



NEW INVESTIGATIONS IN FORMER HYDROCARBON EXPLORATION WELLS IN THE AQUITAINE BASIN, FRANCE: HOW TO GET RELIABLE DATA? A CASE STUDY

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DEEP BOREHOLES...

Are often difficult to accurately sample using pumping techniques

Because wellbore purging induces *flow-weighted averaged samples*.
& because the use of heavy material is often needed.

What to do then?

Deep sampling is of peculiar interest in such a case – especially when some information about the physico-chemical structure of the aquifer at screen level is known.

What will you discover when browsing poster?

- An application study in South-West France (in the Aquitaine basin).
- There, deep aquifers are often crosscut by exploration wells drilled for hydrocarbon exploration (up to more than 4000 m).
- When no hydrocarbon resource was found, the boreholes were plugged to a certain depth and abandoned, then converted into piezometer by perforating their casings (over a ten of meters).
- Endeavour the chemistry of deep aquifers,



830 The maximum depth
(m) of deep sampling during this survey

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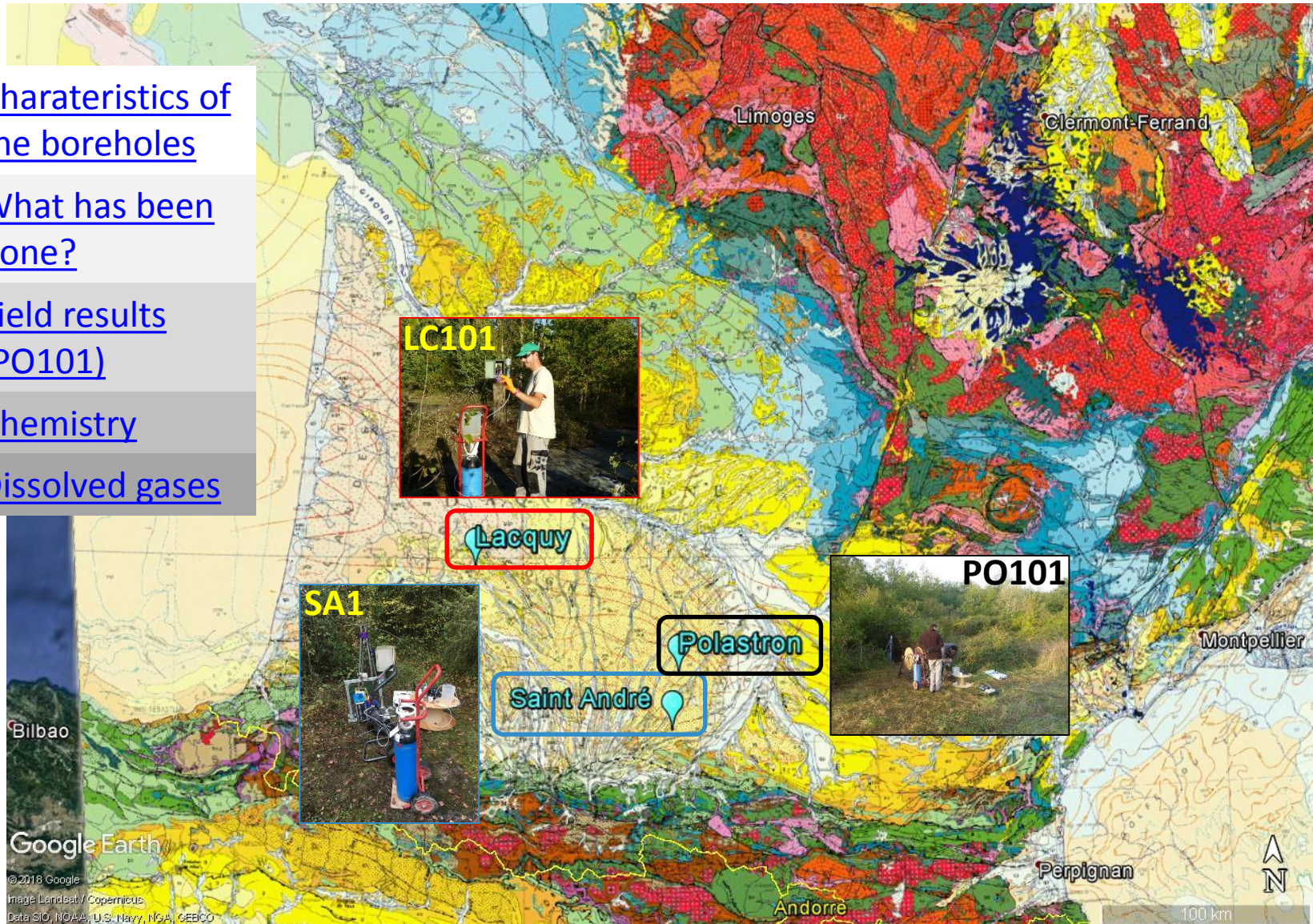
Characteristics of the boreholes

