

<b>Project Number</b>	8
<b>Name/title of the PhD course</b>	Doctoral Thesis in Earth and Environmental Sciences
<b>Name/Title of the PhD project</b>	<i>H<sub>2</sub> migration and reactivity along faults: laboratory and modelling study</i>
<b>Recruiting organisation and Department/Faculty of reference</b>	ISTerre laboratory is part of the Université Grenoble Alpes, and it is a world leading research institution in geoscience (ranked 24th by the Shanghai QS ranking; Earth Science field 2022), with 110 permanent scientists and 41 engineers. ISTerre has a strong expertise in the field of H <sub>2</sub> generation, migration and reactivity in geological environments with five permanent scientists and three engineers working in this field for more than one decade. The PhD student will work in the Natural Hydrogen Observatory Group Grenoble ( <a href="https://nativeh2project.osug.fr/">https://nativeh2project.osug.fr/</a> ) led by Laurent Truche & Frederic Victor Donzé. Equipment and infrastructures available to the recruited DC is presented in the Web site of the H <sub>2</sub> group.
<b>Scientific context and Objectives</b>	Hydrogen is a reducing agent that may react with oxidized species (e.g. pyrite, hematite, sulfate) in the geological media. Hydrogen reactivity may be purely abiotic (involving catalytic mineral surfaces) or microbially mediated. Such reactivity may decrease the quality of the resource by consuming H <sub>2</sub> and producing toxic compounds like H <sub>2</sub> S. Hydrogen may also be adsorbed at the surface of microporous minerals like clays. All these phenomena are still poorly quantified and have never been studied in a self-consistent manner. This PhD project will address the 3 following objectives: 1) quantifying H <sub>2</sub> adsorption at high H <sub>2</sub> pressure and T ranging from 25 to 80°C; 2) understanding H <sub>2</sub> reactivity (both microbial and abiotic) in core samples (reservoir and caprocks) 3) modeling H <sub>2</sub> migration and fluid-rock interaction in reservoir rocks and along fractures in caprocks.
<b>Expected Results</b>	The expected results are as follow: - amount of H <sub>2</sub> uptake by rocks (reservoir and caprocks) at relevant pressure and temperature (volumetric adsorption isotherms); - H <sub>2</sub> migration and reactivity through reservoir and cap rocks at the core scale under relevant UHS condition (parametric experiments in tri-axial cell) ; - a reactive transport model calibrated with the previously obtained experimental data (adsorption, kinetics, permeability).
<b>Secondment opportunities</b>	University of Edinburg (Pr. K. Eldman) and University Napoli (Pr. D. Giovannelli)
<b>Brief CV of main Supervisor</b>	Laurent Truche is professor of geochemistry&georesources and co-leading the Natural Hydrogen Observatory Group Grenoble, responsible for assessing the potential of native hydrogen ( <a href="https://nativeh2project.osug.fr/">https://nativeh2project.osug.fr/</a> ). He is in charge of the Georesources Master Program at UGA. He works on fluid-rock-gas interaction at elevated temperature and pressure. His research aims to understand redox process occurring in the Earth's crust (H <sub>2</sub> migration from sources to sinks, ore forming processes, sulfur cycle) and deep underground engineered structures (nuclear waste repository, H <sub>2</sub> and CO <sub>2</sub> storage). He is particularly interested in H <sub>2</sub> behavior in deep geological environments. He uses a multidisciplinary approach that combine field investigations, hydrothermal experiments, in situ spectroscopy and reactive transport modelling. He (co-)supervised 10 PhD theses, 6 post-docs and 15 master students in geochemistry and georesources. Publication list: <a href="https://scholar.google.fr/citations?hl=fr&amp;user=66zPxNUAAAAJ">https://scholar.google.fr/citations?hl=fr&amp;user=66zPxNUAAAAJ</a>
<b>Publications</b>	<ol style="list-style-type: none"> <li>1. Lefeuvre, N., Truche, L., Donzé, F. V., Gal, F., Tremosa, J., Fakoury, R. A., ... &amp; Gaucher, E. C. (2022). Natural hydrogen migration along thrust faults in foothill basins: The North Pyrenean Frontal Thrust case study. <i>Applied Geochemistry</i>, 145, 105396.</li> <li>2. Lefeuvre, N., Truche, L., Donzé, F. V., Ducoux, M., Barré, G., Fakoury, R. A., ... &amp; Gaucher, E. C. (2021). Native H<sub>2</sub> exploration in the western Pyrenean foothills. <i>Geochemistry, Geophysics, Geosystems</i>, 22(8), e2021GC009917.</li> <li>3. Truche, Laurent, Thomas M. McCollom, and Isabelle Martinez. "Hydrogen and abiotic hydrocarbons: molecules that change the world." <i>Elements: An International Magazine of Mineralogy, Geochemistry, and Petrology</i> 16.1 (2020): 13-18.</li> </ol>
<b>Projects participation</b>	<ol style="list-style-type: none"> <li>1. Natural H<sub>2</sub> exploration (French National Research Agency)</li> <li>2. H<sub>2</sub> reactivity (microbial and abiotic) in reservoir and caprocks (Shell)</li> <li>3. Kinetic of H<sub>2</sub> generation from steel corrosion in cimentitious environment (EDF)</li> </ol>