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

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1 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.

2 Context

The extension of the Eocene aquifer is a bit less than 15,000 km². Its depth is ranging between about -1,500 m and land surface due to geological structures. Less than 50 operated wells unequally distributed on the aquifer area allow accessing to the deep water. For the geochemical characterizations of these waters, previous sampling campaigns performed between 1990 and 2000 allowed defining the chemistry of the water and isotopic properties (Blavoux et al., 1993 ; André et al., 2002; 2005). Specific measurements were done particularly on sulfate and carbon isotopes and first hypothesis based on geochemical observations were proposed (Figure 1).

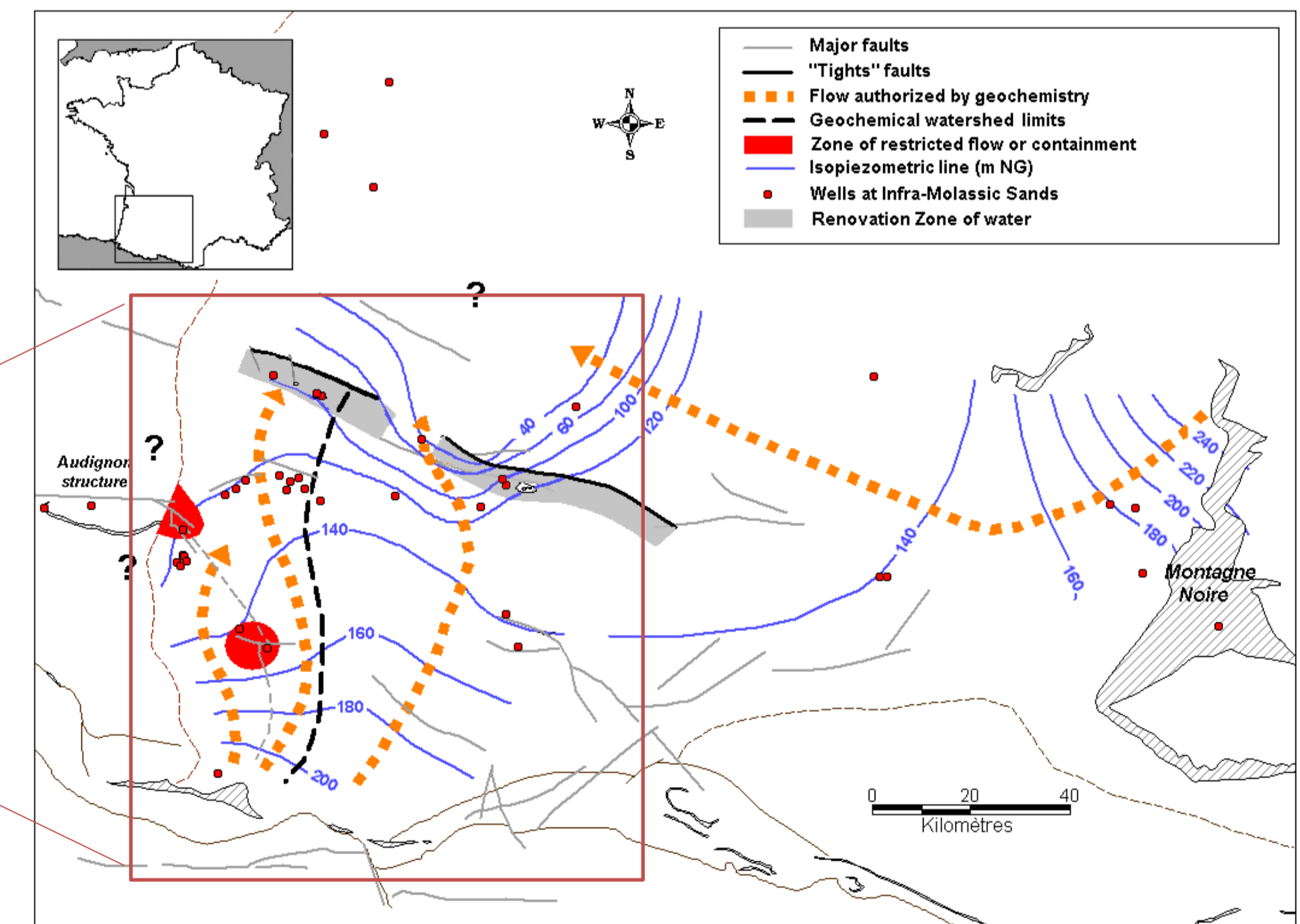


Figure 1 : Major flow directions suggested by geochemical modelling (André et al., 2005)

