Geophysical Research Abstracts
Vol. 13, EGU2011-10343, 2011
EGU General Assembly 2011

Dating tools applied to mineralized Eocene groundwater, for a sustainable management of the Entre-deux-Mers drinking water, Aquitaine Basin, South western France.

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In the south-west of France, the Eocene aquifer is one of the main resources for irrigation, thermo-mineral water, and mainly for drinking water in the Bordeaux region.

This aquifer is characterized by the presence of a large mineralized area, centered on the Entre-deux-Mers region, between the Garonne and the Dordogne rivers, where the groundwaters show strong mineralization and anomalous levels of critical elements, such as sulphates and fluoride, leading to difficulties of resource exploitation for drinking water supply.

Initiated early 2009, the CARISMEAU 2 project, focuses on the geochemical, multi-isotopic and hydrogeological characterization of this mineralized groundwater sector of the Entre-deux-Mers area. The main objectives of this project are to improve the understanding of the origin of the salinity of this mineralized area and to investigate how these mineralized waters circulate in the Eocene aquifer and/or in this multi-layer aquifer system.

The deposit sequences characterizing the Eocene aquifer system are progradational westward, from detrital deposits to carbonates. The Eocene sands and the Eocene limestones are hydraulically connected, the limit of their extension is located under the city of Bordeaux. The groundwater recharge may occur through the Eocene outcrops located in the north and north-east of this mineralized area of the Entre-deux-Mers, and also by vertical leakage from the Oligocene aquifer.

Furthermore, the second aspect to consider in this saline area concerns the piezometric evolution of the Eocene aquifer years after years. In fact, a trough in the potentiometric surface is noticeable for the Eocene Aquifer, centred under the city of Bordeaux. For years, the decline of the piezometric surface is roughly one meter per year in the center. The cone of pressure relief in this confined aquifer stretches to the east year after year in the same direction, toward the Garonne and the Dordogne rivers.

In autumn 2009, the first investigation of over 50 wells and springs gave preliminary characterizations of the aquifer. Groundwaters from more than 50 boreholes have been sampled. Others groundwater samples come from continuously monitoring, in 2010 - 2011, during long-term pumping of several boreholes for drinking water.

Combined geochemical analysis (major and trace elements) and classical isotopic methods using $\delta^{18}O_{H20}$ and $\delta^{2}H_{H20}$, $\delta^{34}S_{SO4}$ and $\delta^{18}O_{SO4}$is carried out. In addition, an innovative set of isotopic methods using strontium isotopes and more exploratory isotopic methods like boron, lithium, uranium/thorium and radium isotopes are applied on the mineralized area. U/Th results are compared to former ^{14}C results. Moreover several ^{3}H analyses have been performed on 11 samples, including one spring which age and original aquifer were unknown.

These dating tools may help to better understand the complex circulations in the Eocene aquifer, of primary importance for drinking water, and its connections to the others aquifer layers. The results of this dating approach coupled with hydrodynamics models, hydrogeological knowledge and a better understanding of the deposit conditions and mineralization may help to better manage this strategic resource of drinking water.