APPLICATION OF GEOLOGIC INFORMATION FOR GROUND-WATER QUALITY MANAGEMENT
- CASE STUDY OF EASTERN ARKANSAS QUATERNARY WELLS -

BURMSHIK KIM[1] and KENNETH F. STEELE[2]

[1] Ph.D. Candidate, Environmental Dynamics Program, University of Arkansas,
113 Ozark Hall, ENDY Program, University of Arkansas, Fayetteville AR 72701, U.S.A.
(Tel: +1-479-527-9520, Fax: +1-479-575-3469, e-mail: bxk03@uark.edu)
[2] Professor , Department of Geosciences, University of Arkansas
113 Ozark Hall, Dept. of Geosciences, Fayetteville AR 72701, U.S.A.
(Tel: +1-479-575-7937, Fax: +1-479-575-3469, e-mail: ksteele@uark.edu)

The objectives of this project were to use ground-water quality from Holocene and Pleistocene aquifers to determine any relationship with the geochemical characteristics of the aquifer sediments. These results were used to demonstrate the use of geologic information for ground-water resource management. The Grand Prairie region was chosen for this study because it uses vast amounts of ground water for irrigation and there are important drinking water supplies as well (Cooper, 2002). The Grand Prairie region is located in the western part of the Mississippi River Valley in Arkansas, including parts of Lonoke, Prairie, Monroe, Jefferson, and Arkansas counties.

To identify wells as obtaining water from Holocene or Pleistocene sediments, a global positioning system (GPS) location of each well was compared with Arkansas geologic map (Haley et al., 1993) digitalized by the Arkansas Archeological Survey using geographic information system (GIS) software. The Student-T test was used to compare Holocene and Pleistocene well waters.

The results show that Holocene aquifer ground water has higher concentrations of Ba, F, Fe, Mn, PO_4, whereas Pleistocene aquifer ground water has higher concentration of HCO_3, alkalinity, Br and higher pH. These differences are statistically significant at a confidence level greater than 95%. Conductance, TDS, Ca, Cl, K, NO_3, Na, and SO_4 do not show statistically significant differences between Holocene and Pleistocene aquifers ground water. These results differ somewhat from previous studies by Kleiss et al. (2000). The differences among the studies and this project can be attributed to the lack of Pleistocene prairie complex (terraces) sediment that comprise a large part of the Grand Prairie region, and differences in size of study areas.

These observations of chemical differences between well water from Holocene and Pleistocene sediments are interpreted to be the result of the difference of grain size in the two types of Quaternary sediments, which cause different ground-water flow rates and oxidation-reduction conditions. The reducing environment of Holocene sediment is caused by the decomposition of organic matter and restricted of ground-water flow, which does not flush the ground-water system. These conditions lead to an anoxic condition with low pH that mobilizes metal ions and PO_4. Well-sorted, larger-grain size results in greater porosity/permeability for Pleistocene sediments, which produces higher ground-water flow and oxidizing conditions. These oxidizing conditions preserve existing hydroxyoxide and phosphate minerals. If reducing ground water, rich in dissolved heavy metals and PO_4, mixes with the oxic waters, metal hydroxyoxide and phosphate minerals precipitate

(Kleiss et al., 2000). Based on these results, proper methods for ground-water quality management can be supported by basic geologic information. Integration of basic geologic information, including general lithologic characteristics of Holocene and Pleistocene sediments, with other data, e.g., human impact and environmental conditions, can aid in the management of ground-water quality.

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