T043-005 Room: C416 Time: May 29 10:00-10:15

DEM Simulation of Structural Development Processes-2; Comparison with Basic Sandbox Experiments

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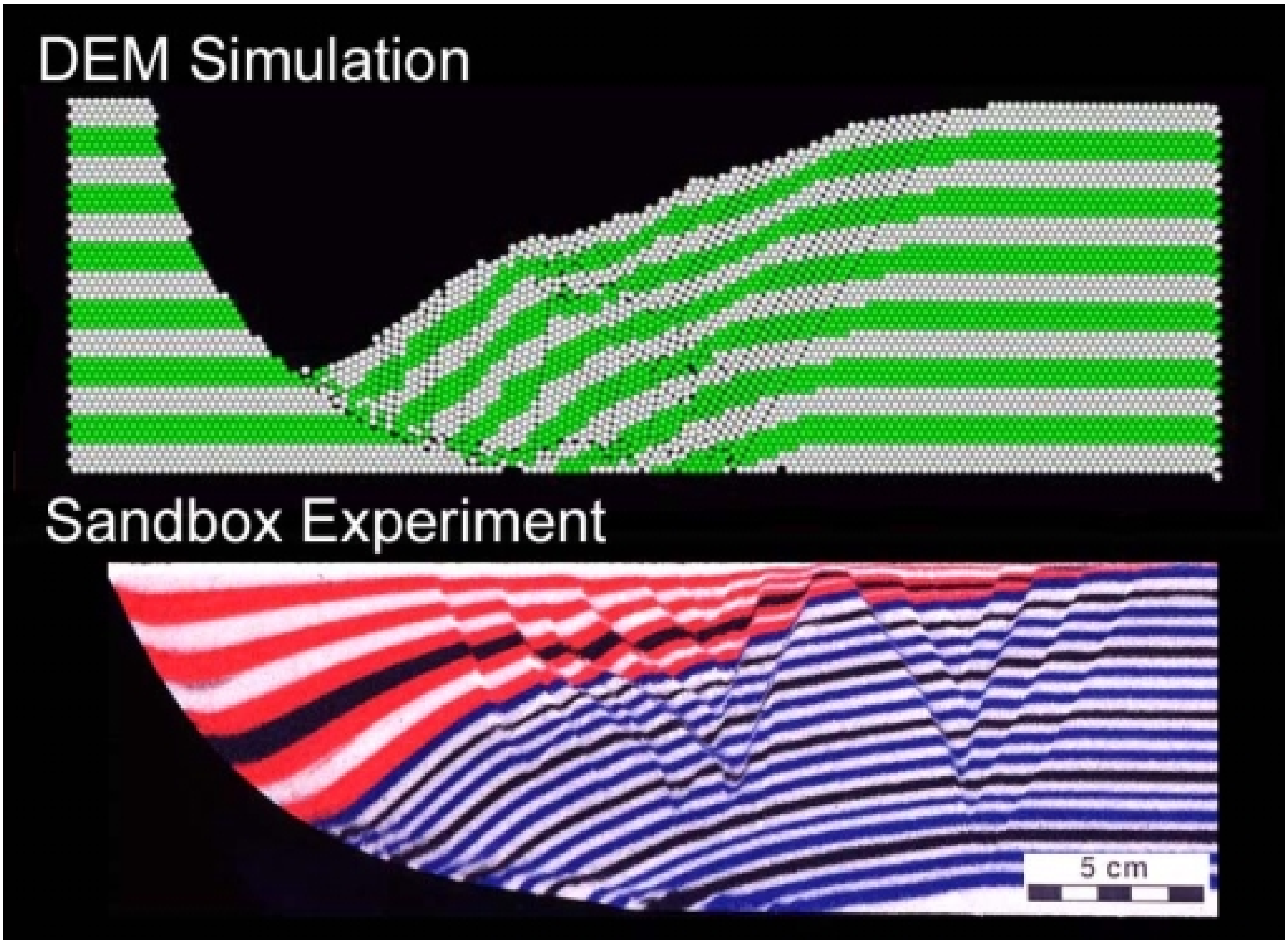
Structural deformation (e.g. folds and faults) within sedimentary basins is a primary interest of petroleum exploration industry and various techniques have been employed to analyze the geometry, kinematics and dynamics of structural development. Analogue experimental modelling has a century-long history as one of such techniques, and fundamental concepts on which many of these techniques are based have been proposed from the model results. Recent understandings on rheological behavior of the continental lithospere suggest that cohesionless dry sand is an appropriate material to model brittle behavior of the upper crust. This type of physical experiments using granular materials (e.g. sandbox) can also be done as numerical simulation (digital modelling) on the computer with the Discrete Element Method (DEM).

The DEM simulation is based upon interactions between a number of small particles. There are two stages in each calculation cycle: the first stage is to evaluate interaction forces for each particle and the second stage is to move all particles by numerical integrations of the Newton's equation of motion for the evaluated external forces. Interaction forces are calculated under the force-displacement law (Cundall and Strack, 1979). In the second stage of computations, particles are moved by the total acting forces evaluated at the first stage.

A series of DEM simulation under simple tectonic settings, extension and contraction, are conducted and the results have been compared with the sandbox experiments. Extension simulation resulted in formation of a series of listric (gentler inclination of the fault plane in depth) normal faults with a sequence away from the free slope. This feature is similar with those observed in natural landslides. Contraction simulation generates reverse faults of two directions; hinterland-vergent and foreland-vergent. These can be seen in sandbox experiments simulating thrust-and-fold belts or subduction tectonics of oceanic lithosphere. In sandbox, however, each fault initiates with a lower inclination (eg.20-30 degree) and then rotates to increase the dip as the deformation progresses and the next fault generates in its footwall. The simulation does not show this feature, probably because the initial plane of each fault shows a planar geometry which dips generally 60 degree, presumably defined by the packing condition and the isotropic grain size distribution of the particles. The overall geometry of the deformed strata shows a wedge shape, a typical deformation geometry of this tectonic setting modelled by a number of sandbox experiments.

The overall deformation styles observed in the digital simulation results can be correlated with those seen in published sandbox experiments done under the similar boundary conditions (Fig.1) and natural deformation structures. This strongly suggests that DEM can be a powerful tool to simulate natural geologic deformations, despite the method needs further refinements.


DEM Simulation
Sandbox Experiment
5 cm