What has been done?

Field results (PO101)

Chemistry

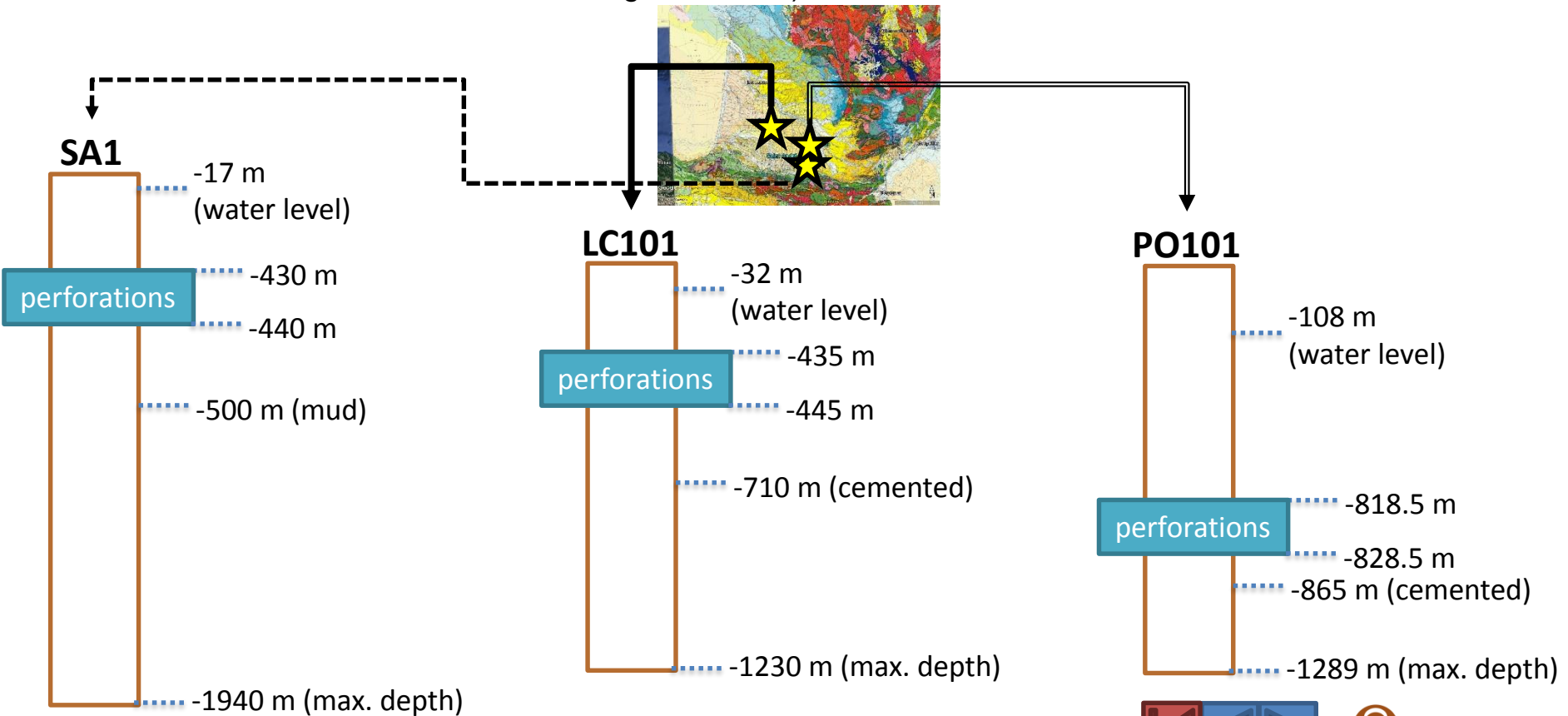
Dissolved gases



Conclusions

CHARACTERISTICS OF THE BOREHOLES

- They belong to the Infra-Molassic Sands Aquifer, Eocene aquifer of great interest.
- Used for drinking water, irrigation, geothermal applications and seasonal gas storage, depending on the location in the basin (120 km NS by 200 km EW) and the depth of the piezometric level (from less than 40 m to more than 200 m below ground level).

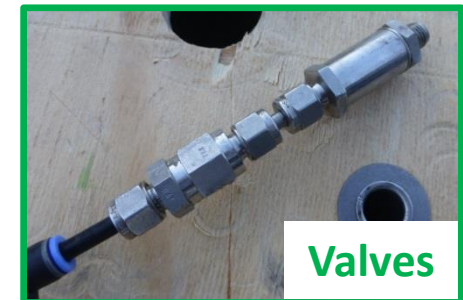
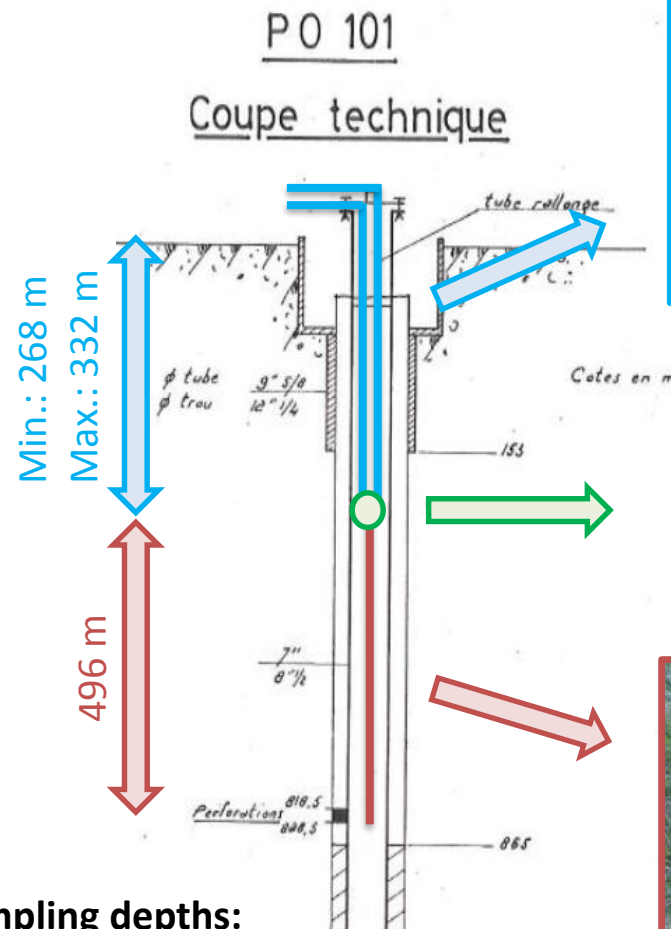


WHAT HAS BEEN DONE?

Detailed investigations:

1. Well logging (T°, EC, pH, ORP, dissolved O₂) + flowmeter measurements + camera inspection;
2. Deep sampling at selected depths (as learned from chemical logging), under ambient flow conditions (PO101 only; SA1 was partially plugged – need of purging; LC101 was also pumped as floating hydrocarbon phases were present);
3. Little borehole stimulation by pumping (water renewal at the perforated level);
4. Deep sampling is performed again at similar depths, to track similarities and/or changes induced by pumping and water renewal at depth.

