Post-Doctoral position at University de Pau et des Pays de l'Adour (France)

Etude de la biodégradation de composés aromatiques dans des réservoirs de stockage de gaz naturel en aquifère par approche isotopique

Study of the biodegradation of aromatic compounds in reservoirs of natural gas storages in aquifer using an isotopic approach

Duration: 24 months
Location: IPREM and LFCR, *Université de Pau et des Pays de l'Adour* (Pau, France)
Beginning: September-October 2024
Compensation: About 2 200 Euros net per month

Description of the post-doctoral position:

The management of groundwater quality is a major concern when storing natural gas in aquifers [1]. Especially, the fate of the aromatic compounds BTEX (Benzene, Toluene, Ethylbenzene and Xylenes), contained as traces in the stored gas, and transferred to the water, need to be monitored as they are known to have adverse effects (e.g. [2]). As a key contribution, the monitoring of BTEX natural attenuation by bio-chemical processes through $\delta^{13}C$ and δD isotope fractionation measurements is very promising [3]. However, it is important to refine the link between isotopic signatures and the studied storage sites according to the reservoir temperatures and heterogeneities (geochemical (mineral assemblage, water composition, …) and petrophysical) and the cycling period (injection vs. withdrawal), for example, to understand why isotopic fractionation is not recorded in the same way within various gas storage reservoirs.

To tackle these issues, researchers of two labs hosted at the *Université de Pau et des Pays de l'Adour* (LFCR and IPREM) and one French gas storage operator, STORENGY, have developed collaborations and obtained a support to fund a two years Post-Doctoral Research Associate (PDRA) position.

Thus, the recruited PDRA will have to tackle some of the above questions related to the BTEX isotopic fractionation for gas storage in aquifers monitoring. To do so, the PDRA will contribute:

1. To maintain the monitoring of BTEX levels and the carbon ($\delta^{13}C$) and hydrogen ($\delta^{2}H$ or δD) isotopic fractionation of these elements in groundwater and natural gas samples for the STORENGY partner, by implementing the analytical methodology, from sampling to detection. The aim will be to supplement the data already acquired and possibly to analyze in greater detail certain natural gas and water samples from underground storage facilities operated by STORENGY.
   In addition, as the biodegradation of benzene can be coupled with the reduction of sulfates, additional isotopic analyses of $\delta^{34}S$ of sulphates and sulphides will be carried out on water samples (taken at the wellhead), where these compounds are present in high concentrations, with the aim of discriminating and better understanding their origin (oxidation-reduction processes, biological/chemical formation processes, etc.).

2. And mainly to refine the link between the isotopic signatures and the studied storage sites as a function of reservoir heterogeneities. Based on data obtained since 2014 during previous work as well as on the acquisition of new measurements, the aim is to provide answers to the following questions:

- What is the impact of the physical geochemical heterogeneity of the reservoirs on the isotopic signature of $\delta^{13}C$ and $\delta^{2}H$ of BTEX?
- Does the isotopic signature of $\delta^{13}C$ and $\delta^{2}H$ of BTEX vary with the injection or withdrawal periods at the sites?
- Why is the increase in the isotopic signature over time of certain compounds (such as benzene, for example) not demonstrated at certain active storage sites?

To answer these questions, statistical studies will be also carried out (using principal component analyses, for example) to highlight any correlation between parameters inherent to the different studied storages. Also, simulations using the PhreeqC geochemical software [5] could help to better understand the reaction processes involved.

Depending on the considerations and needs of part 2, more samples could be taken into consideration as very little data has been acquired at certain sites. One of the aims of this study could therefore be to expand the database of gas and water isotopic analyses (part 1).

References:

[1] Hunkeler D., R.U. Meckenstock, B. Lollar, T.C. Schmidt, J.T. Wilson, U.S. Environmental Protection Agency, Washington D.C., 2009.
[2] Aullo T. PhD thesis of the Université de Pau et des Pays de l'Adour, 2013.
[3] Mancini S.A., A.C. Ulrich, G. Lacrampe-Couloume, B. Sleep, E.A. Edwards, B. Sherwood Lollar, Applied and Environmental Microbiology, 191, 2003.
[4] Wanner P., D. Hunkeler, Chemosphere 219, 1032, 2019.
[5] Parkhurst, D.L., and Appelo, C.A.J.. Geological Survey Techniques and Methods, book 6, chap. A43, 497 p., https://doi.org/10.3133/tm6A43.

Required qualification:

PhD in Geochemistry, Analytical Chemistry, Chemical Engineering, or related domain.

Profile sought:

Candidate capable of developing analytical laboratory protocols, with experience in numerical simulations and/or isotopic geochemistry or motivated to strengthen his/her skills in these fields. Training in the use of the Phreeqc geochemical software may be provided.

Application:

C.V. + Motivation letter (deadline 31 May 2024) to

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