

Using geochemical tools to study the distribution of saline groundwater in aquifers separated by aquitards: examples from Israel

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ABSTRACT

This study shows the effect of separation by aquitard layers on the distribution of saline groundwater in coastal aquifers. Two examples of Israeli coastal aquifers are given - the Mediterranean Sea and the Dead Sea (DS) - both of which are built of several sub-aquifers. The vertical separation is formed in the DS area even in cases that the clayey aquitard layers is less than 1 m thick. This vertical separation is exhibited by large differences in hydraulic heads (2-5 meters), salinity (TDS of 50-340 g/l) and chemical composition (e.g. Na/Cl variations in the range of 0.28-0.55). Similar features are evidenced in the Mediterranean coastal aquifer, where the separating aquitard layers are thicker (~5-10 meters). Here, the different sub-aquifers host fresh and saline groundwater of different ages (¹⁴C and tritium ages ranging from tens to thousands years), as well as different chemical compositions.

This high resolution of results can only be obtained by drilling without fluids. Otherwise, a significant limitation of the spatial information may lead to wrong representation of any studied aquifer. This is especially important in saline systems where only partial flushing occur and thus large variations in salinity and chemical composition are expected.

The main factors controlling the salinity of groundwater in specific sub-aquifers in coastal aquifers are their connection to the sea or saline lakes, existence of brines, salinization and flushing rates and separation by aquitard layers.