Université de Neuchâtel
Centre d'hydrogéologie et géothermie

MSc in Hydrogeology and Geothermics
Thesis topic proposal 2024

Emanation of dissolved noble gases associated to rock deformation

Context and objectives

One of the main challenges for deep reservoir engineering is to quantify and predict the controls of fluid movement and pore pressure build-up on deformation and potential inelastic effects such fracture slip and fracture propagation (Cappa and Rudqvist, 2011). We have shown in a recent paper that temporal changes in dissolved solutes, such as noble gases, can reveal important information into the evolution of flow path connectivity during rock deformation (Roques et al, 2020). The perspectives offered by this new discovery currently frame new research activities between UniNE, EAWAG and ETHZ related to reservoir engineering and induced seismicity. Our main hypothesis considers that the amount of radiogenic noble gases released during stress build-up and fracturing scales with the surface area of newly generated fractures.

Methodology

This Msc project will include both laboratory (mechanical lab at ETHZ) and in-situ experiments in the Bedretto Laboratory. First, the student will study the origin of noble gas tracers emanated from the rock masses during deformation under core test experiments. The idea would be to evaluate metrics linking geochemical anomalies (eg. He/Ar ratios) to stress changes and rock damage. This will be allowed by measuring jointly noble gas concentrations, triaxial strain and acoustic emission during core loading experiments (preliminary test results performed at the mechanical lab of ETHZ is presented in Figure 1). In addition, the student will aim at deploying an in-situ monitoring systems during a stimulation experiment performed in Bedretto in order to better understand the link between fluid movements, noble gas release and rock deformation in an in-situ context.

Supervision and collaboration

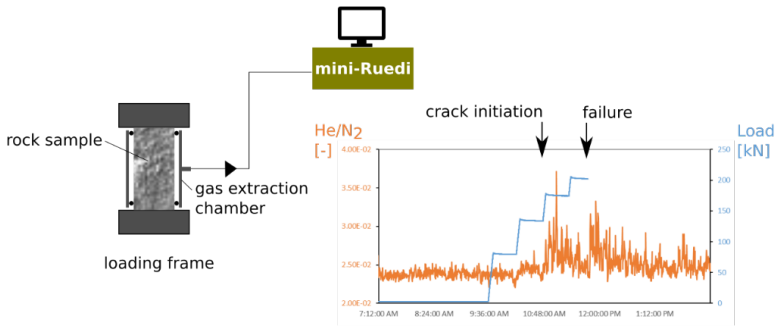

Figure 1: Preliminary results for continuous monitoring of gas emanation from a rock sample using portable membrane inlet gas spectrometer (miniRuedi). Results show increasing concentrations in radiogenic He occures when microcracks develop and after failure of the core sample.

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