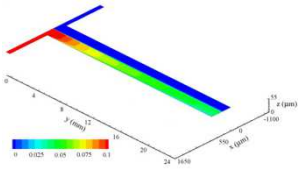
# PhD position in reactive transport

## Thermophysical processes effects in reactive transport mechanisms induced by $CO_2$ injection in deep saline aquifers



Employer: Université de Pau et des Pays de l'Adour (UPPA)

Laboratoires: **Laboratoire des Fluides Complexes et de leurs Réservoirs (LFCR),** UMR 5150, UPPA/CNRS/TOTAL, 1 Allée du parc Montaury, 64600 Anglet ; **Bureau de recherches géologiques et minières (BRGM)**, 3 av. Claude Guillemin, BP 36009, 45060 Orléans & **Institut des Sciences de la Terre d'Orléans (ISTO)**, Université d'Orléans/CNRS/BRGM, 1A rue de la Férollerie, 45100 Orléans

Date and duration: 3 years starting from October 2018

Subject: The dissolution of $CO_2$ in deep saline aquifers is recognized as one of the fundamental mechanisms for the geological storage of large quantities of $CO_2$. The injection of $CO_2$ into these reservoirs induces several coupled phenomena, including mass and heat exchanges between phases ($CO_2$ - brine - minerals). In addition to the naturally occurring geothermal temperature gradient, larger localized temperature gradients are generated during the injection. These gradients generate the phenomenon of thermodiffusion, which induces a segregation of the dissolved chemical species in the mixtures. This effect is not taken into account in the existing models of $CO_2$ dissolution in aquifers and of reactive transport simulating the long-term evolution of the system. This PhD project is related to the CO2ES Chair, a partnership among E2S-UPPA, TOTAL and BRGM. The goal of the project is to improve our understanding of the various trapping and transport processes involved in $CO_2$ geological storage. The objective of the PhD project is twofold: i) to evaluate to which extent thermodiffusion mechanisms contribute to differentiating brines within a reservoir and to generating specific dissolution / precipitation reactions under $CO_2$ storage conditions; ii) to understand physical and physico-chemical processes at the interfaces between phases ($CO_2$ - brine - minerals) in systems stressed by large thermal gradients, especially in the near-wellbore region.

For this purpose, thermodiffusion experiments on mixtures of $CO_2$-water-salt, water-salt1-salt2 and the related subsystems will be conducted at the LFCR (Anglet).The different convection thresholds will be investigated by shadowgraphy, and the diffusion and Soret coefficients will be estimated. Then microfluidic experiments will be developed to observe the interface between two highly contrasting electrolyte solutions in the presence of a temperature gradient perpendicular to the interface. The impact of the thermal gradient on the formation and organization of mineral deposits will be quantified by optical microscopy. Numerical modeling of reactive transport in the presence of the geothermal gradient but also local thermal gradients will be performed at BRGM/ISTO (Orléans). Finally, the possibility for dealing with global or local inhomogeneities of temperature will be integrated in one of the existing software used for simulating the multiphase reactive transport processes induced by $CO_2$ injection.

Desired profile: The candidate must hold a master or equivalent degree with majors in physics or physical chemistry, with a strong background in fluid mechanics and coupled processes in chemical engineering, geoenergies, etc. Experiences with microfluidic experiments and image analysis are a plus. Good knowledge in English and good writing skills are required.

Techniques used: Shadowgraphy, microfabrication, microfluidics, microscopy, image processing and analysis, numerical simulations, reactive transport modeling

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