

2.4.14

On the influence of fluids on deformation processes of halite crystals

T. LOHKÄMPER, G. JORDAN, K. RÖLLER, B. STÖCKHERT
AND W. SCHMAHL

Ruhr-Universität Bochum, Institut für Geologie, Mineralogie
und Geophysik, D-44780 Bochum
(Thomas.Lohkaemper@ruhr-uni-bochum.de)

Compaction and deformation processes in sedimentary environments and along crustal faults are supposed to be mainly driven by dissolution precipitation creep. This mechanism is assumed to drive shape changes of minerals and formation of shape preferred orientation. Thus, the change of potential energy expressed in the work term $(\sigma - p)v$ is assumed to play the dominant role [1, 2] where σ is the surface normal stress, p is the hydrostatic pressure and v is the molar volume of the solid in its stressed state.

In our experiments we investigated the loaded interfaces of single halite crystals in contact with silica by standard optics and by phase shift interference microscopy. The load was up to 7.7 N and the contact faces were in the range of 0.36 square millimetres. At first the interface was dry and then saturated NaCl-solution was added. In some cases the halite surfaces were decorated with Vickers micro hardness indents. We additionally measured the change in axial length of the crystal by white light interference microscopy.

The investigations confirm that saturated NaCl-solutions can influence the strength of halite single crystals. After fluid had been added to the crystals, the axial shortening of the crystals was up to 0.5% within the first 50 hours. The observation of the interface decorated with Vickers micro hardness indents reveals that elastically and plastically deformed regions dissolve in saturated solution. We suggest that the most likely driving force for this kind of dissolution is the stored elastic and plastic strain energy density within the crystal. Within the loaded face these dissolution processes lead to a flattening of the contact area. The dissolved material diffuses within the interface and recrystallizes in large pores, which act as sinks, whereas smaller pores remain stable. The axial shortening of the crystal is not caused by extensive material transport out of the contact area, but without much doubt it is caused by smoothing of asperities and increased plasticity due to the presence of the fluid.

References

- [1] Gibbs J.W. (1906) *The collected works of J.W. Gibbs*, New Haven, Yale Univ. Press, **1**, 184-201.
- [2] Paterson M.S. (1973) *Rev. Geophy. Sp. Phy.* **11**, 2, 355-389.

2.4.P01

The influence of elastic stresses and fluid pressure on the structure of grain boundaries

D. KOEHN

Department of Earth Sciences, Tectonophysics, University of
Mainz, Becherweg 21, 55099 Mainz, Germany
(koehn@mail.uni-mainz.de)

Pressure solution creep is an important mechanism during the compaction of sedimentary basins in the upper crust of the Earth. The structure of a confined grain-boundary is important during the process of pressure solution. It is still debated whether the structure is rough, smooth or changes with time. Therefore the dynamics of such interfaces are not well known even though recent advances are promising. One approach to study such an interface is to construct a numerical model that can simulate the physico-chemical interactions in such interfaces. Such a model allows to study the dynamic evolution of a grain-boundary during compaction and ongoing pressure-solution creep. This presentation shows an introduction of a numerical model that can account for the physico-chemical interactions in confined grain-boundaries during pressure solution creep in the elastic regime. The solid is represented by an elastic spring model and the fluid by a finite difference approach. Fluid pressure acts on the solid and changes with increasing deformation. The physico-chemical coupling is treated using a linear rate law from Transition State Theory where the driving force for dissolution/precipitation depends on gradients in elastic energy, surface energy and stress. The presentation will show how these parameters influence the structure of the confined contact.