



Isotope hydrological fingerprints, hydrochemistry and groundwater dynamics in the potash and rock salt-mining town of Stassfurt, Germany

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Salt mines are very sensitive to water inflow. Water inflow into mines can trigger salt dissolution processes, subsidence and subsequently ground subsidence, especially if the entering water is undersaturated with respect to certain minerals. This is equally the case in the former potash and rock salt-mining town of Stassfurt, Saxony-Anhalt, Germany, where surface breaks and land falls have been observed in the past 150 years, which are still proceeding today. The hydrochemical composition of groundwater in the Stassfurt area is governed by the geologically defined aquifer storeys. The aquifers in the upper unconsolidated rock aquifer as well as those in the Triassic aquifer and the upper caprock are very similar due to their hydraulic connection. They are dominated by NaCl and CaSO₄ solutions. The salt contents are strongly related to depth. Gypsum and anhydrite saturation is reached, as well as halite saturation at the contact to the rock salt. Highly concentrated solutions of an Mg-K-Cl type predominate in the deep saline aquifers including the cavities of the abandoned salt mines, and replace the NaCl-CaSO₄ solution type with increasing depth. Solutions that are saturated with respect to halite, carnallite, sylvite and kainite can be found in depths below approx. 150 m below the surface. Beside the establishment of typical hydrochemical and isotope hydrological fingerprints (³H, ³He_{tri}, ⁴He, ¹⁴C, ¹³C) of the individual aquifers, we here characterize residence times of groundwater and mixing trends. In addition, hydraulic connections within as well as in- and outflow of water into the flooded mines are discussed to assess potential instabilities and dissolution risks.