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3D-Modelling of deformed salt cubes: A contribution to paleostress analysis

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The Northern Calcareous Alps are a fold-and-thrust belt. The Haselgebirge Formation comprising rocksalt was one of the major detachement levels during Alpine orogenesis. Haselgebirge is a mélange of halite and mudrock (ca. 50% - 50%). In undestroyed mudrock halite „cubes" are found often. They are supposed to have formed during very early diagenesis as euhedral cubes (Gornitz and Schreiber, 1981). Now, their shapes comprise tetragonal bodies, rombohedrons, parallelepipeds or mixtures of these (Görgey, 1912). The aim of the study is to reconstruct the paleostress orientation related to the sedimentary layering. Sample ALT-4 from the rocksalt deposit Altaussee was chosen for high-resolution X-ray computed tomgraphy (HRXCT). It was carried out at the University of Texas, High-Resolution X-ray CT Facility to produce a stack of 158 slices of 1024x1024 16bit TIFF images. Although the halite crystal shapes can be clearly detected visually in the TIFF images, the abundant background noise prevents standard image classification methods from yielding satisfactory results. As a consequence, halite crystal contours were manually digitized in each HRXCT image slice. Corel Draw was used to classify three crystal shape quality categories: best, medium and poor. The classified 158 slices were forwarded to the computer program Voxler for 3D-reconstruction and visualization of the halite crystals. Median filtering and shrink-grow filtering (erosion - dilation operation) improved the quality of the crystal shapes. The resulting voxel array was forwarded to the computer program Windicom for calculating strain ellipses. From a total of 62 crystal shapes, 52 individual strain ellipses and one representative average strain ellipse were determined. The sedimentary layers were reconstructed from the HRXCT image stack by manually digitizing their traces, followed by a geostatistical optimization (computer programs ImageJ and Surfer). Finally, the geometries of the average strain ellipse and the sedimentary layers were recombined in one reference system (AutoCAD). Here, the angle between the smallest axis of the strain ellipsoid (main compression) and the surface normal of the sedimentary layer could be determined to be about 25°. By the disk-shaped average strain ellipsoid a compaction seems reasonable, however oblique to the sedimentary layering.

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