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Multi-isotopes constraints on the origins and processes of groundwater salinization in coastal aquifers. Example of Recife, Northeast of Brazil

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The Recife Metropolitan Region (PE, Brazil) is a typical "hot spot" illustrating the problems of southern countries on water issues inducing high pressures on water resources both on quantity and quality in the context of global social and environmental changes. This study focuses on the groundwater geochemistry in a costal multilayer aquifer and aims at investigating the sources and processes of salinization. The RMR basement is constituted by two different Precambrian blocks separated by a large lineament area. The sedimentary fillings of the two basins present different origins that can be distinguished by the Sr isotope composition. The northern deep Beberibe aquifer displays very high strontium isotope ratios with a large range of values (87Sr/86Sr = 0.7102 to 0.7233) illustrating the main continental origin of sediments whereas the southern deep Cabo aquifer showed lower 87Sr/86Sr values (87Sr/86Sr = 0.7097 to 0.7141) indicating the contribution of the marine sedimentation dating from the Atlantic opening. Although sulfate isotopes, Electric Conductivity and Cl contents indicate a clear mixing with seawater for some samples of the deep Cabo and Beberibe aquifers, all 87Sr/86Sr values are above the present-day seawater composition. This can be related to the complex local history of transgression/regression phases that induced alternatively salinisation and freshening with gains and losses of cations and Sr, together with water-rock interactions. Stable isotopes of the water molecule clearly evidence the local present day recharge especially within the surficial aquifer, whereas some samples are affected by in situ evaporation processes and/or recharge with evaporated water originating from dam used for water supply. The two deep aquifers display a high range of B concentrations ($\sim$20 to 600 μg.L-1) and B isotope composition (δ11B = 6.7 to 68.5 ‰, with the highest values known to date (63-68.5‰. This suggests multiple sources and processes affecting B behavior, among which mixing with saline water, B sorption on clays/organic matter and mixing with wastewater. Indeed, the Tertiary and Quaternary surficial aquifers are highly contaminated with wastewater and locally salinized; here salinisation is possibly due to present seawater intrusion.