EXAMPLE OF DEEP SAMPLING AT PO101



5 sampling depths:
764 – 810 m (above perforations)
819 – 823 – 828 m (perforations)

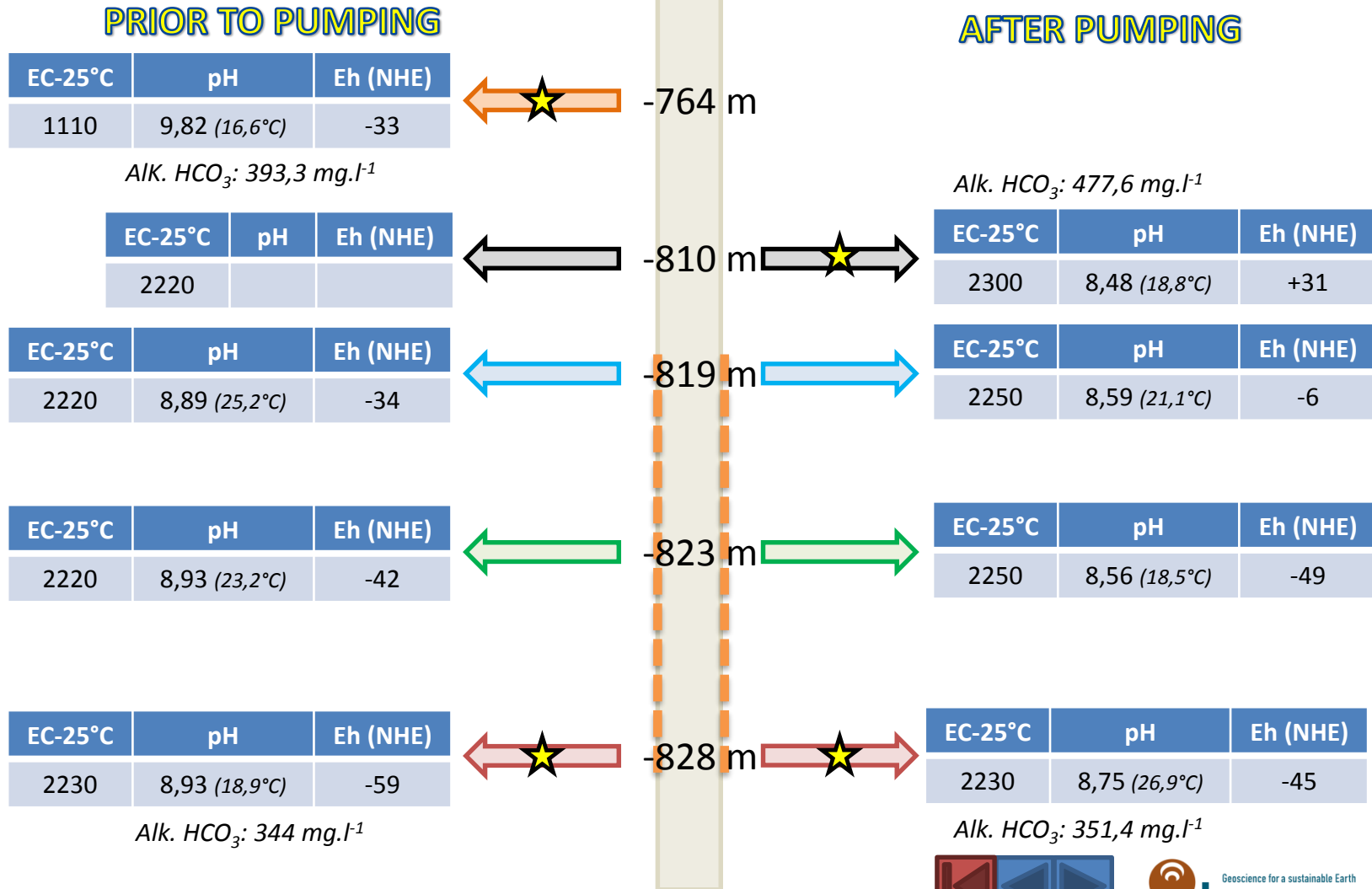
WHAT HAS BEEN MONITORED IN THE FIELD?

