



What are the transport distances in dissolution-precipitation creep?

Berit Schwichtenberg (1), Florian Füsseis (1), Ian Butler (1), and Edward Andò (2)

(1) University of Edinburgh, Grant Institute, School of Geosciences, Edinburgh, United Kingdom

(berit.schwichtenberg@ed.ac.uk), (2) Université Grenoble Alpes, CNRS, Grenoble INP1, Laboratoire 3SR, Grenoble, France

Chemical compaction is a relevant factor influencing groundwater resources, geological repositories for waste and CO₂ sequestration as well as oil and gas reservoirs. In this context sheet silicates are hypothesized to reinforce chemical compaction by dissolution-precipitation creep (DPC) and thereby influence the hydraulic properties as well as the direction of fluid flow. To test these ideas we designed uniaxial compaction experiments in x-ray transparent oedometers, using samples where a layer of a salt/biotite mixture is sandwiched in between two marginal salt layers.

Here we present time-resolved (4D) microtomographic data collected with our in-house microCT scanner over 1600 hours of compaction. These data allow us to analyse slow chemical compaction processes on the grain scale, as well as explore the effects of chemical and mechanical feedbacks on the evolving material. The samples' dynamically evolving transport properties can be characterised via pore segmentation and a percolation analysis. Using advanced quantitative volume correlation techniques we determine a locally resolved displacement field, calculate strain tensors on the grain scale and track separated biotite grains during progressive shortening. Our analyses show that biotite grains influence the dynamic evolution of porosity in the sample, clearly causing a reduction of porosity in their vicinity. However, they do not cause strain localization and axial shortening is homogeneously distributed within our sample. This means that porosity reduction is not achieved by pore collapse but by precipitation of salt that has been transported into the biotite layer.

Our observations invite a renewed discussion of the effect of phyllosilicates on DPC, with a particular emphasis on the length scales of the processes involved. We claim that, in our experiments, the diffusive transport processes invoked in classical theoretical models of DPC are superseded by chemo-mechanical feedbacks that arise on longer length scales. These feedbacks drive salt diffusion from the marginal pure salt layers into the central salt-biotite mixture over distances of several hundred μm and several grain diameters. Such a mechanism was postulated by Merino et al. (1983, *Contrib Mineral Petrol* 82, 360-370).