

Fossil groundwater in a deltaic aquifer that supplies to a desalination plant

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ABSTRACT

The detrital coastal aquifer of the Andarax delta, SE Spain, supplies to a desalination plant (Almería Desalination Plant) from 17 beach boreholes since 2007. These boreholes cut all the aquifer thick (around 100 m) and they are located 30 - 150 m inland along the delta shoreline. The aquifer from which the water is taken—Lower Andarax Aquifer—extends along the whole valley and delta of the river Andarax and is formed by Pliocene and Quaternary fluviodeltaic deposits. The daily volume of salty groundwater intake of the plant has changed over time, currently being around 28,000 m³/day. Three piezometers, aligned perpendicular to the shoreline and placed at 100 (PI), 200 (PII) and 300 (PIII) m from the coast, have been used to monitor the changes that the desalination plant pumping has generated in the aquifer. Since the desalination plant started to work until today, EC logs and samplings have been carried out periodically in these piezometers and also in some borehole that supplies to the plant. The EC profiles show that there is a transition zone between saltwater and freshwater in the aquifer, and the freshwater layer has increased its thickness over time due to the pumping. EC groundwater values supplied to the plant show are around 45 mS/cm, lower than seawater conductivity (55 mS/cm).

Carbon-13 and Carbon-14 isotopes were utilized in this study to determine the age of groundwater. The results show that freshwater and seawater are modern. Nevertheless, saltwater in the deepest part of the aquifer further landward is fossil, with ¹⁴C_{DIC} age about 10,000 years old. Finally, the samples taken in the mixing interface have an intermediate value, showing that they are a mix between fresh and saltwater.

According to these results, we can demonstrate that water taken by the desalination plant is recent seawater, which is partially mixed with freshwater from the upper level. This mix lowers the groundwater EC. There are also some differences between water temperature supplied to the plant and other samples, being 2-3 °C lower the first one, which also point out its recent character. The presence of fossil groundwater in the deepest part of the aquifer is related to the Flandrian transgression, around 10,000 years BP, when the Andarax delta did not exist and instead, an estuary was formed in this area. The seawater from this estuary infiltrated towards the base of the aquifer and it is still located at this site.

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