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# DEM Simulation of Clay Smear along Faults

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The smearing of clay is an important sealing mechanism in fault zones of sand-clay sequences. One process which can strongly influence the thickness and therfore sealing capacity of clay smears is the mixing between sand and clay. This process has been discussed in the literature and was identified in laboratory experiments, but its rate as a function of sand and clay properties, pressure and shear strain is poorly understood.
In this work a Discrete Element (DEM) simulation is used to investigate influence of geometrical and material parameters on the mixing between sand and clay during shear of a layered sequence and therefore the properties of the resulting clay smear. While the sand is modelled at the grain scale, this can not be done for the clay due to the large difference in scale. Therefore the model only attempts to reproduce the micro-mechanical processes at the scale of the sand grains whereas for the clay only the bulk properties are matched.
The simulation model consists of a 2D box containg layers of sand and clay which are represented by DEM particles with different size and frictional properties. On the boundaries orthogonal to the layering a constant normal stress is applied. The model is then sheared perpendicular to the orientation of the layers by moving the edges of the model with a constant velocity. We have investigated both models with and without periodic boundary conditions in the direction of shear. The models with periodic boundary conditions are representative of fault zones in a sand-clay sequence with periodic layering whereas the models without periodic boundary conditions are representative of fault zones across a single clay layer or a group of clay layers embedded in a sand matrix. A sufficiently large contrast in the frictional properties between the sand and the clay has been obtained by using different grain shapes for the sand layers. The results show the development of structures in the mixing zone between sand and clay layers which are comparable to those observed in laboratory experiments. In particular, a thickening of the mixed layer with increasing strain is observed. In nature, this will produce a thicker clay-rich gouge than expected from simple shearing the separate clay and sand layers, and to a stabiliization of shear because softening is less pronounced in a mixture.