Geophysical Research Abstracts
Vol. 12, EGU2010-14171, 2010
EGU General Assembly 2010

Subsurface dissolution of evaporites: where do we stand?

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Evaporites of gypsum or rock salt are the most soluble common rock formation. Undersaturated groundwater in contact with evaporitic rock formations leads to subsurface dissolution, or subrosion of evaporites and, hence, to the development of karst. Depending on the geological setting, the subrosion may cause widespread land subsidence. Even small subsidence rates can significantly affect sensitive urban infrastructure, such as larger buildings, dams, power plants, or traffic lines. The factors controlling formation and shape of deep-seated subrosion are still not fully understood. The key to understand the process is related to the role of groundwater undersaturated with NaCl or CaSO4, and its driving energy. The energy can be provided by a hydrostatic head, or a density gradient, which causes groundwater to flow through the system. To further understand the process of subrosion we performed (1) laboratory dissolution experiments to study the effect induced by freshwater contacting salt; and (2) a combination of flow tank and modeling experiments to study the effect of density-driven flow in heterogeneous media. The presented results show that the development of evaporitic karst is tightly related to geologic structures. For example, the locations of normal faults control the shape of subhorizontal interstratal solution cavities. In addition, an increase of formational dip of the salt layer by a few degrees may lead to an increase of the salt dissolution rate of up to several magnitudes. The findings are used to provide more accurate predictions on risk areas for land subsidence.