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Using multi-component hydrochemical pattern for water balance calculations of intricate water resources in semi-arid regions – a case study in Wadi Al Arab, Jordan.

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Groundwater harvesting in the semi-arid Wadi al Arab, located in the NW most corner of the Kingdom of Jordan, is supposed to be sustainable. However, since implementation of intense well fields, which take water from the Cretaceous A7/B2 aquifer, springs along the wadi course dried out and groundwater table dropped locally tremendous. To overcome the uncertainties in qualitatively and quantitatively characterising that water resource, a multi-component hydrochemical study was carried out within the SMART-project, which was also used to provide reliable boundary conditions to build up a transient numerical flow model.
Wadi Al Arab represents a multi-aquifer system, with unknown interactions between the Cenozoic and Cretaceous aquifers. The exact identification and qualitatively characterization of the different groundwater bodies, the definition of their flow regimes and the recharge rate is a necessary step to calculate a reliable water balance and a rational policy of water management.
Inter-aquifer flow prevents the benchmark treatment of the groundwater bodies and its detection by classical methods is an almost impossible task. In order to overcome these difficulties, the main known components of the multi-aquifer system were analysed for REY (REE+ Yttrium) abundance, major elements and for stable isotopes of water (δ18O and δD). The different waters in the area were than classified considering these parameters. This enabled identifying their respective replenishment areas and to elucidate the mixing processes controlled by structural features. This study shows that REY patterns are a powerful tool to decipher the lithology of the catchment area and the intricate patterns of flow paths of the aquifer systems. These information allow the correct definition of boundary conditions for a successful hydraulic modelling.