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Numerical modeling approach of sinkhole propagation using the eXtended FEM code ‘roxol‘

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Subrosion and underground cavities lead to instability of the earth′s surface. To minimize sinkhole hazard, it is necessary to have a better understanding of the processes and collapse mechanisms. Recent cases of subrosion in Germany that result in collapse structures (sinkholes) are used as a basis for this study. The aim is to simulate the collapse mechanism in order to specify the conditions in which sinkholes form. Using the XFEM code ‘roxol‘ (geomecon GmbH), it is possible to localize zones, in which rock failure occurs. Initiation of fracture propagation and interaction within these zones can be simulated.

As a first approximation, we use a 2D model with simplified excavation and fault geometry and assume linear elastic, impermeable and non-poroelastic material behavior for the overburden layers; local stress field parameters are supplied by boundary conditions. We estimate the distribution of stress and strain in areas with critical loads to simulate failure under the influence of the stress field, material properties, as well as fault and joint geometry. Varying these parameters allows the calculation of the critical loads in which fractures propagate and failure occurs.

The XFEM code ‘roxol‘ is a suitable approach to simulate the development of sinkholes. In this study, fracture propagation, as well as the interaction between existing joints are the most important parameters. Therefore, our first approach will be extended by local input parameters to develop predictions of time-dependent rock failure.