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Distribution of mineralized groundwaters in a deep aquifer due to geological heterogeneities and paleogeographic conditions: the Eocene aquifer in the Aquitaine Basin (France)

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In the sedimentary Nord Aquitaine Basin (south-west of France), the Eocene aquifer, mostly confined, is one of the main resources for irrigation, thermo-mineral water, and moreover for drinking water in the Bordeaux region. In this aquifer, a large saline area has been identified, where the groundwaters show high values of mineralization and anomalous levels of critical elements, such as sulfates and fluoride, leading to difficulties of resource exploitation for drinking water supply (i.e. the Entre-deux-Mers area).

This study focused on the geochemical, multi-isotopic and hydrogeological characterization of these mineralized groundwaters with the aims to improve the understanding of the origin of the salinity in this mineralized area and how these waters circulate in the Eocene aquifer system.

Compared to existing data, many new analysis including both major and trace elements, and several isotope systematics show a common origin for the mineralized groundwaters. These data are completed by a detailed geochemical modeling which determines the chemical processes that led to the acquisition of this mineralization, notwithstanding that the spatial distribution of the mineralization is very heterogeneous.

The vertical and lateral localization of the mineralization in the aquifer was scrutinized through with an important paleogeographic reconstruction. This was undertaken to locate horizons which can be source and origin of this mineralization. Following a reinterpretation of existing data and acquisition of new ones (logs, mineralogical analysis of cuttings), several levels have been identified in the Eocene aquifer containing either evaporates, or fluorine. Their geographical organization was designed and the spatial distribution is consistent with geochemical analysis.

The extreme lateral variability of the mineralization appears to be rooted in the complexity of the overlapping layers of low permeability within the Eocene aquifer system. A hydrodynamic and geochemical modeling can be run at local scale, in accordance with the regional hydrodynamic model. Both have validated hypotheses on groundwaters circulation within the heterogeneous Eocene aquifer system.