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Pressure solution compaction of two very soluble brittle salts ($NaClO_3$ and KH_2PO_4) as rock analogues

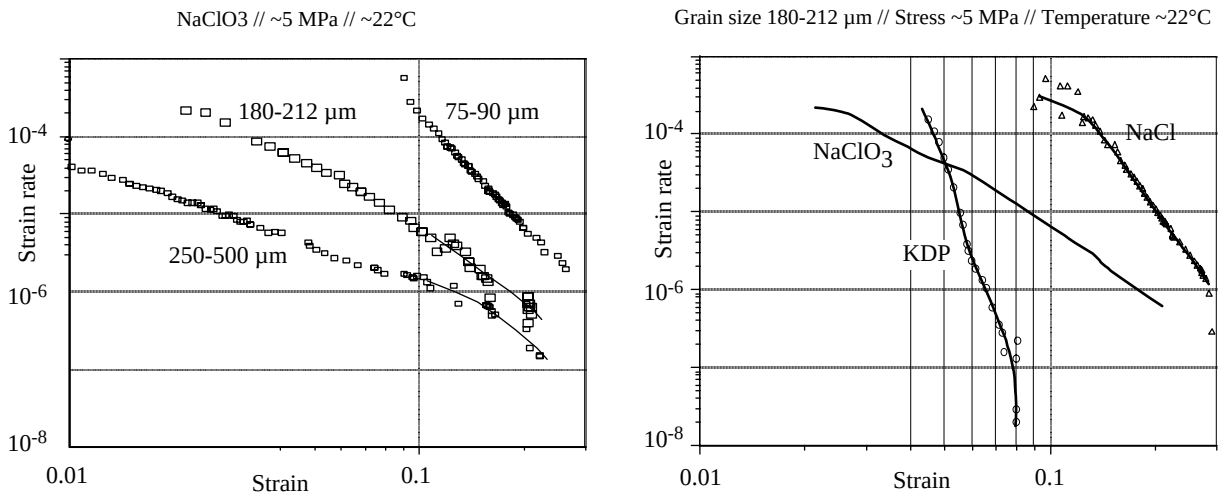
Bas den Brok and Cees Passchier

Institut für Geowissenschaften,
Johannes Gutenberg-Universität Mainz, Becherweg 21, D-55099 Mainz, Germany.
(denbrok@mail.uni-mainz.de; cpasschi@mail.uni-mainz.de)

We want to experimentally investigate in situ the deformation of polycrystalline aggregates of brittle salts as rock analogues in the pressure solution deformation regime. We are specially interested in the deformation microstructures developed in an aggregate consisting of relatively large (porphyro-)clasts in a fine grained matrix. At present, we are in the stage of testing the pressure solution compaction behaviour of two candidate materials: the brittle salts NaClO3 (Sodium chlorate) and KH2PO4 (Potassium di hydrogen phospate). The reason that we choose these two salts is (i) that they have a relatively high solubility at room temperature, (ii) that their dissolution and precipitation rates are very high, and (iii) that they do not deform plastically at room P-T conditions. The latter is the major reason that we did not choose NaCl for our experiments, as it deforms plastically at room P-T conditions at very low stresses.

To test whether both of these materials indeed deform by pressure solution creep at room P-T conditions we carried out a series of compaction experiments under different constant applied loads (corresponding to stresses of 1-10 MPa) and for different average grain sizes (75-500 µm). Compaction experiments were carried out in a 1.2 mm diameter cappilary glass tube as well as in a 5 mm diameter steel tube. Aggregates were first loaded dry at constant load, then saturated solution of the salt was added, and the displacement of the loading piston continuously monitored with an LVDT. Stress was either calculated from the weight resting on the piston (in case of the glass tube) or measured with a load cell (in case of the steel tube). Samples loaded dry show no time dependent compaction. As soon as saturated solution was added samples started to creep. Typical compaction rates at strains of 0.1 fall in the range 10-7 to 10-4 /s. Typical log strain versus log strain rate curves are shown below. No compaction occured when fluids were added in which the solids are insoluble (ethanol in case of KH2PO4 and ethyl acetate in case of NaClO3).

Our mechanical results indicate that difusion controlled pressure solution is the dominant compaction mechanism in the NaClO3 aggregates at stresses in the range 1-10 MPa, grain size in the range 75-500 µm and at room P-T conditions.



Left: Log strain rate versus log strain diagram of NaClO3 aggregates compacted at ~5 MPa and ~22°C, showing the effect of the grain size on the compaction rate. **Right:** Log strain rate versus log strain diagram of NaCl, NaClO3 and KH2PO4 (KDP) for a grain size in the range 180-212 µm, a stress of ~5 MPa and a temperature of ~22°C.