Geophysical Research Abstracts
Vol. 15, EGU2013-13842, 2013
EGU General Assembly 2013

DEM modeling of failure mechanisms induced by excavations on the Moon

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2D Discrete Element Method (DEM) analyses were performed for excavations supported by retaining walls in lunar environment. The lunar terrain is made of a layer of sand (regolith) which differs from terrestrial sands for two main features: the presence of adhesive attractive forces due to van der Waals interactions and grains being very irregular in shape leading to high interlocking. A simplified contact model based on linear elasticity and perfect plasticity was employed. The contact model includes a moment – relative rotation law to account for high interlocking among grains and a normal adhesion law to account for the van der Waals interactions. Analyses of the excavations were run under both lunar and terrestrial environments.
Under lunar environment, gravity is approximately one sixth than the value on Earth and adhesion forces between grains of lunar regolith due to van der Waals interactions are not negligible. From the DEM simulations it emerged that van der Waals interactions may significantly increase the bending moment and deflection of the retaining wall, and the ground displacements. Hence this study indicates that an unsafe estimate of the wall response to an excavation on the Moon would be obtained from physical experiments performed in a terrestrial environment, i.e. considering the effect of gravity but neglecting the van der Waals interactions.