

Groundwater degradation by different salinization processes: three case studies on the application of environmental isotopes to assess seawater intrusion vs. dissolution of salt minerals in coastal areas

^aCarreira P M, ^bMarques J M, ^aNunes D, ^cPina A

Environmental isotope studies were used to assess the origin of salinization and to complement other geochemical investigations which, in some cases, did not provide conclusive results. We present three case studies on coastal aquifers: i) at the Meso-Cenozoic Portuguese S border (Algarve basin), ii) at the Lower Tagus – Sado sedimentary Basin and iii) in the Santiago volcanic island: Cabo Verde. In all cases there occurs groundwater salinization, up to several grams of TDS/L. The source of this high mineralization could be: a) seawater encroachment; b) dissolution of diapiric structures intruding the aquifers or dispersed saline minerals and c) brine dissolution at depth.

In the first case, the Algarve basin was subdivided into two main sectors: i) Portimão – Estombar sector: the karst springs found along Arade River banks, together with wells drilled through the adjacent karstic formations, clearly shown to be fed by a mixture of sea and fresh water, as evidenced by $\delta^{18}\text{O}$ features; ii) in the second sector Faro - Tavira, the correlation coefficient of $\delta^{18}\text{O}$ vs. electrical conductivity is poor ($r = 0.246$). In this sub-sector, the increase in the salt concentration is usually not followed by an isotopic effect: dissolution from salt domes seems to be the prevailing mechanism of groundwater salinization rather than seawater intrusion.

In the second case study, performed in the Lower Ta-

gus – Sado Basin, located in Setúbal -Lisbon region, there is a growing concern that the groundwater systems maybe in danger by overexploitation due to i) mixing with shallow aquifers (highly polluted), ii) seawater intrusion processes in coastal areas, or iii) brine dissolution detected at depth by geophysical studies. Geophysical studies have demonstrated that a regional graben structure is responsible for the rising of brine or ancient seawater trapped in the sediments, during the basin formation. Furthermore, a gradual change from $\text{HCO}_3\text{-Ca}$ to Cl-Na -type is observed in the groundwater samples from this area.

Concerning the third case study, Santiago Island, the sampling was performed along two transects. There are no permanent rivers on the island. A few years ago a small dam was built (Poilão Dam). Apart from this, the water resources are restricted to groundwater, exploited by means of springs, galleries, dug and drilled wells. Isotopic data ($\delta^{18}\text{O}$ and $\delta^2\text{H}$) together with chemical parameters were used in the appraisal of salinization mechanisms in the aquifer systems (sea water intrusion vs. marine aerosols) and in the quantification of the amount (percentage) of mixture between seawater and fresh water. Physical-chemical parameters together with the environmental isotopic data were applied in the characterization of the main groundwater flow paths.

^a Instituto Tecnológico e Nuclear (ITN), Estrada Nacional nº10, 2686-953 Sacavém, Portugal (carreira@itn.pt)

^b Instituto Superior Técnico, Technical University of Lisbon, Center of Petrology and Geochemistry

^c Instituto Superior de Educação, Praia, Santiago, Cabo Verde