Geophysical Research Abstracts
Vol. 19, EGU2017-1633-1, 2017
EGU General Assembly 2017

Geochemical processes in a calcareous sandstone aquifer during managed aquifer recharge with desalinated seawater

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In the last three years we monitor Managed Aquifer Recharge (MAR) of post-treated desalinated seawater (PTDES) in an infiltration pond, at the Menashe site that overlies the northern part of the Israeli Coastal Aquifer. The PTDES are stabilized with $CaCO_3$ during post-treatment in the desalination plant and their chemical composition differs from those of any other water recharged to the aquifer and of the natural groundwater. We use suction cups in the unsaturated zone, shallow observation wells within the pond and production wells that encircles the MAR Menashe site, to study the geochemical processes during MAR with PTDES. Ion-enrichment (remineralization) of the recharged water was observed in both unsaturated zone and shallow observation wells samples. Enrichment occurs mainly in the first few meters below the pond surface by ion-exchange processes. Mg^{2+} enrichment is most prominent due to its deficiency in the PTDES. It is explained by ion-exchange with Ca^{2+}, as the PTDES (enriched with Ca^{2+}) infiltrates through a calcareous-sandstone aquifer with various amount of adsorbed Mg^{2+} (3–27 meq/kg). Hence, the higher concentration of Ca^{+2} in the PTDES together with its higher affinity to the sediments promotes the release of Mg^{2+} ions to the recharged water. Water isotopes analysis of the production wells were used to estimate residence time and mixing with local groundwater. At the end of 2016, it was found that the percentage of PTDES in adjacent down-gradient production wells was around 10%, while more distant or up-gradient wells show no mixing with PTDES. The distinct isotope contrast between the recharged desalinated seawater (δ^2H=+11.2$\pm$0.2‰) and the local groundwater (δ^2H ranged from -22.7 to -16.7‰) is a promising tool to evaluate future mixing processes at the Menshae MAR site. Using the Menashe MAR system for remineralization could be beneficial as a primary or complementary post-treatment technique. However, the sustainability of this process is still questionable, as the recharged water remineralization is accompanied by mineral depletion of the pond sediments. Study on the feasibility of this remineralization scheme is currently ongoing using laboratory column experiments and reactive transport modelling.