DISCRETE ELEMENT METHOD MODELLING OF THE STRUCTURE AND GROWTH OF NORMAL FAULTS IN LAYERED SEQUENCES

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ABSTRACT

Numerical modelling of the growth of normal faults in layered sequences has been conducted to investigate the effect of strength contrast between beds and confining pressure using the Discrete Element Method (DEM), where rocks are modelled as assemblages of randomly distributed particles that interact with each other at their contacts. The modelled lithologies have rheologies equivalent to those of limestone (layers of bonded particles) and shale (non-bonded particles), respectively. Propagation of a single normal fault through the mulitlayer is achieved by a predefined fault at the base of the model.

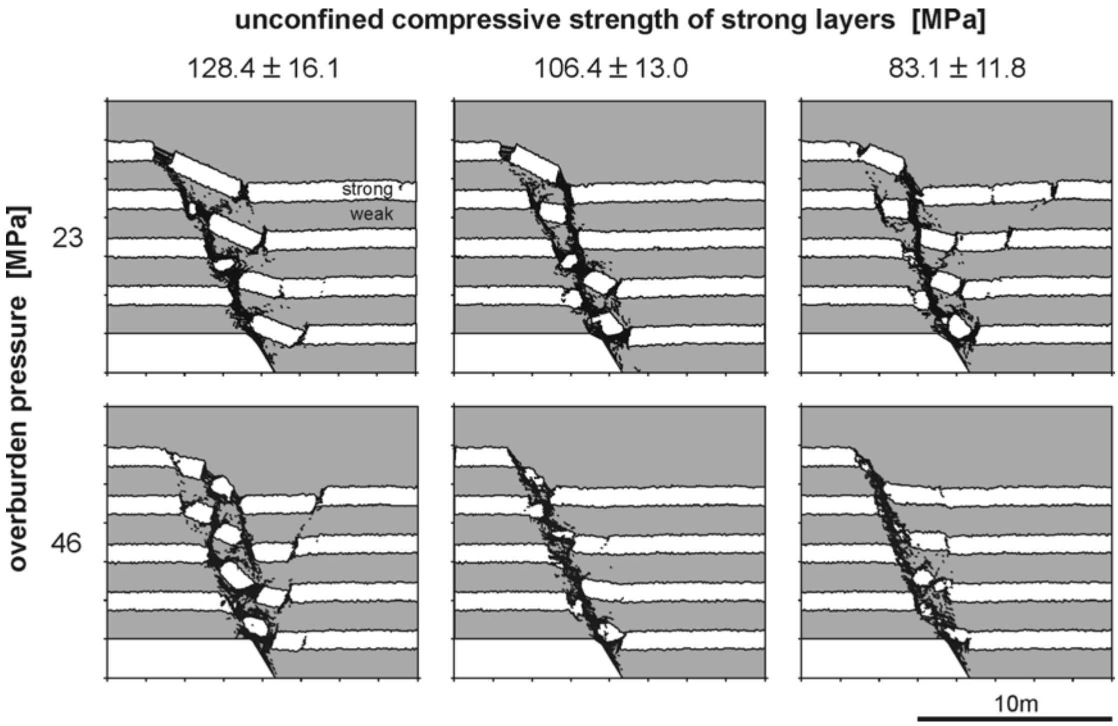

Figure 1. DEM model results at a throw of 2 m with particle separations >10 cm shown as black lines.

The model results suggest that faults in sequences with high strength contrast at low confining pressure are highly segmented due to different types of failure (extension vs. shear failure) in the different layers (Figure 1). The degree of segmentation decreases as the strength contrast decreases and confining pressure increases. Faults at low confining pressure localize as extension fractures within the strong layers and are later linked via shallow dipping faults in the weak ones. This leads to initial staircase geometries that, with increasing displacement, cause space problems that are later resolved by splaying and fault segmentation. The model results show a transition from extension to hybrid and to shear fracture with increasing confining pressure and an associated decrease in fault zone complexity.

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