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Trace element content, source and distribution regularities in groundwater of Baltic Artesian basin

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The territory of Latvia is a part of the Baltic Artesian (Sedimentary) basin which considering water chemistry and intensity of water connection between aquifers can be divided into three major water exchange zones: freshwater (active water exchange), saline (delayed exchange), and brines (stagnant water exchange zone). An extensive data set about groundwater in Latvia is available from the beginning of the 1960s. Regular groundwater monitoring mainly contains data about groundwater levels, major ion chemistry and physical parameters. Two types of data sources are available on groundwater trace element concentrations in Latvia: 1) the data from geological mapping and hydrogeological exploration during Soviet times and 2) recent studies, particularly „Agricultural influence on groundwater in Latvia" (Gosk et al. 2006). It is impossible to test the quality of the first; therefore, the old data is incomparable to data obtained by modern methods. The second data source is mainly limited to Quaternary sedimentary aquifer susceptible to agricultural influence. Lack of available trace element data in deeper strata led to begin such a study.
The aim of this study is to determine the distribution and sources of trace elements in groundwater in Latvia and compare the results with WHO and EU potable water standards. The obtained results will be compared with the major ion chemistry data and interpret together with stable isotope signals as well as tritium and CFC's data to determine surface recharge intensity thus distinguish possible trace element source. Approximately two hundred groundwater samples from monitoring and supply wells as well as boreholes, and springs will be analyzed by total x-ray fluorescence (TXRF) and atomic absorption spectroscopy (AAS) techniques to determine the concentration of trace elements.
The major benefits of using TXRF analysis is a simple multi-element analysis without external calibration, low maintenance and operating costs, and a small amount of groundwater sample needed (micrograms range). Disadvantage of TXRF analysis is a lower sensitivity compared to ICP-MS. The TXRF analysis will be validated against atomic absorption spectroscopy (AAS) and inductively coupled plasma mass spectrometry (ICP-MS) techniques.
Studies suggest that uranium, arsenic, cobalt and copper values in groundwater can be often derived from agricultural fertilizers. At a regional scale, uranium concentrations in a shallow groundwater samples exceeding 20 μg/L (WHO guideline) appear to be more frequently observed in the southwestern and central parts of Latvia. Arsenic concentrations exceeding 10 μg/L (WHO guideline) are found in the central and the north-eastward part of Latvia. Higher concentrations of several trace elements generally are found in the central and eastern part of Latvia. Investigation also shows that some exceeding trace element concentrations can be associated with gypsum dissolution in shallow groundwater samples.
On account of incomplete studies it is essential to determine the trace element baseline values in Latvian confined aquifers to avoid pollutant migration to lower aquifers.
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Reference:
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