

Distribution and relation of selected trace elements and mixtures to environmental factors in the Glacial Aquifer System, northern United States

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This report will be published as an SIR

I. Abstract

II. Introduction

(Text describing problem statement, background info)

A. Purpose and Scope

Purpose: Is there a spatial pattern to any or all these trace elements and if so, what causes the patterns, how can we transfer that information to unsampled areas of the aquifer based on statistical and spatial analysis techniques. If a relation can be identified between different types of ground water and the environmental or geologic characteristics of the sample location then these relations can be used to extrapolate estimates of water-quality to unsampled areas. Also to examine combined trace element priority pollutants in an index for total toxicity. Previous studies–Faith’s spatial distribution. Squillace and others, ES&T 2002 vol 36 pg 1923-1930.

Scope: The analysis described in this paper includes data from LUS and SUS wells sampled by NAWQA during Cycle 1 and the beginning of Cycle 2. Data is from across the glaciated area of the United States. Arsenic, radon, and uranium are covered in other reports.

B. Description of Study Area -- The study area includes the Northern parts of the United States that were at one time covered with continental or alpine glaciers. The study area includes parts of 26 states including: Alaska, Connecticut, Idaho, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Dakota, Ohio, Pennsylvania, Rhode Island, South Dakota, Tennessee, Vermont, Washington, Wisconsin. The Glacial Aquifer is one of the most important aquifers in the United States.

Potential Figures:

1. Location of glacial aquifer system in the Northern United States.

1. General glacial history

- a. Glacial Lobes (Cordilleran and Laurentide)
- b. Soils
- c. Surficial Geology
- d. Bedrock Geology

Potential Figures:

2. Map showing surficial geology of the glacial aquifer system, northern United States.
3. Map showing bedrock geology (type of rocks) of the glacial aquifer system, northern United States.

2. Glacial aquifer system framework

The glacial aquifer system framework takes into account the natural characteristics of the glacial aquifer system that are most likely to affect water-quality in the aquifer

Potential Figures:

4. Diagram showing the framework for studying the glacial aquifer system in the northern United States.

a. Natural Vulnerability

This section will discuss the division of glacial aquifer system into regions based on physiography and glacial lobes. Where the glacial material comes from affects its chemical properties. Natural contaminants such as radon, uranium, and arsenic are present in the aquifer material because of glacial source material.

i. Glacial lobes

ii. Regions based on physiography

Potential Figures:

5. Map showing the glacial lobes and physiography of the glacial aquifer system, northern United States.

Potential Figures:

6. Map showing the texture of surficial deposits of the glacial aquifer system, northern United States.

c. Physical setting

This section will discuss the aquifer geometry/depositional setting and describe what the boundary constraints are within the aquifer system (Deposits in valley fill or as layer/lens).

C. Previous studies

Methods and approach – Cite reports describing how data were collected for NAWQA and how we selected the data and edited it for analysis. This could be used by all reports. Include principal Components, ANOVA, etc – all methods. Data Sources such as ground-water trace elements and chemistry and ancillary data [mineralogy, sources, other stuff]. Also discuss QA/QC of trace element data – since hasn't been previously published. Dependent on the report by L. Apodaca.

Distribution of trace elements – all of schedule 2703 that have sufficient data – is there a spatial pattern and why is there a pattern? Show maps of distribution?

- Iron and manganese
- Cadmium
- Chromium
- Lead
- Selenium

- Zinc
- Cobalt
- Molybdenum
- Vanadium

Relations of trace element patterns to selected hydrogeologic factors

- water use/well type (domestic, monitoring, or public supply)
- depth – total depth of well
- Source mineralogy (extrapolated from RASS/Pluto sediment and soils chemical data – make surface from data)
- glacial framework (glacial lobes, regions, surficial texture, and aquifer setting (layer/lens or buried valley)) (natural vulnerability and intrinsic susceptibility – susceptibility related to age (older more susceptible to TE?) and permeability)
- water age – residence time
- other

Relations of trace element patterns to selected water-quality properties and constituents

- Dissolved-solids concentration
- redox conditions [dissolved oxygen, hydrogen sulfide/sulfate, iron and manganese, others]
- dissolved organic carbon (complexes)

Trace elements and mixtures in relation to health-based screening levels

- Comparison to MCLs and standards.
- Total Priority Pollutant Concentrations Index (combined totals) – find which occur most often together. Based on multivariate co-occurrence look at distribution of total concentrations. (see pesticide article Squillace and others, ESNT 2002 vol 36 pg 1923-1930?). Look at mixtures in relation to other factors like redox, and hydrogeologic factors. With graphs showing the mixtures and detection frequency (see example report). Determine mixtures, use non-parametric statistics to look at comparison between groups and significance (wilcoxon rank sum).

Summary and Conclusions

References