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Estimation of groundwater age in the central part of the Baltic Artesian Basin based on new isotope data from Latvia

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Hydrogeological conditions of the Baltic Artesian basin (BAB) have changed rapidly during the Quaternary period. Therefore this work aims to give better overview of the complexity of the groundwater recharge and discharge dynamics beyond country borders, taking into account only shared geological framework, common climate conditions and geological development. To maintain better understanding of the processes that took part in the formation of groundwater that can be observed nowadays several methods were applied placing major emphasis on the new oxygen and hydrogen stable isotope ratio results.

Earlier investigations in the northern part of the basin indicated glacial melt water intrusion in the Cambrian-Vendian. Several radiocarbon and stable isotope studies in groundwater have been done at the southern part of the basin as well reporting extensive groundwater recharge during the Late Pleistocene suggesting that recharge took place under different recharge mechanisms compared with the northern part.

In 2010 to 2012 an extensive field campaign was undertaken, collecting more than 300 groundwater samples for deuterium and stable oxygen, 30 for stable carbon and 10 for radiocarbon analysis mostly from central part (Latvia) of the BAB covering all the major aquifer systems where previously collected data was sparse or absent. A specific motivation for the research was to identify relict glacial meltwater in the groundwater system. The broader aim was to estimate the baseline isotopic composition of groundwater in the region. Here a new data set is presented.

Na-Ca-Cl brine found at the deepest – stagnation zone and is characterized by δ^{18}O values above -5 ‰ and δD values approaching -40 ‰ in respect to VSMOW. The slow exchange zone is characterized by δ^{18}O values around -11.7 ‰ and δD values around -84.8 ‰ . Mean δ^{18}O and δD value of the groundwater in the active water exchange zone is -11.0 ‰ and 79.2 ‰ respectively.

Characteristically the groundwater in the active and slow exchange zone is more depleted comparing to the precipitation values observed in the eighties and the depletion is increasing with depth down to the level where strongly enriched brines are encountered.

Absence of radiocarbon in the deepest aquifers show that groundwater recharged before last glaciation.

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