Contribution ID: **750** Type: **Poster Presentation**

Structural controls on the development of karst environments: A multi-scale experimental investigation

Wednesday, 24 May 2023 16:10 (1h 30m)

About 25% of the global population depends on karst groundwater. It is therefore essential to better understand the genesis and development of karst environments. Karst landscapes are shaped by multiple physical and chemical processes that occur over thousands to millions of years, the dominant one being the dissolution of soluble rocks like limestone or dolomite. This process strongly depends on the partial pressure of acidifying gases like CO2 in the atmosphere, the soil type, and the presence of faults in geological formations. Although karstification and rock dissolution are natural processes, they are strongly influenced by anthropic activities, especially air and water pollution, as well as land use.

The aim of this study is to better understand the dissolution kinetics and especially its control on dissolution patterns determination. To do so we developed a multi-scale experimental protocol based on dynamic alteration of rock samples. Coreflood experiments were performed on 80 - 100 mm long core plugs (core plug scale - cm) and micro-coreflood experiments were performed on grounded samples (rock powder scale - µm). In the coreflood experiments, CO2-saturated water was injected at a flowrate of 140 cm3/h for 5 days, under 30 bar confining pressure and at room temperature. The petrophysical properties of samples were measured, and CT scanner imaging, SEM observation and BET analysis were performed before and after the coreflood experiments. Micro-coreflood experiments were performed on different grain size powders using chromatography columns. These experiments were designed to study dissolution kinetics for multiple grain sizes and thus deconvolute the structural and chemical impacts. For both coreflood and micro-coreflood experiments, chemical concentrations of dissolved species were determined using ICP-AES.

Two carbonate rocks are considered: Euville crinoidal limestone (Phi=12-18%, k=10-150 mD) and Lavoux oolitic limestone (Phi=20-30%, k=100-300 mD). Both limestones have similar mineralogy (99% calcite) and a bimodal porosity distribution, but their microstructure is significantly different. Despite their higher porosity and permeability, Lavoux samples show a larger fraction of micropores. Choosing these samples allow to investigate microstructural effects on dissolution processes regardless of major chemical compositions variations.

For coreflood experiments, CT Scanner imaging shows that dissolution patterns in Lavoux limestone are dominated by the development of localized dissolution channels ("wormholes"); whereas dissolution in Euville limestone appears more diffuse. Mean porosity increased by around 4% for Lavoux samples and 2-3% for Euville samples, while permeability increased by at least 10 and 35 times respectively. Core plug-scale results show that higher mean dissolution rates for Lavoux samples.

BET analysis and SEM observations show that the higher dissolution kinetics of Lavoux limestone is mainly related to a larger specific surface area leading to a higher reactivity. The difference in dissolution kinetics between Lavoux and Euville limestones is still present in the micro-coreflood experiments, but it decreases with grain size, revealing a specific structure for each limestone even at the powder scale. These results suggest that the specific surface area of the microporous grains is a key control parameter for larger scale dissolution

.

Participation

In-Person

References

MDPI Energies Student Poster Award

No, do not submit my presenation for the student posters award.

Country

France

Acceptance of the Terms & Conditions

Click here to agree

Energy Transition Focused Abstracts

Primary author: Mr BRIOLET, Théo (IFP Energies Nouvelles, Laboratoire de Géologie, UMR 8538, CNRS, Ecole normale supérieure, PSL Research University)

Co-authors: Mrs BEMER, Elisabeth (IFP Energies Nouvelles); Mr SISSMANN, Olivier (IFP Energies Nouvelles); Mr FORTIN, Jérôme (Laboratoire de Géologie, UMR 8538, CNRS, Ecole normale supérieure, PSL Research University)

Presenter: Mr BRIOLET, Théo (IFP Energies Nouvelles, Laboratoire de Géologie, UMR 8538, CNRS, Ecole normale supérieure, PSL Research University)

Session Classification: Poster

Track Classification: (MS08) Mixing, dispersion and reaction processes across scales in heterogeneous and fractured media