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Revision of radiocarbon ages in groundwater from the Eocene aquifer in the Aquitaine basin (France)

Laurent André (1,2), Jean-Luc Michelot (3), Pierre Deschamps (4), Elise Decouchon (1), and Arnaud Wuilleumier (5)

(1) BRGM (French Geological Survey), 45060 Orleans, France (l.andre@brgm.fr), (2) ISTO - Institut des Sciences de la Terre d'Orléans - UMR7327 - 45071 Orléans - France, (3) CNRS – Université Paris Sud – Geosciences Paris Sud – 91405 Orsay - France, (4) CNRS - CEREGE – 31 Chemin Joseph Aiguier – 13402 Marseille - France, (5) BRGM (French Geological Survey), 33600 Pessac, France

In deep aquifers the complex flow pattern originating from the geological structure often leads to difficult predictions of water origin, determination of the main flow paths, potential mixing of waters. All these uncertainties prevent an efficient management of the resource. In the context of the Aquitaine basin (France), new investigations were done on the Eocene aquifer, a sandstone reservoir located in the southern sector of the basin (south of the Garonne river). The waters of this aquifer are used for various purposes such as drinking water, geothermal energy, irrigation, thermalism.

Because of these different uses, geological, hydrogeological and geochemical studies were lead in order to better understand the main flow paths and potential interactions of these waters with sus- and subjacent deep horizons. However, due to the aquifer extensions (a bit less than 15 000 km^2) and the scarcity of the access points (less than 50 operated wells unequally distributed on the aquifer area), many questions are still not solved.

For the geochemical characterizations of these waters, previous sampling campaigns performed between 1990 and 2000 allowed defining the chemistry of the water and some isotopic properties (André et al., 2005, Journal of Hydrology 305, 40–62). Specific measurements were done on the estimation of the age of the waters. These first investigations gave carbon 14 activities ranging from 0.5 pMC (in the deepest parts of the aquifer) to about 20 pMC (close to the outcrops) with average values close to 3 pMC.

New investigations were recently done to complement the characterizations of the groundwater. The main goal was to propose a new sampling method adapted to ancient waters but also to use the latest measurement tools. The sampling for Carbon 14 measurements consists to use sampling inox bottles with a volume of 500 mL. Two taps at the inlet and outlet of the bottle allow a perfect isolation of the water from the atmosphere during the sampling time. Then, in lab, the bottle is connected to an analytical line including an AMS (Accelerator Mass Spectroscopy). Water samples were also collected to measure the Chloride 36 content in order to determine (i) the potential mixing of the groundwater with oldest ones or (ii) a different origin of the waters according to the location in the reservoir.

Results of Carbon 14 analyses show that waters are oldest than the ages determined in previous investigations. The new measured Carbon 14 activities are not exceeding 1 pMC for all the waters in the deepest parts of the reservoir, corresponding to ages older than 30,000 years. The new measurements also confirm the potential mixing of waters with youngest ones close to the outcrops. This re-estimation of the ages slightly modifies the flow paths proposed up to now, particularly close to the geological structures. Furthermore, these new data provide hints on the reservoir properties (like permeability) and it will help to constrain the hydrogeological models.