# Combining boron isotopes and carbamazepine to monitor artificial recharge (southern Mediterranean)

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The groundwater resources of coastal areas are highly vulnerable, being located either in complex hydrogeological structures or in local shallow aquifers where water stress and salt water intrusion occur under the multiple constraints governed by increasing anthropogenic pressures and climatic conditions. Yet, recent integrated water resource planning often relies on alternative water supplies. In order to limit seawater intrusion in an agricultural overexploited watershed and to ensure water availability, managed aquifer recharge with treated wastewater was settled in the Korba aquifer on the east coast of Tunisia.

Water quality monitoring was implemented in order to determine the different system components and to trace the effectiveness of the artificial recharge. Groundwater samples taken from recharge control piezometers and surrounding farm wells were analyzed for their chemical contents, for their boron isotopes, a proven tracer of groundwater salinization and domestic sewage, and their carbamazepine content, an anti-epileptic known to pass through wastewater treatment and so recognized as a pertinent tracer of wastewater contamination.

The aquifer system is constituted by the superficial and shallow Plio-Quaternary formations and by the deeper Miocene units which constitute its basement. Marine Pliocene sediments display interbedded sandstone-sand-marl topped with variably clayey sandstone. Quaternary deposits are mainly made of fossiliferous carbonated sandstones.

The system equilibrium was permanently disturbed by the different temporal dynamics of continuous processes such as cation exchange, and by threshold processes linked to oxidation-reductive conditions. The boron isotopic compositions of groundwaters displayed a significant variability (10 - 45 ‰) and significantly shifted back-and-forth due to mixing with end-members of various origins. Under the variable contribution of meteoric recharge, the Plio-Quaternary groundwater was subject to seawater intrusion that locally induced high $\delta^{11}B$ values superior to the seawater signature ($\delta^{11}B$ > 39 ‰, no carbamazepine). The managed recharge water ($\delta^{11}B$ of 10.7-13.8 ‰) was brackish and of poor quality with a carbamazepine content showing a large short term variability with an average daily level of 328 ± 61 ng/L. A few piezometers in the vicinity of the recharge site gradually acquired a B isotopic composition close to the wastewater signature with increasing carbamazepine contents (from 20 to 910 ng/L). The combination of boron isotopic signatures with boron and carbamazepine contents can be a useful tool to assess sources and mixing of treated wastewaters in groundwaters.