Title:
DEM simulation based modeling of fault zone evolution in brittle-ductile layered rocks.

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Abstract:
In this work, Discrete Element Modeling (DEM) is used to simulate and study the evolution of normal faults in brittle ductile layered rocks. The simulations were realized using the open source DEM package ESyS-Particle (https://launchpad.net/esys-particle/).

The principal model setup is one layer of a cemented granular material between two layers of a cohesionless granular material. A basement fault is positioned underneath the layers to initiate normal faulting. The cohesion of the cemented layer and the basement fault angle were varied to study their influence on the fault evolution inside the mechanically layered material. Different random packings of the material were used to estimate the effect of the material heterogeneity.

The results show the existence of two different fault domains depending on the basement-fault angle, 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.