

## Isotopically light meltwater from Scandinavian Ice Sheet in the Cambrian-Vendian aquifer system in northern Estonia: further study prospects

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The Cambrian-Vendian aquifer system is the lowermost of the six aquifer systems of Estonia. Its thickness amounts to 90 m and outcrops along the northern coast of Estonia on the bottom of the Gulf of Finland. The aquifer system is, as a rule, confined by 60 to 90m thick clays of the Lontova formation, having a strong isolation capacity. However, in places the bedrock formations are penetrated down to the crystalline basement by ancient buried valleys, filled mostly with loamy till but sometimes glacio-fluvial gravel occurs in the lower portion of the valleys.

Extensive isotope investigations of the groundwater were combined with geochemical studies in order to understand the processes and climate conditions during the paleorecharge, the age structure of deep waters and the mixing components and their variation. Also amount and composition of extracted gases were determined. A three-dimensional hydrodynamic model covering the whole territory of Estonia was developed for to study the groundwater dynamics.

The oxygen isotope composition of groundwater in most of aquifer systems in Estonia ranges from -11.0 to -12.2 ‰. However, the groundwater in the Cambrian-Vendian aquifer system has a heavily depleted oxygen isotope composition. The values of  $\delta^{18}\text{O}$  vary mainly from -18.1 to -22‰. At the same time, the long term mean annual  $\delta^{18}\text{O}$  DOI: 10.2312/GFZ.mga.046

values in contemporary precipitation in

Estonia are -10.4‰. Low  $\delta^{18}\text{O}$  values in the Cambrian-Vendian aquifer are indicative of recharge in cold conditions, whilst low  $^{14}\text{C}$  concentrations are indicative of long residence time of groundwater. In some samples unexpectedly high gas concentrations (two-five times over-saturation) have been found. Analyses of the gas composition in several cases showed rather high concentration of methane with low  $\delta^{13}\text{C}$  values. This indicates that methane has most probably biogenic origin.

Based on the results of recent studies [1, 2] our current hypothesis is that Cambrian Vendian groundwater in northern Estonia formed by basal melting of Scandinavian Ice Sheet at high fluid pressure and it carries a very distinct signature of dissolved gas concentrations.

To test this concept the following new research in collaboration with Free University of Amsterdam (H. Kooi), University of Heidelberg (W. Aeschbach-Hertig) and others is planned:

- (a) Acquisition of high-quality noble gas, isotopic and hydrochemical data in Cambrian-Vendian aquifer.
- (b) Comprehensive study of ice-core data and gas-entrapment models to establish a quantitative end-member model for the gas content of basal melting recharge water.

- (c) Interpretation of existing and newly acquired data (a) in terms of basal melting signatures and mapping of occurrence and distribution of such waters.

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### **References**

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