

One-Year Postdoctoral Position (M/F)

“Experimental Investigation of the Potential and Kinetics of H₂ Production in Continental Rocks”

As part of the EPOCH2 research project, funded by Carnot ISIFoR and involving four partner institutions—UAR 3360-DMEX and UMR 5150-LFCR at the University of Pau and Pays de l'Adour (Pau, France), UMR 5563-GET at the Observatoire Midi Pyrénées (Toulouse, France), and IFP Energies Nouvelles (Rueil-Malmaison and Lyon, France; member of the Carnot Institute IFPEN Energies Resources)—we are offering a one-year postdoctoral position.

Research project

The DMEX platform has developed expertise in the theoretical estimation of H₂ production from continental rocks, which are accessible for potential exploitation. This approach relies on the characterization of the physico-chemical properties of centimeter-scale natural samples using a combination of non-destructive 3D imaging techniques (X-ray tomography and spectral tomography), complemented by analyses such as scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), and electron microprobe analysis [1–4]. The coupling of all these data enables the identification and quantification of Fe³⁺-rich secondary mineral phases formed during redox reactions, thereby allowing the theoretical estimation of the amount of H₂ generated per kilogram of rock. The Fe²⁺ present in these rocks, which can be oxidized to Fe³⁺, thus represents a potential source of exploitable H₂.

To date, most experimental studies on the oxidation of Fe²⁺ to Fe³⁺ have been conducted on powdered samples, which poorly represent natural rock textures. The EPOCH2 project aims to experimentally investigate the conditions, kinetics, and efficiency of Fe²⁺ oxidation in real samples derived from potentially exploitable rock–fluid systems. A key innovative aspect of this project is the development of an experimental protocol using a range of sample types—from rock powders (to enable comparison with existing literature) to rock cores that are representative of natural conditions and allow investigation at relevant scales.

Ultimately, the results will enable the identification, at large scale, of areas with potential for natural hydrogen production in continental settings, and the development of a predictive model for H₂ generation. This model will account for optimal mineralogical, chemical, textural, and porosity conditions, while considering the characteristics of the reactive environment.

Within this project, the protocol will be tested on rock samples from the North American Precambrian basement, whose theoretical H₂ production potential was demonstrated in a previous ISIFoR–IFPEN Energies Resources project (ExploH₂) [2], as well as on other continental rocks of diverse nature with a known H₂ potential.

The EPOCH2 project benefits from the complementary expertise of several laboratories in experimental system development (LFCR), 2D physico-chemical rock characterization (GET), 3D imaging (DMEX), and gas analysis (IFPEN).

Références :

[1] Kularatne K, P Sénéchal P, Combaudon V, Darouich O, Subirana MA, Proietti A, Delhaye C, Schaumlöffel D, Sissmann O, Deville E, Derluyn H. 2024. X-ray micro-computed tomography-based approach to estimate the upper limit of natural H₂ generation by Fe²⁺ oxidation in the intracratonic lithologies, *International Journal of Hydrogen Energy*, 78, 861-870.

[2] Muckensturm N, Sénéchal P, Sissmann O, Poulizac J, Derluyn H. 2025. Imaging serpentinised rocks from the Mid-Atlantic ridge through μ -CT, spectral CT and 2D techniques: towards a better characterisation of alteration reactions – oral presentation at the 5th International Rock Imaging Summit.

[3] Combaudon V., Centrella S., Kularatne K., Sissmann O., Deville E., Derluyn H. 2026. Mass transfer evaluation of the hydration of an olivine-bearing monzo-diorite from the Mid-Continent Rift in Kansas (USA), *Global and Planetary Change*, 256, 105158.

[4] Kularatne, K., Darouich, O., Sénéchal, P., Moonen, P., Derluyn, H. Laboratory spectral X-ray tomography for the differentiation of common rock-forming minerals, accepted for publication in *Scientific Reports*.

Required qualifications

- PhD with expertise in X-ray tomography imaging, electron microscopy, electron microprobe analysis, image processing, and geology
- Proficiency in image analysis tools (e.g., Dragonfly, ImageJ)
- Experience in physico-chemical characterization and interpretation
- Skills in data analysis using, e.g., Matlab and/or Python

The candidate should be rigorous, curious, and able to work independently, with a strong interest in research. Good communication and teamwork skills are essential. Proficiency in both English and French is required.

Location and supervision

The position will be based in Pau (France), at the X-ray Imaging Center of the University of Pau and Pays de l'Adour (UAR3360, DMEX, <https://imagingcenter.univ-pau.fr/>), with short visits to IFPEN (Lyon or Paris) and GET (Toulouse).

The project will be supervised by Dr. Pascale Sénéchal (DMEX), Dr. Hannelore Derluyn (LFCR), Prof. Peter Moonen (LFCR-DMEX), Dr. Michel Grégoire (GET), and Dr. Olivier Sissmann (IFPEN).

Salary

Approximately €3,000 gross per month.

Start date and application procedure

The position is expected to start in September 2026 for a duration of 12 months. Applications will be reviewed until the position is filled.

Applicants should send a motivation letter and CV to the following addresses, with “**EPOCH2 candidate**” in the subject line : pascale.senechal@univ-pau.fr; hannelore.derluyn@univ-pau.fr; olivier.sissmann@ifpen.fr