# Chemo-mechanics of salt and ice crystallization in rocks: a 4D study using X-ray micro computed tomography

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## ABSTRACT

Salt crystallization and freezing in rocks are the cause of landscape weathering, of production loss of oil and gas reservoirs and of the weathering of natural building stones in our cultural heritage. In-pore formation of salt and ice crystals may cause pore clogging and permeability changes, and may induce deformation and fracturing of the porous rock. It consequently has implications on the fluid transport in and the mechanics of the porous solid. Theories have been developed to describe the crystallization in pores and to couple the microscopic development of crystallization pressure with the macroscopic mechanical response of the material based on the theory of poromechanics [1]. Direct experimental studies of the governing processes in rocks at the pore scale level are however limited.

It remains essential to acquire data on the distribution of crystals within porous structures, on the kinetics of dissolution and precipitation reactions, and on their implications for the eventual development of fractures. This information is needed to improve the accuracy of poromechanical models that are currently employed. At the Ghent University Center for Tomography (UGCT), a cooling stage and a climatic chamber were developed, compatible with the center's high-resolution X-ray micro-tomography scanners. They allow for inducing crystallization by cooling and drying, respectively, and for dynamically visualizing ice and salt precipitation and fracturing in rocks. This will be illustrated by a study on fracture dynamics in rock under freeze-thaw cycles [2] and by a study on salt crystallization dynamics in rocks under drying-wetting cycles. Experimental data derived from the image processing will be presented, and will be linked to the theory of poromechanics.

## REFERENCES

[1] Coussy, O. Mechanics and Physics of Porous Solids. Wiley, UK 2010.
[2] De Kock, T., Boone, M.A., De Schryver, T., Van Stappen, J., Derluyn, H., Masschaele, B., De Schutter, G., Cnudde, V. A pore scale study of fracture dynamics in rock using X-ray micro-CT under freeze-thaw cycling, Environmental Science & Technology, under review.

## GRAPHICS