Institut des Sciences de la Terre

Postdoctoral or Research Engineer position:

Hydrogen and associated gas exploration in agpaitic igneous complexes – ANR H2KOLA

Over the last 30 years, geochemical research has demonstrated that H_2, formed by chemical and nuclear reactions, occurs on Earth in several specific geologic environments. Hundreds of natural H_2 seepages, generally connected with circulation of hydrothermal fluids through ultramafic rocks, have been discovered both under the seafloors and on the continents. Recent exploration of deep ancient fluids trapped in some Precambrian crystalline bedrocks have also revealed surprisingly high level of H_2 and CH_4, and observations of intra-cratonic H_2 seepages and accumulations with no obvious genetic link with ultramafic formations challenge our understanding of hydrogen production and fate in the crust.

Molecular hydrogen, together with other hydrocarbons (HCs) of putative abiotic origin, are also spectacularly enriched in some peralkaline/agpaitic intrusive rocks. This has been well documented in the Ilímaussaq (Greenland), Strange Lake (Canada), and Lovozero-Khibiny (Kola Peninsula, Russia) plutons, with the two latter neighbouring massifs being particularly enriched in these gases. For this reason, and because of the extensive studies that have been conducted on them by our Russian colleagues, we have selected them as the geological targets of the H2Kola project. Both intrusions host world class ore deposits of critical metals (REE, Ta, Nb, Zr, Ti) and phosphorus, which have been mined for more than 50 years. In these rocks, H_2, CH_4 and higher HCs are observed in fluid inclusions entrapped in minerals, but they are also known to migrate freely in fracture networks and to escape in underground mine galleries where they pose critical safety issues. This results in a unique incidence of H_2 occluded in minerals, diffusely dispersed, and focused in rock fractures and soil seepages. Such occurrences raise important scientific questions regarding, 1) the nature and dynamic of the source(s) of H_2, 2) the role that H_2 and associated gases may have played in the formation of the giant ore deposits in these massifs, 3) the environmental impact of gas migration on local ecosystems, and 4) the energy potential that natural hydrogen stock or flow may represent.

The aim of this joint Franco-Russian collaborative H2Kola project (supported both by ANR and RSF agencies) is to investigate abiotic hydrogen and associated gas migration by taking the Lovozero-Khibiny massifs as a case study. Our ambition is to provide a new integrated source-to-seep view of hydrogen migration in the Earth's crust, from deep geological sources to the near surface. We will document the source(s), fluxes and dynamic of H_2 and abiotic hydrocarbons according to a multiscale and multi-technics approach. New specific gas sensors will be developed for this purpose. Thanks to this integrative approach, we will define a new targeting method that can be used for H_2 exploration in agpaitic/peralkaline environments and in other contexts. We will also reveal the role of gas migration on critical metals ore genesis, and environmental perturbation observed in the region

The hired Postdoctoral Scientist or Research Engineer will develop innovative methodologies for gas monitoring in the field (gas adsorption sensors, onsite measurement of noble gases content and stable (H, C, O) isotopes fractionation, remote detection of gas seepages), and in rock samples (fluid inclusions, thermal desorption, crushing). He/she will participate to field investigations. The objective will be to track H_2 seepages and to reveal geological/topographic control on gas migration. The main activities are expected to be the following:

- Raman spectroscopy and fluid inclusion analysis (35%)
- Setting up the mobile mass spectrometer (25%)
- develop and test passive gas adsorption sensors (20%)
- monitoring gas seepage in the field (1-2 months per year – 20%)

Profile: The applicant should hold a PhD in one of the following fields: geochemistry, mass spectrometry, isotopes geochemistry, IR-Raman spectroscopy. In addition, the candidate should be accustomed to field missions in remote areas. The candidate is expected to be proficient in English. Good command in Russian will be a bonus.

Conditions: position of **1.5 to 2 years** depending on salary. Expected date of employment: **April 1 2021**.

Wage : gross monthly salary starting from 2038€ and depending on the candidate's experience.

Application: send your CV, motivation letter, and letter of reference to 1) Laurent Truche (Pr, Univ. Grenoble Alpes, ISTerre), laurent.truche@univ-grenoble-alpes.fr and 2) UGA Human Resources: dgdrh-recrutement@univ-grenoble-alpes.fr

Application deadline: **no later than March 19 2021**.

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