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Defining a conceptual model for the coastal aquifers of Mediterranean islands, an example from Corsica (France)

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A hydrochemical and isotope study was conducted to identify the flow paths, the recharge areas and the geochemical processes governing the evolution of groundwater in a Mediterranean carbonate coastal aquifer. The study is expected to improve the hydrogeological conceptual model based on environmental tracer investigations tools to characterise and quantify the aquifer system of Bonifacio. The groundwater resource represents the unique drinking water resource of the southern Corsica and the region faces a high pressures over the groundwater resource during the touristic period (2,000,000 tourists per year). A well-documented description of the geology and structure of this basin was the starting point for a detailed hydrogeochemical and isotopic study at the aquifer scale.
A hydrochemical (physico-chemical parameters, major ions) and isotope (δ2H, δ18O, 3H) survey of rainwater and groundwater has been carried out monthly during almost two years. A local meteoric water line has been defined and marine, terrestrial and anthropogenic influences on the recharge water hydrochemistry have been described. Preferential recharge during autumn/winter of rainfall is observed and a depletion in the isotopic signature for some groundwater samples suggests a recharge in higher altitude from the surrounding granites. A modification of the input signal during infiltration through the unsaturated zone appears and the groundwater hydrochemistry displays differential variations in time and space, with the presence of inertial water bodies in the lower aquifer mainly. In this context, CFCs (CFC-11, CFC-12, CFC-113) and SF6 were used to evaluate groundwater residence time. CFCs have been relevant despite the presence of a deep unsaturated zone and the computed rate of groundwater renewal is pluriannual to multi-decadal. Natural SF6 was found in granites and has been used as a direct tracer of groundwater origin, highlighting its role in the aquifer lateral recharge. Strontium isotopes (87Sr/86Sr) were used to improve knowledge of groundwater mineralization and mixing processes. The use 87Sr/86Sr vs δ18O was relevant and helped confirming and quantifying the granitic contribution to the aquifer recharge. To improve the quantification of the water balance terms, submarine groundwater discharges have been studied using aerial infrared images in conjunction with Radon and Radium isotopes (222Rn, 223,224Ra).