Dating of saline groundwater from several Israeli aquifers, indication for paleo seawater intrusion and comparison with results of numerical simulations

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ABSTRACT

This study deals with dating of saline groundwater, with salinity closed to that of seawater (mostly >75% seawater). Such dating was seldom conducted before since, in most cases, even the most saline water samples have a significant component of fresh water. Moreover, since the carbon concentration in the fresh groundwater is usually significantly larger than that of seawater, dating of the saline component with the radiocarbon method is difficult even in cases where the fresh component is 25% of the mixture.

We attempt to date saline groundwater in two of the main aquifers in Israel (the Coastal Aquifer and the Mountain Aquifer), using the most saline samples that could be obtained (some are >90% seawater) and correcting with the NetPath geochemical code, in order to estimate the time of seawater intrusion into these aquifers.

In the Coastal Aquifer, most of the saline water was found to be young (>50 years, tritium containing, ~60 PMC) indicating recent seawater intrusion. However, in some of the deeper sub-aquifers older saline water was found (5-10 PMC, i.e. older than ~10000 years), implying penetration of seawater at older time. Complementary age determinations were conducted on the fresh groundwater, some of which were found to be very old.

In the Mountain Aquifer, old saline water bodies were found in several locations. Estimation of the age of the different end members (fresh and saline) showed that the seawater component is older than 30000 year, probably beyond radiocarbon dating. The isotopic values of this old seawater component is similar to that of the present seawater (e.g. $\delta^{18}O$ of ~1.5‰ and 1.8‰ in old and recent seawater) which implies that the intrusion took place in similar sea conditions to that of the present ones. An attempt to determine the age of this old seawater will be done with noble gases.

Numerical simulations were conducted with FEFLOW in order to examine the flow regime in the different parts of the coastal aquifer. At this stage, only some preliminary steady state simulations were conducted and were found to fit quite well with ages of saline groundwater. Transient simulations are planned to be conducted in the next stage in order to simulate the effect of sea level changes (e.g. the rise of 120 meters at the end of the glacial period) on the rate of seawater intrusion into the coastal aquifers. These preliminary data show that dating of seawater component can be conducted provided high salinity groundwater is found.