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Experimental deformation of synthetic rocksalt to large strain in torsion

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Halite is one of the main minerals in evaporitic rocks. Such rocks play an important role in localizing deformation in sedimentary sequences, implying that their strength is lower than that of other rocks. Salt tectonics commonly take place in the uppermost 5 km of the Earth's crust, where temperatures are generally $<$200˚C and the lithostatic pressure is $<$120 MPa. In order to understand the role of evaporites, rheological data on steady-state flow of rocksalt and the associated deformation mechanisms form an important background. We have performed experimental deformation tests to understand how different parameters such as confining pressure, temperature, differential stress and strain rate influence the behaviour of halite-dominated rocksalt.

In particular we have studied the rheological and textural evolution of synthetic rocksalt samples on a series of experiments in torsion up to shear strains of $\gamma > 6$. The experiments were performed at constant angular displacement rates corresponding to shear strain rates between $10^{-6} – 10^{-4}s^{-1}$, at confining pressure of 200 MPa and temperatures at 60, 100 and 200˚C. Shear stress versus shear strain data show a typical yielding at the beginning of the experiment. Beyond the yield point the shear stress continued to increase with increasing shear strain. In the experiments steady-state flow conditions were never reached, i.e. the material shows strain hardening even at a high shear strain of γ = 6. This implies that a meaningful constitutive flow law for rocksalt involves a strain dependence parameter.

Detailed micro fabric analysis by EBSD mapping of a sample with maximal shear strain of γ = 4.2 revealed a crystallographic preferred orientation (CPO) of moderate strength around a {110}$<$110$>$ component, i.e. a {110} plane parallel to the shear plane and a $<$110$>$ direction towards the shear direction. CPO as well as grain sizes and shapes did not show any significant gradients with finite strain.