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Full-Field Numerical Simulation of Halite Dynamic Recrystallization From Subgrain Rotation to Grain Boundary Migration

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Full-field numerical modelling is a useful method to gain understanding of rock salt deformation at multiple scales, but it is quite challenging due to the anisotropy and complex plastic behavior of halite and other evaporite minerals at the single crystal level, together with dynamic recrystallization processes. We overcome these challenges and present novel results of full-field numerical simulation of dynamic recrystallization of halite polycrystalline aggregates during simple shear deformation, including subgrain rotation and grain boundary migration recrystallization processes. The results illustrate that the approach successfully reproduces the evolution of pure halite microstructures from laboratory torsion deformation experiments at 100-300□ up to shear strain of four. Temperature determines the competition between (i) grain size reduction controlled by dislocation glide and subgrain rotation recrystallization (at low temperature) and (ii) grain growth associated with grain boundary migration (at higher temperature), while the resulting crystallographic preferred orientations are similar for all cases. The analysis of the misorientation reveals that the relationship between subgrain misorientation and strain follows a power law relationship with a general exponent of 2/3. However, with progressive deformation, dynamic recrystallization leads to a gradual deviation from this relationship. Therefore, predicting strain or temperature from microstructures necessitates careful calibration.