- The main goal was to add data on poorly constrained boreholes: complete characterization of dissolved chemical species has been done.
- *Here the focus is on major elements and dissolved gases. This has helped to select samples for complementary isotope analyses (under progress).*



SITE CHARACTERIZATION

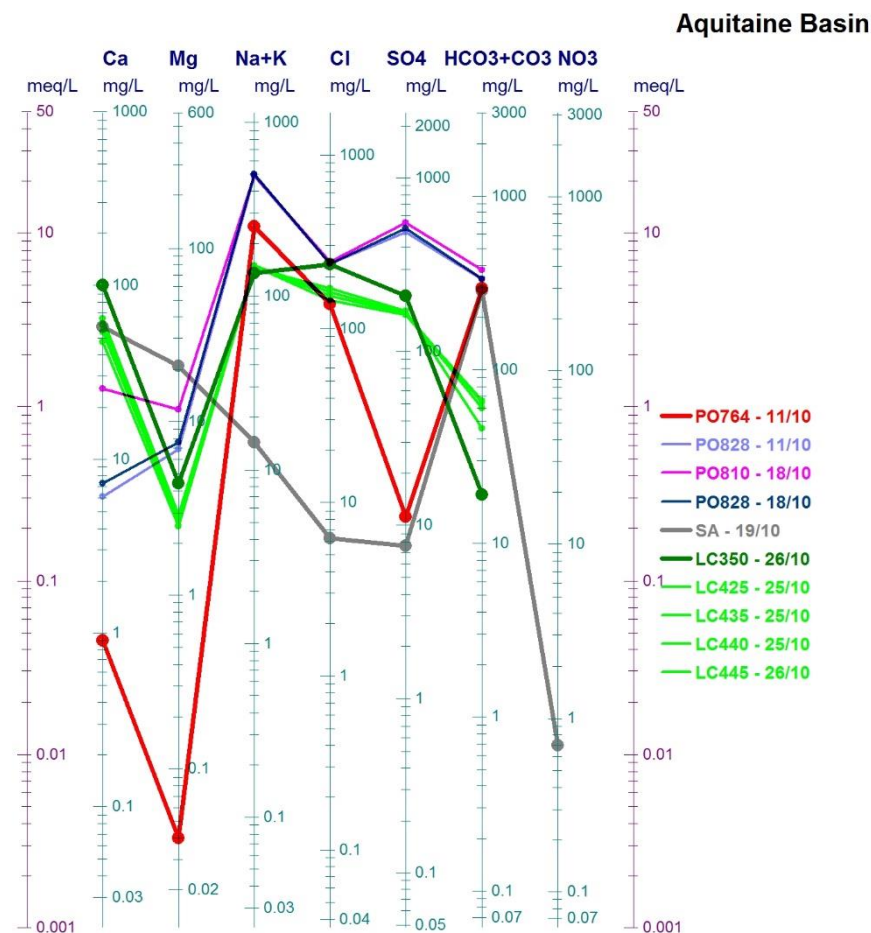
Example of Polastron



DISSOLVED ELEMENTS

Influence of pumping.

