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Petrophysical characterisation of a clastic coastal aquifer with implications for saltwater intrusion and the evolution of groundwater resources. The GRAIN D'SEL and DEM'EAUX ROUSSILLON projects, Occitanie, France.

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More than 80 Mm^3 per year are pumped into the Roussillon plain coastal aquifer located between the Pyrenean massif to the South and West, and the Mediterranean to the East. This is a 350 m thick Pliocene multilayered aquifer, with sandy layers embedded in low-permeability clayey material and topped by Quaternary alluvial deposits. The groundwater resource is primarily used for drinking water and irrigation. For more than 40 years, this aquifer has been undergoing a piezometric level decline due to pumping, while water demand is expected to increase with ongoing climate change, sea level rise and increasing demand in water use. Consequently, the Roussillon aquifer is likely to suffer from sea water intrusion and marine submersion in the near future.

As part of the Dem'Eaux Roussillon project, a set of downhole geophysical profiles was recorded at three drillsites, in Saint Cyprien and Barcares along the Mediterranean shore and at Pollestres, 14 km inland. Downhole petrophysical data (NMR porosity and permeability, acoustic velocities, electrical resistivity and spectral gamma natural radioactivity) contribute to better define the penetrated structure. Core petrophysical measurements were also made to support and calibrate these analyses and, in particular, to provide a dm-scale description of the subsurface pore fluid electrical conductivity along the length of each hole. A combined analysis of the latter with porosity and permeability points at incipient and m-scale intrusion processes along discreate horizons.

Repeated downhole measurements overtime and fluid sampling provide a means to follow the dynamics of these intrusion processes found to be more acute at the Barcarès site to the North than close to the Pyrenean, at Saint Cyprien. While permanent downhole geophysical observatories have been installed to measure at high frequency both formation electrical resistivity and temperature, a real time management of groundwater resources should contribute to improve aquifer water quality in the future. These observatories datasets will be analyzed and modeled on the basis of smaller scale petrophysical data, providing both an assessment of water quality evolution in terms of salinity from resistivity and quantity in terms of flow rate from temperature.