Experimental investigation of the dissolution of fractures. From early stage instability to phase diagram

F. Osselin[1,*], A. Budek[1], O. Cybulski[2], P. Kondratiuk, P[1]. Garstecki[2] and P. Szymczak[1]

1 - Institute of Theoretical Physics, Faculty of Physics, University of Warsaw, Pasteura 5, 02-093 Warsaw, Poland
2 - Institute of Physical Chemistry, Polish Academy of Sciences, Kasprzaka 44/50, 01-224, Warsaw Poland
* florian.osselin@gmail.com

ABSTRACT

Dissolution of natural rocks is a fundamental geological process and a key part of landscape formation and weathering processes. Moreover, in current hot topics like Carbon Capture and Storage or Enhanced Oil Recovery, mastering dissolution of the host rock is fundamental for the efficiency and the security of the operation. The basic principles of dissolution are well-known and the theory of the reactive infiltration instability has been extensively studied. However, the experimental aspect has proved very challenging because of the strong dependence of the outcome with pore network, chemical composition, flow rate...

In this study we are trying to tackle this issue by using a very simple and efficient device consisting of a chip of pure gypsum inserted between two polycarbonate plates and subjected to a constant flow rate of pure water. Thanks to this device, we are able to control all parameters such as flow rate, fracture aperture, roughness of the walls... but also to observe in situ the progression of the dissolution thanks to the transparency of the polycarbonate which is impossible with 3D rocks. We have been using this experimental set-up to explore and investigate all aspects of the dissolution in a fracture, such as initial instability and phase diagram of different dissolution patterns, and to compare it with theory and simulations, yielding very good agreement and interesting feedbacks on the coupling between flow and chemistry in geological media

References

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