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Deformation mechanisms of naturally deformed halite mylonites from salt diapirs of the North German Zechstein Basin: Evidences from neutron texture analyses

B. Leiss (1), Y. Küster (2), T. Seidel (1), M. Schramm (2) and K. Ullemeyer (3)

(1) Geoscience Centre of the University of Göttingen, Goldschmidtstr. 3, 37077 Göttingen, Germany, (2) Federal Institute for Geosciences and Natural Resources (BGR), Stilleweg 2, 30655 Hannover, Germany (3) Geological Institute, University of Freiburg, Albertstr. 23-B, 79104 Freiburg, Germany, (bleiss1@gwdg.de)

For halite, the development of crystallographic preferred orientations (textures) by deformation and/or recrystallisation is quite well-known from experiments. Texture analyses of naturally deformed halite from salt diapirs, however, are rare. This study presents first results of a detailed textural characterisation of salt diapirs by correlating textures with micro-, macro- as well as large scale salt structures.

Samples were taken from drill cores from the large scale salt structures of Gorleben, Morsleben, Teutschenthal, and Remlingen (Asse), all situated in the North German Zechstein Basin. Shear zones are well-defined on the drill core surfaces and compare well to observations directly made in the drifts of the Morsleben mine at a larger scale. For texture analyses, samples with significant grain shape preferred orientation and the long axes ranging from 1 mm to 10 mm were selected. In general, the aspect ratio is between 2 and 2.5. Grain boundaries are straight or weakly lobate. All these features are usually strong indicators for intracrystalline slip as the main deformation mechanism, so these samples were expected to display textures.

Bulk texture measurements of naturally deformed halite are hard to realize since even mylonitic rock salt displays grain sizes $>$ 1 mm, the textures are usually weak, and sample surface preparation is difficult. Due to low absorption of neutrons in matter, neutron diffraction is particularly suitable for rock salt texture analysis. Measurements were carried out at the SKAT diffractometer in Dubna (Russia) applying cube-shaped, cylindrical and spherical samples with dimensions up to five centimetres.

At first glance, the pole figures indicate different textures. A detailed data analysis, however, reveals that the pole figures just represent the sample shape. This obviously absorption-related effect is discussed in the literature, but up to now was not observed in rocks in that distinctness. So we assume that this effect is typical for halite.

Correction of the sample shape effect revealed that all the samples show no crystallographic preferred orientations. Since a postdeformational disintegration of a pre-existing syndeformational texture seems to be unlikely - considering especially the anisotropic grain shape fabric - the main deformation mechanism was not intracrystalline slip but diffusion, solution/precipitation, and/or oriented fibre growth by, e.g., crack-seal mechanisms. For the samples presented, the proof of a ‘non-texture’ gives strong evidence for these deformation mechanisms, which in Halite are difficult to verify by other experiments or observations. The results clearly demonstrate that in nature the deformation processes of halite need much more attention for the setup of rheological models related to the application of using salt structures as hydrocarbon storage caverns or as host rocks for the disposal of radioactive waste.