

PROPOSED REGIONAL SYNTHESIS REPORTS

- Started in FY04 -

Ground-Water Status and Trends: Principal Aquifer Synthesis

Proposed Report Title: Distribution and relation of selected trace elements to environmental factors in the glacial aquifer system, northern United States

Scope: Principal aquifer: glacial and alluvial aquifer system

Study Units: Land-use Survey or Major Aquifer Survey networks: Those of all Study Units underlain by glacial aquifer where trace elements were monitored.

Time Period: 1991-2001 (Cycle I)

Land Use(s): All

Inter-Regional Principal Aquifer Proposal? Yes

Constituents: Iron and manganese and selected trace elements of schedules 2703 and 2710

Expected Authors: Lead: George Groschen and Kelly Warner

Contributing: Terri Arnold, Bill Morrow, and Jennifer Hogan

Objectives:

1. Characterize the regional distribution of 8 trace elements and iron and manganese in the glacial and alluvial aquifer system and implications for drinking water sources using the glacial hydrogeological framework.
2. Assess differences in trace elements based on the glacial aquifer hydrogeological framework developed by Warner and others to aid transferability of findings.

Data Interpretation Approach and Feasibility: Compilation of all trace element data, schedules 2703 and 2710 (see list at end), for all Land-use survey and Subunit survey or major aquifer survey networks. Generate summary statistics and use those for mapping categories of trace element concentrations and locations of exceedances. Several trace elements may have high frequencies of non-detections or detections near the reporting limit. Methods for effectively addressing non-detects will be identified during the data compilation step. Ancillary data that could be use for identifying potential natural (such as RASS and PLUTO) and anthropogenic

sources (TRI and other information sources) may be available. Although, many of these elements are redox-sensitive a phenomenological approach will be used rather than thermodynamic equilibrium-based modeling. Further, because depth below land surface also is a controlling factor for organic matter, microbial communities, and residence times, this complicating factor will have to be evaluated for its influence.

Methods:

1. Maps and box plots
2. Maps and correlations based on the hydrogeological framework-transferability to areas not sampled will be determined by the correlations with the hydrogeological framework.
3. Comparison patterns of exceedances to hydrogeological framework
4. Assessment of the effect of well/aquifer depth on the occurrence of the selected trace elements.
5. Will coordinate with other regional report authors on compiling the data. The report proposed here and the proposed report-Delineation of hydrochemical regions within the glacial aquifer system (Arnold and others)-will share some major ancillary data. Coordination with the authors of the Arsenic and Radiochemical reports is planned. Doing so will avoid redundancy and enhance the interpretations of all reports.
6. S-plus and Datadesk software will be used for statistical and graphical analyses. Geostatistical Analyst will be used for geospatial analysis.

Staff Availability: Groschen 0.5 FTE, Morrow 0.2 in FY05, and Hogan 0.2 FTE in FY05.

Complexity: Moderate. Manipulating the large data set. Availability of appropriate ancillary data may be the largest hurdle to completing all objectives.

Risks/Contingencies: Spatial distribution of trace element data in the glacial and alluvial aquifer system is sparse and erratic. Extrapolation to the entire area of the regional aquifer will need to be thoroughly assessed. The feasibility for extrapolation of these results using the hydrogeologic framework will be reviewed before data analyses are completed.

Other Program Contacts: Lori Apodaca, Mary Ann Thomas, Norm Granneman

Expected Outcome: A description of the patterns of trace elements occurrence across the glacial aquifer and identification of the sources and geochemical factors that control the concentrations. A Scientific Investigations report is the intended outlet for the results of this investigation.

Why is this topic important to report on? No regional or aquifer-wide compilation and summarization of the occurrence and distribution of trace elements is available for the glacial aquifer. Priority pollutant trace elements include: Chromium, Cadmium, Zinc, Lead, Selenium, Arsenic, Radon-222, and Uranium

Other regional synthesis reports are being planned to characterize the occurrence and distribution of the last three trace elements in different areas or other aquifers specifically, but not the first 5, iron and manganese, and other elements in schedules 2703 and 2710. Many of the first six occur together or with dissolved iron and/or manganese. Characterizing the co-occurrence of trace elements and iron and manganese would be helpful for regulators.

Why does this topic need to be addressed now? A data set of sufficient scope and depth is now available from the first cycle of ground-water NAWQA studies. A regional perspective is needed as a baseline for assessing the availability of ground water for increasing supply. To assess the nature of local contamination issues and to develop reasonable remediation goals for contaminated soils and ground water, a regional scientific context of trace element occurrence in the glacial aquifer is needed.

Who cares and why? As water-availability becomes a larger issue there will be increased pressure to develop ground-water resource-they will want to understand the extent and nature of trace element-related problems. Regulatory agencies who are dealing with problems with trace elements, both naturally and anthropogenically need baseline information on regional aquifer concentrations and patterns. They also need to know the transferability of the explanatory factors for trace elements and iron and manganese of the glacial aquifer across states.

There is concern that many of these trace elements are in agricultural fertilizer because steel industry can dispose of some wastes by using it as zinc fertilizer, waste can be recycled in fertilizer, and waste can also be applied as land treatment. *Factory Farming: Toxic Waste and Fertilizer in the United States, 1990-1995.* (51) March 1998. Environmental Working Group. Characterizing the distribution and occurrence of these trace elements in shallow ground water would facilitate the determination if these waste disposal practices are contaminating ground water.

Page 64 of *Opportunities to improve the U.S. Geological Survey National Water Quality Assessment Program* the National Research Council recommends that NAWQA, "Describe the occurrence and co-occurrence of contaminants and contaminant mixtures in the environment that should be considered by other agencies for toxicological and health effects research and risk assessments".

Selected References: U.S. Geological Survey, 2001, *National Geochemical Database: Soil data from the PLUTO geochemical database*. U.S. Geological Survey, Reston, VA.