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Impact of sedimentologic and structural evolution of the Aquitaine Basin on actual water quality. Eocene sand aquifer, south western France.

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In the sedimentary Aquitaine Basin, the Eocene Sand Aquifer system, mostly confined, represents strategic resources for drinking water, irrigation, gas storage and geothermal resources. Therefore, its quantity and quality issues are essential for the sustainable management in this large region that extends over 116,000 km2 (i.e. one-fifth of the French territory). The Eocene Sand Aquifer system comprises at least five aquifers: Paleocene, Eocene infra-molassic sands, early Eocene, middle Eocene, and late Eocene. The extension and thickness of Eocene aquifer layers and negative confined layers vary throughout the basin, from several tens of metres to a hundred metres. The deposit sequences characterizing the Eocene Aquifer System are progradational westward from detrital deposits to carbonates. Eocene sands and Eocene limestones are hydraulically connected and covered by an aquiclude of up to several hundred metres thick of molassic sediments.

The groundwater recharge is assumed to occur through the Eocene outcrops located in the north and north-east, and in the south east in contact with the Montagne Noire as well as by vertical leakage from the upper and lower aquifers. Another recharge is suspected in the south near the Petites Pyrenees.

The north and south evolutions of the piezometric surface are different. In the north, because of years of pumping, a trough in the potentiometric surface has been formed. The piezometric decline is roughly one meter per year in the depression centre. In the south, the decline of the water table is roughly half a meter per year.

Two hydrodynamic models exist for the Aquitaine Basin (one in the north and the other in the south) and allow knowing the flow circulations between the different aquifer layers in this multi-layer system. Upward or/and downward leakages are observed notably between the Eocene, Paleocene and Infra-Molassic Sands layers and the others. However, a major difficulty for the sustainable management is the lack of knowledge in the central part of this area, due to a lack of geological prospection data.

The quality of waters induces others management difficulties. The geochemical analyses reflect the influence of the lithologies (e.g. carbonates, silicates and evaporites). The highest mineralization is generally encountered in water draining evaporitic formations; but can also be observed in areas where such lithologies are not yet observed. Thus, many boreholes used for drinking water supply present waters with sulphate and fluoride concentrations exceeding the drinking water standards, while secondary resource for dilution is not always present.

These mineralizations are related to at least three different processes:

- In the south, under the effect of tectonic stresses due to the Pyrenean orogenesis, the evaporitic Triassic deposits have been affected. Phenomena of halokinesis and diapirism appeared. If some salt diapirs are known today at the surface, others affect only the first overlying layers, and thus are less characterized. Borehole near a diapir has a SO4 - Na water type reflecting anhydrite and/or halite dissolution.
- In the Gironde estuary, old brackish or saline water are trapped under the Flandrian clay, in contact with underlying Eocene aquifer and contaminate some wells.
- In the Entre-deux-Mers and the Medoc, groundwaters of the Eocene aquifer indicate the presence of evaporates despite there is no diapirism identified in the vicinity. Some gypsum deposits are known at outcrop in the study area margin and are assumed to come from non-marine deposits in the framework of endoreic basins like temporary lakes.

Coupling hydrogeological, geological and geochemical approaches may help to better understand and constrain management of this complex aquifer system.