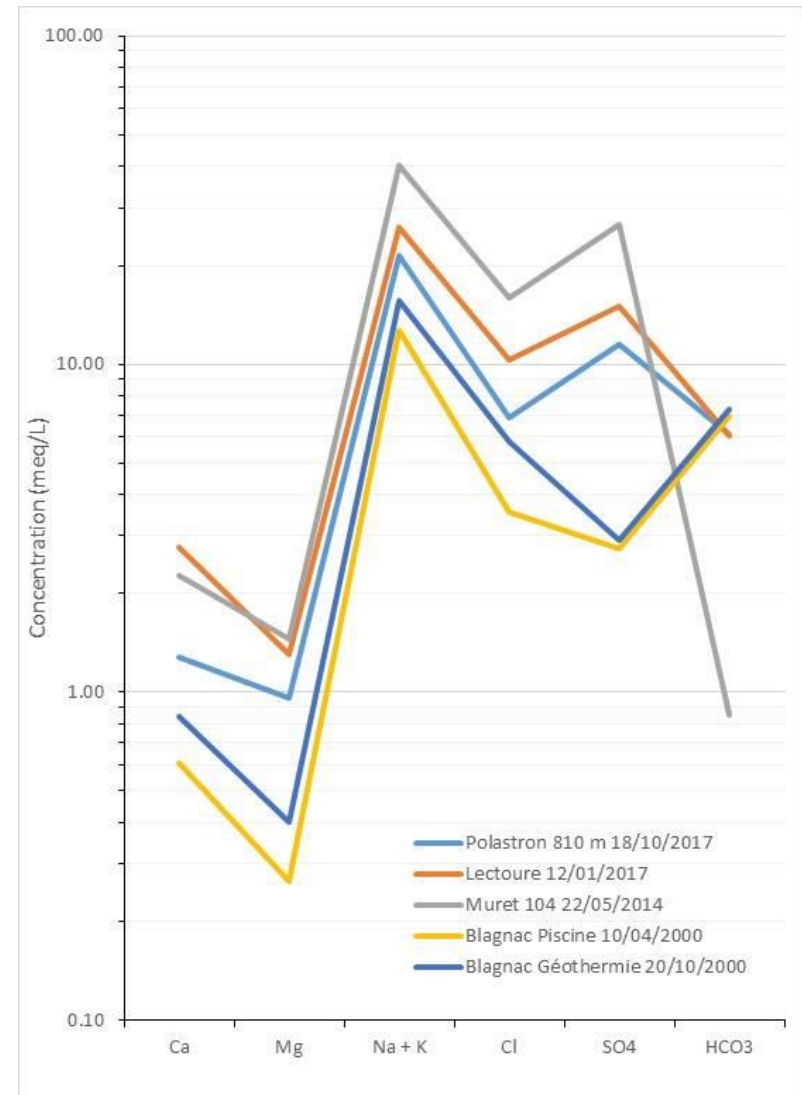
- As shown by Schöeller plot, especially for PO, there is minor influence of the pumping when considering samples taken at screens' level.
- When multiple samples are taken in the screened section (case of LC samples), low variability is found → relative homogeneity of the perforated interval.
- At the opposite there is strong variation when samples are taken above this level (LC350) → this highlights the need of complete well purging to get representative samples.
- This also highlights the pertinence of deep sampling in such situations.