3 Objectives

Despite the geological, hydrogeological and geochemical studies led on this aquifer, some questions are still not solved:

- Exchanges of water with sus- and subjacent deep horizons.
- Transfers of water to the North and to the West

New investigations are done in the Framework of the GAIA project (cf Oral presentation EGU2018-7537) to complement the characterizations of the aquifer. Efforts are partly focused on the geochemical properties of waters, especially radiocarbon isotope.

4 Sampling methodology and raw results

The water sampling for ¹⁴C measurements consists to use inox bottles with a volume of 500 mL (Figure 2). Two taps at the inlet and outlet of the bottle allow a perfect isolation of the water from the atmosphere during the sampling period.



Figure 2 : sampling of waters for ¹⁴C measurements with inox bottles

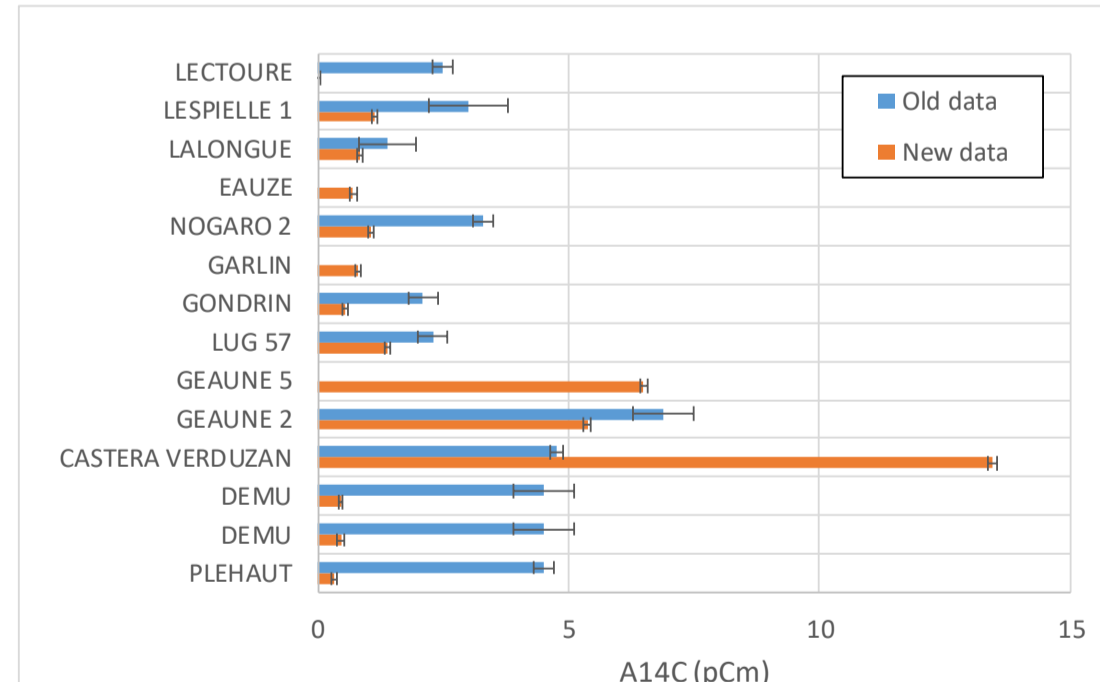
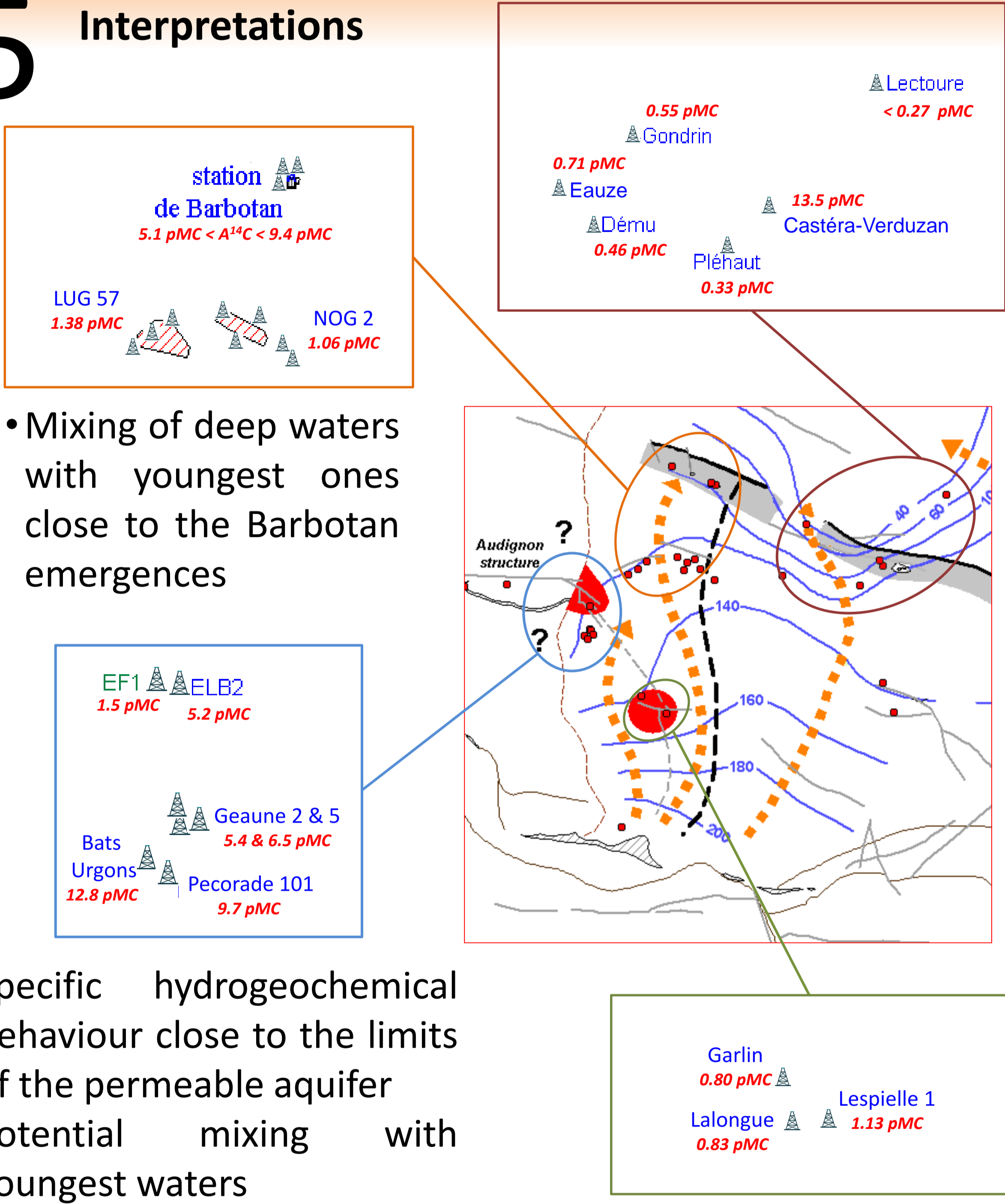


Figure 3 : Comparison of new and old ¹⁴C measurements

¹⁴C activities are lower than the ones determined in previous investigations. The new measured ¹⁴C activities are not exceeding 1 pMC for all the waters issued from the deepest parts of the reservoir, corresponding to ages older than 30,000 years (Figure 3).

5 Interpretations



- Mixing of deep waters with youngest ones close to the Barbotan emergences
- Specific hydrogeochemical behaviour close to the limits of the permeable aquifer
- Potential mixing with youngest waters

- Origin of water different in the North of the Celt-Aquitaine structure (Lectoure)
- Mixing of young waters with deep waters close to the structure correlated with an increase in carbonate content (Castéra-Verduzan)
- Very low ¹⁴C activities elsewhere
- Ages of waters higher than 30,000 years
- Local stagnation close to the Garlin deep structure

7 References

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6 Conclusions

The new measurements 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.

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