

# Porosity and permeability generated during the experimental replacement of calcite by fluorite

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## ABSTRACT

In the context of fluid-rock interaction, the study of how fluids move through low permeable rocks is of most importance. In natural rocks, fluids can permeate through grain boundaries and/or pre-existing fractures, but permeability can also be generated by chemical alteration. This is the case of coupled dissolution-precipitation reactions, characterized by the generation of porosity enhancing fluid mobility (Putnis et al., 2002). To the best of our knowledge, no attempt was made before to measure the porosity and/or permeability generated during such reactions.

In this study we reacted a number of calcite single crystals with fluoride containing fluids at 40°C during several reaction times (2, 4, 8, 16, 22, 32 days) resulting in the partial replacement of the samples by porous fluorite. Reacted samples were dried and the permeability (connected porosity) was measured using nitrogen adsorption. A parallel experiment was made at 200°C during 8 days resulting in the total replacement of a calcite single crystal by fluorite. This sample was dried and milled using broad ion beam (BIB) to prepare low-relief polished surfaces for high-resolution SEM imaging to extrapolate total porosity. All samples were analysed using SEM for characterization of the products reaction front and microstructure.

Nitrogen adsorption results show that there is a linear relationship between the permeability and the fraction of fluorite transformed, and a power law relationship of each with the reaction time. Pore diameter ranged between 31 and 310 Å. The concentration of pores was higher for three specific pore diameters in each sample: at the lowest diameter (~31 Å); at a middle diameter (between 100 and 160 Å, depending on the sample); and at the higher diameters (for samples reacted for more than 2 days, ranging from 216 to 310 Å). Results from total porosity extrapolation will be presented.

## References

1. Putnis A. (2002). Mineral replacement reactions: from macroscopic observations to microscopic mechanisms, 66(August), 689–708. <http://doi.org/10.1180/0026461026650056>