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DEM simulations of the evolution of fault zones in brittle-ductile layered rocks

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The development of normal faults in brittle ductile layered rocks is modeled in this work using the Discrete Element Model (DEM) approach. The simulations were realized using the open source DEM package ESyS-Particle (https://launchpad.net/esys-particle/).
The models consist of one cemented layer inside a cohesionless granular material above a basement fault in a gravity field. The cohesion of the cemented layer and the angle of the basement fault were varied. Different random packings of the material were used to estimate the effect of the material heterogeneity. Results show, that two structural domains exist, a graben domain and a precursor domain. In both of these domains, the variation in cohesion of the hard layer produces large differences in the structural evolution. As expected, the largest changes in fault gouge evolution occur when the increase in cohesion of the hard layer make the minimum principle stress become tensile. The main parameter that determines the amount of tectonic abrasion in the fault zones is the cohesion of the brittle layer. This leads to a gradual thinning of the layer with low cohesion and development of blocks and fragments in case of a relatively high cohesion. Thus, continuity of the sheared layer is higher in the rocks with low cohesion. The structural domain also affects the continuity of the brittle layer: in the precursor domain the brittle layer is more continuous than in the graben domain.