Chemical composition of waters from deep aquifers is impacted by the interactions between waters and reservoir rocks. The determination of an accurate chemical composition of waters is thus necessary to identify the origin of this mineralisation. The water chemistry of the Infra-Molassic Eocene aquifer (Aquitaine Basin - France) has been investigated through different studies highlighting various origins for water mineralization. Isotopic analyses helped, in agreement with hydrogeology, to identify geochemical basins whose properties modify the chemical water composition (André, 2002; Douez, 2007).

The chemical composition of waters from this deep aquifer (about 500 to 1000 m depth) does usually not change with time. However, seasonal variations of sulphate concentrations occur in a specific area. About 200 analyses of sulphate collected during more than 10 years show variations between 10 and 110 mg SO₄/L. These local variations are correlated with the water conductivity and anti-correlated with piezometric variations (reaching about 80 m per year) induced by the seasonal storage of natural gas in a close sector of the aquifer.

Several hypotheses can be considered in order to explain these sulphate concentration variations:

- **mixing** of waters from different aquifers,
- **vertical transfers** by advection or dispersion from the upper molassic aquitard,
- **local biological processes...**

The objectives of this study are to determine which of these hydro-chemical processes plays the most important role.

This study uses both isotopic tracers (δ¹⁸O and δ³⁴S of sulphates, δ¹³C and δ¹⁴C) and composition of trace elements (Fe, Ba, Sr...) in order to determine the origin of these variations. It will be based on existing chemical data but also on the acquisition of new ones with quarterly samplings of waters (on the well of interest and 4 neighboring wells located within a 10 km range).

This chemical approach will be secondly coupled with an **hydrochemical model** of the specific area in order to understand the local behaviour of the aquifer (residence time, recharge processes, interaction with adjacent reservoirs/aquitards).

These isotopic measurements will be coupled in the hydro-geochemical model with variations of sulphur isotopes in order to define the source of sulphur, knowing that no sulphur-bearing mineral is present in the aquifer (André et al., 2002).

This study uses different geochemical tools in order to determine the origin of the mineralization of deep waters. Based on sulphur isotope measurements, first calculations determined potential exchange at the interface between aquifer and aquitard.

This study uses new geochemical markers to identify and confirm/infirm these exchanges.