



**HAL**  
open science

# A continuous approach for modelling fracture formation and its application to gas fracturing of Callovo-Oxfordian claystone

Amorim Romain Rodrigues De, Rabone Jeremy, Christian La Borderie,  
Olivier Maurel, Pont Stefano Dal, Briffaut Matthieu, Vu Minh-Ngoc, Vaissiere  
Rémi de La

## ► To cite this version:

Amorim Romain Rodrigues De, Rabone Jeremy, Christian La Borderie, Olivier Maurel, Pont Stefano Dal, et al.. A continuous approach for modelling fracture formation and its application to gas fracturing of Callovo-Oxfordian claystone. COMPLAS 23, Sep 2023, Barcelona, Spain. hal-04301850

**HAL Id: hal-04301850**

**<https://univ-pau.hal.science/hal-04301850v1>**

Submitted on 23 Nov 2023

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

## A continuous approach for modelling fracture formation and its application to gas fracturing of Callovo-Oxfordian claystone

Jeremy RABONE<sup>†</sup>, Romain RODRIGUES DE AMORIM<sup>†</sup>, Christian LABORDERIE<sup>†</sup>, Olivier MAUREL<sup>†</sup>, Stefano DAL PONT<sup>‡</sup>, Matthieu BRIFFAUT<sup>§</sup>, Minh-Ngoc VU<sup>||</sup> AND Rémi DE LA VAISSIERE<sup>||</sup>

<sup>†</sup> E2S UPPA, SIAME, Université de Pau et des Pays de l'Adour, France  
christian.laborderie@univ-pau.fr

<sup>‡</sup> CNRS, Grenoble INP, 3SR, Université Grenoble Alpes, France

<sup>§</sup> CNRS, UMR 9013 - LaMcube, Centrale Lille, France

<sup>||</sup> Andra Underground Research Laboratory; Bure, France

### ABSTRACT

The Callovo-Oxfordian argillite beds located some 500m beneath the surface of the Meuse plain have been chosen as a site for the storage of nuclear material, particularly spent fuels and high level wastes. Determining the medium to long term mechanical response of the argillite to boring, changes in saturation arising during stockage and following sealing is essential to planning the repository. The presence of metals in the components of the repository conducts to the production of gases and to a pressure build up which are being taken into account through experiments to measure the resistance of the argillite subjected to hydraulic stresses.

Recent advances in a model [1] implemented in the Cast3m finite elements code couple poroelasticity, plastic deformation, damage through cracking at the micro-scale, reversible opening of macro-scale cracks, diffusion of water and air with associated changes in degree of saturation and pore pressure, and swelling of clay minerals in a single, continuous model. Realistic simulations of argillite, incorporating spatial variations of properties such as arise from bedding planes, can be easily prepared and the model applied to them. Since the mechanical properties of argillite change from a relatively soft and plastic response near saturation to more a brittle response when dried, the variation of mechanical properties with the degree of saturation are an intrinsic part of the model.

Simulations of the hydraulic fracturing experiments using the model reproduce the behaviour observed in the laboratory.

### REFERENCES

- [1] Wang, H., La Borderie, C., Gallipoli, D. and Vu, M. N. (2020). Numerical modelling of the hydro-mechanical behaviour of unsaturated COx. *Geotechnical Research*, 8(1), 3-15.