Geophysical Research Abstracts
Vol. 19, EGU2017-15175, 2017
EGU General Assembly 2017

Discovering complex groundwater dynamics of a multiple aquifer system on the base of stable and radio-isotope patterns

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The water supply in semi-arid Israel and Palestine, predominantly relies on groundwater as freshwater resource, stressed by increasing demand and low recharge rates. Sustainable management of such resources requires a sound understanding of its groundwater migration through space and time, particularly in structurally complex multi-aquifer systems as the Eastern Mountain Aquifer, affected by salting. To differentiate between the flow paths of the different water bodies and their respective residence times, a multi-tracer approach, combining age dating isotopes (^{36}Cl/Cl; ^{3}H) with rock specific isotopes like ^{87}Sr/^{86}Sr and δ^{34}S-SO_4 was applied. As a result, the investigated groundwaters from the two Cretaceous aquifers and their respective flow paths are differentiable by e.g. their ^{87}Sr/^{86}Sr signatures, resembling the intensity of the rock-water interaction and hence indirectly residence times. In the discharge areas within the Jordan Valley and along the Dead Sea shore, δ^{34}S-SO_4 ratios reveal the different sources of salinity (ascending brines, interstitial brines and dissolved salts). Based on ^{36}Cl and ^{3}H and the atmospheric input functions, very heterogeneous infiltration times and effective flow velocities, respectively, indicate an at least dual porosity system, resulting in distinctly different regimes of matrix and pipe flow.