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Discrete Element Simulation of the formation of open Fractures during normal faulting of cohesive Materials.

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During normal faulting of a brittle cohesive materials under low confining stress the formation of open fractures has been observed both in field studies and in sandbox experiments using cohesive powders such as gypsum. However, in nature it is difficult to observe the mechanical processes which lead to the formation of these structures throughout the whole volume of material involved. In sandbox experiments it has been possible to observe the evolution of the geometry of the evolving open fractures with the use of CT-scanning technology, but a direct observation of the forces involved isn't possible.

We therefore investigate the process of the formation of open fractures during normal faulting of cohesive materials by numerical simulations using a discrete element method (DEM) approach. In this simulation method the material is modelled as a collection of spherical particles interacting by elastic-brittle bonds which can break if a fracture criterium is exeeded or, if there is no bond between particles, by frictional interactions. Therefore, discontinuities such as faults and fractures naturally develop during the evolution of the model.

The simulation setup is modelled directly on the sandbox experiments. The initial configuration of the model consists of a layer of cohesive material laterally confined in a box but with a free upper surface. The bottom plate of the box contains a preexisting inclined fault along which part of the box is moved to induce normal faulting in the cohesive granular layer above. This model enables us to observe both the structures resulting from the deformation of the cohesive layer and the processes generating them. Comparing the results from simulations with experimental and field observations, we find that the geometry of the observed fault structures is very similar.