general, none of these natural sources of arsenic appear to be documented in south Louisiana although variable geochemical conditions could influence movement of arsenic in rocks that are typical of the area in question.

CONCLUSIONS AND RECOMMENDATIONS

The source of arsenic in the Cow Island area of south Louisiana cannot be attributed to any one specific source. Numerous natural sources of arsenic are known in general but are not common in south Louisiana. Some, like geothermal or evaporative concentration, seem very unlikely. Others, perhaps release from sulfide or oxide minerals, could occur if the right circumstances were present. However, since these minerals are not abundant in the type of rocks in the study area, it also seems unlikely that this would be a cause of elevated arsenic. Of the potential anthropogenic sources of arsenic, at least two are known in the area: pesticide usage areas and old cemeteries. One cattle dip has been identified within about a half mile of the highest values of arsenic found in the LDEQ sampling event and apparently several others have operated in the area in the past. Cattle that used these vats evidently roamed freely through the area. A couple of cemeteries are present in the area but it has not been documented whether they contain older sites or if they might have used arsenic as an embalming agent. Thus it is not possible to say with certainty what the source of the arsenic may be and how it may have moved but arsenic introduced by humans seems the most likely source.

There are some recommendations that can be made to help determine the source and/or movement of arsenic in the area. It would be useful to have more analyses in the area of high arsenic and to test rocks, sediments, or soils in those areas for any natural or introduced arsenic. Specifically, it would help to check around the old cattle dips and perhaps also near the cemeteries or in other areas where arsenic usage is suspected. Similarly, testing surface waters might help delineate if arsenic is present or how the arsenic has moved. Ultimately, the installation of shallow wells might be the only definitive method to verify the source and direction of movement of arsenic in ground water in the Cow Island area.

REFERENCES


