A multi-isotope approach to trace salinisation in the lower Valley of Wadi Medjerda, Nothern Tunisia

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The study of the Lower Valley of Wadi Medjerda (LVWM) a coastal aquifer located in northern Tunisia, involves a comprehensive geochemical and isotopic evaluation of water samples collected between 2016 and 2017. The purpose of the study was to evaluate the chemical vulnerability of groundwater to potential environmental change stemming from the increase of groundwater salinity and abstraction. Different methods using geochemistry (ions Na^+/Cl^-, Br^-/Cl^-, Ca^{2+}/Cl^-, B^-/Cl^-) and isotopes (^{18}O, ^{2}H, ^{11}B, $^{87}Sr/^{86}Sr$) are compared with the hydrodynamic information and salinity map for identifying the main processes involved in the increase of groundwater salinity. The δ^2H–$\delta^{18}O$ signatures show mixing between seawater and freshwater.

The $^{87}Sr/^{86}Sr$ ratios are close to that of seawater for some samples and seem to follow a two end-members mixing line and then increase with depth, reflecting water–rock interaction with clay formations while punctual low values reflect interaction with carbonate. Boron isotopes highlight secondary processes such as adsorption/desorption onto clays in addition to mixings. According to the isotopic data, desorption processes triggered by a modification in chemical equilibrium and an increase in ionic strength by seawater intrusion significantly increased Sr and probably B concentrations in groundwater.

Along the coast of the lower valley of wadi Medjerda (LVWM), and resulting from the groundwater overexploitation, the irrigation development that induces the soil leaching is the major reason for the mineralization increase. The qualitative degradation of the groundwater is also caused by dissolution of evaporate rocks (gypsum and halite minerals) in the aquifer and by seawater intrusion.

Finally, combining the results of this study and those of neighbor aquifers, we discuss the possible future evolution of this aquifer system under global change, as well as the potential management strategies needed to preserve quantitatively and qualitatively this water resource.