Large sedimentary aquifer system and sustainable management: investigations of hydrogeological and geochemical variations in 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 region. The system 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. According to isotopic data, both present-day recharge and old recharge (16-35 ky) can be evidenced. 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.

Furthermore, in the south part, around two sites of gas storage, significant fluctuations of the potentiometric surface are superimposed to the variations resulting from water abstraction, due to the injection and abstraction of gas. 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 complex geological structures (anticlines, synclines, faults, grabens, horsts, salt diapirs) must also be taken into account in order to develop modelling approaches.

In addition to the quantitative aspect, 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.

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