Caracterisation of the mechanical properties of Callovo-Oxfordian claystone in laboratory and in-situ conditions

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Résumé

The use of nuclear energy requires safe solutions for the storage of radioactive waste. A solution proposed for high activity radioactive waste is the storage in deep low permeability geological formations such as claystones. In France, the mechanical behavior of the Callovo-Oxfordian (COx) claystone is investigated in the Bure URL by Andra, the French agency for the management of radioactive wastes. Motivated by this challenge, an experimental study of the COx claystone was carried out.

Crack propagation is the main mechanism of failure in materials. However, in anisotropic materials, like claystone, the behavior of cracks both during their propagation and their initiation phase remains poorly understood. As a result, this work aims also at improving our understanding of the mechanisms of fracture in anisotropic materials, through the example of the COx claystone. In this context, we performed a systematic characterization of the fracture properties of the COx claystone, both during the crack propagation phase (through the measurement of the toughness in different directions of the material, for different water content levels) as well as in the phase of initiation (through the measurement of its cohesive stress in different directions too). We then showed that we could measure these material parameters from a statistical analysis of the resulting fracture surfaces.

Finally, we applied this fractographic method of material characterization to fractures due to the excavation of the gallery extracted in the URL at 490 m deep, in order to measure the fracture properties of COx claystone in in-situ conditions.

Mots-Clés: Fracture mechanics, Quantitative fractography, Anysotropy, Callovo, Oxfordian claystone

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