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Mapping of intrastratal halite karst with the correlation of interferometric synthetic aperture radar (InSAR) data to models of geological displacement along faults

Eric Zechner, Bernhard Mitosch, Horst Dresmann, and Peter Huggenberger
University of Basel, Department of Environmental Sciences, Basel, Switzerland (eric.zechner@unibas.ch)

Previous modeling studies of evaporite dissolution (Zidane et al. 2014) showed that the presence of conductive subvertical fault zones within carbonates and evaporites plays an important role as flow paths for variable-density flow of groundwater and transport of dissolved salt. In addition, fault zone heterogeneity presents an important factor affecting halite dissolution. As a consequence, the intrastratal halite karst preferentially develops closer to conductive fault zones. Therefore, highest surface subsidence rates due to the intrastratal halite karst are expected above conductive fault zones. However, precise delineation of subsurface fault zones, and, even more so, structural and hydraulic characterization of the fault zones is often not possible due to the lack of sensitive data.
The presented study directly relates remote-sensing imagery of surface deformation to modeling studies of faulted geological horizons. The working hypothesis assumes that the larger the displacement of geological horizons along normal faults, the higher the fracturing and brecciation of rocks within the fault zones, which then increases the potential for a higher permeability along fault zones. A series of interferometric synthetic aperture radar images (InSAR) from 2003 to 2010 cover an area of the Tabular Jura of north-western Switzerland, which is affected by intrastratal halite karst. Averaged surface deformation rates calculated from both Persistent Scatterer and Small Baseline techniques show more than 10mm/y subsidence in some parts of the study area. Horst and Graben structures of the same area are mapped with 3D models of faulted geological horizons, and are mostly based on borehole information. Resulting displacements along normal faults and strike-slip faults vary between a few meters to over 500m, and are calculated onto a first layer of 2D traces representing the fault zone. The possible correlation between the displacements along faults and a second layer of averaged surface deformation rates is calculated with the spatial superposition of both layers.

Zidane, A., Zechner, E., Huggenberger, P., and Younes, A. 2014: Simulation of rock salt dissolution and its impact on land subsidence, Hydrol. Earth Syst. Sci., 18, 2177-2189, doi:10.5194/hess-18-2177-2014.