Delineation of High Salinity Conditions in the Cambro-Ordovician Aquifer of Eastern Wisconsin

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by
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BACKGROUND/NEED

The Cambro-Ordovician aquifer (also known as the deep sandstone aquifer) serves as the primary drinking water source for those urban areas in eastern Wisconsin that do not have access to Lake Michigan water. There is a growing recognition that, in some portions of the aquifer, total dissolved solids (TDS) content of the water is quite high. In some areas TDS is rising over time however the underlying hydrologic and geochemical processes that cause high salinities are not well understood. This is of immediate concern to the affected municipalities because of the limits it puts on the amount of water that can be pumped

OBJECTIVES

To delineate, in a cohesive manner, the extent of high salinity conditions within the Cambro-Ordovician aquifer.

METHODS

The study used the existing chemical data contained in the WDNR Drinking Water Database to map the spatial extent of high salinity and the chemical character of the high salinity. Salinity trends over time and with respect to the stratigraphic intervals were also investigated

RESULTS AND DISCUSSION

In general, relatively fresh Ca-HCO 3 -rich water is found in the southwest portion of the study area and increasingly saline water is found in the northeast portion of the study area. This increase in salinity is due to an equimolar rise in calcium and sulfate indicating dissolution of gypsum as the probable source. A NaCl signature is seen in a localized band centered in Brown, Calumet and western Fond du Lac counties. The probable source is dissolution of halite. Although individual wells exhibit a rise in TDS over time, the aquifer as a whole produces water that is remarkably constant in TDS. The vast majority of wells are changing less than 10 ppm per year with an equal number exhibiting an increasing and decreasing salinity. The data is insufficient to support any relationship between either salinity or chemical character and the occurrence of a particular stratigraphic interval within the well.

CONCLUSIONS/IMPLICATIONS/RECOMMENDATIONS

This study calls into question the idea that higher salinity is a function of the confined/unconfined boundary beneath the Maquoketa Shale subcrop. Salinity does not appear to be correlative to depth within the aquifer and, except in localized wells, salinity is not increasing over time. The pattern of may be due to the amount of sedimentary gypsum that is present or may be due to portions of the aquifer that have not been adequately flushed. Whether this is related to current pumpage rates is not clear.

Particular problem areas (such as Waukesha County) should be studied in detail to determine the causes behind localized increases in salinity and chemical character. Changes in salinity and chemical character may underlie the

presence of other trace level contaminants (in particular naturally occurring radioisotopes) in these same areas. A clear knowledge of the groundwater flow regime is a necessary component to any detailed geochemical study.

RELATED PUBLICATIONS

None.