DISSOLVED ELEMENTS

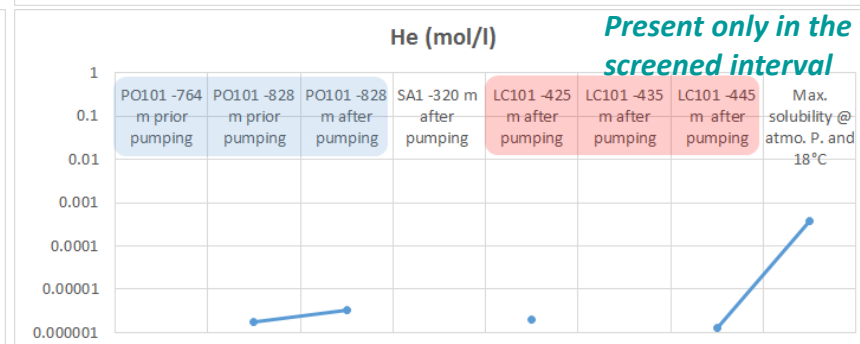
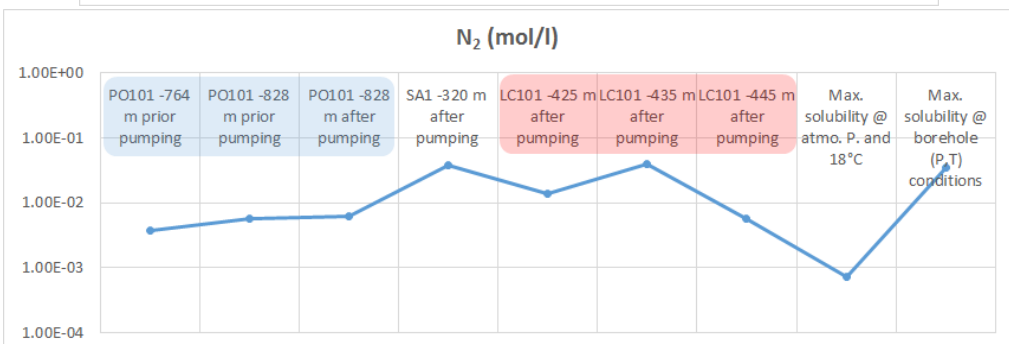
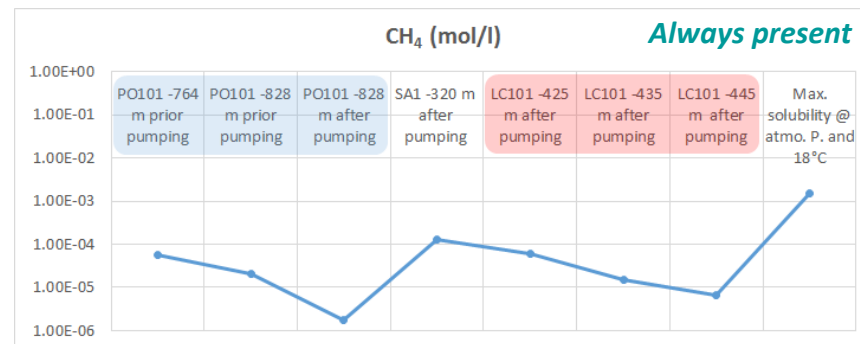
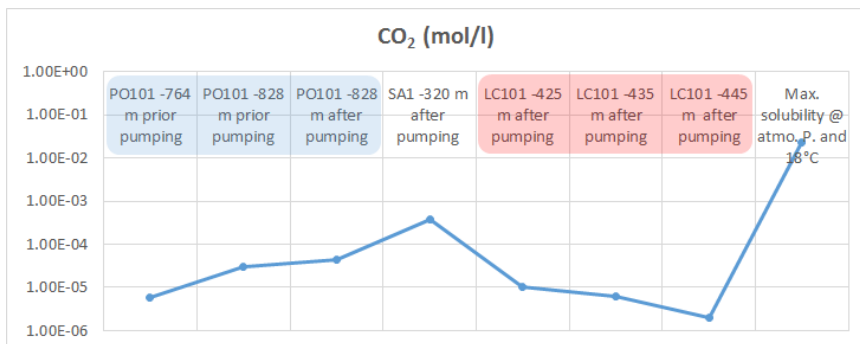
Information at the basin' scale.

- Compared to other boreholes set in similar geological context, the new data confirm a common origin and some mixing trends can be hypothesized.
- Further information will come from isotope analyses (in progress).



DISSOLVED GASES

- Samples are taken directly in the water flux when operating the deep sampling system – samples are stored in evacuated glass bulbs.
- Gases are under dissolved state with the exception of N_2 (slight degassing may occur when the water is circulated in the sampling system but no degassing occurs at screens' level). For PO101, this bubble nucleation may occur when deep waters are at depths lesser than -190 m (this occurs when a pumping is made).



GENERAL CONCLUSIONS

- *New investigations have been performed in low productive boreholes using deep sampling in the Aquitaine basin.*
- *Comparison of data acquired prior to and after a slight pumping suggests that reasonable estimates of the chemistry can be obtained if the sampler is lowered at the level of the screened section even if no pumping is made.*
- *A slight pumping may give complementary insurance on the water renewal at depth. This doesn't preclude the lowering of the deep sampler in the screened section, to avoid disturbance that may be caused by vertical gradients in the borehole.*
- *These deep waters are rich in Na and Cl, associated with Ca and HCO_3 .*
- *They are also containing noticeable amounts of dissolved gases such as CO_2 , light alkanes or helium. Nitrogen is the dominant specie and punctually some degassing may exist when deep waters are artificially drawn to the surface (during pumping or during sampling). Extra-care must then be taken if noble gas sampling has to be performed.*