Geophysical Research Abstracts, Vol. 8, 10317, 2006
SRef-ID: 1607-7962/gra/EGU06-A-10317

Compaction bands: A comparison of strain and stress controlled DEM simulations

G. Marketos and M. D. Bolton

Cambridge University Engineering Department, Cambridge, U.K.

gm256@cam.ac.uk / Fax: 00441223460777 / Phone: 00441223742371

We have conducted a set of discrete element simulations on a three-dimensional high-porosity granular sample consisting of 9000 spherical particles. Two micro-mechanisms of failure were contrasted, the crushing of grains and the failure of inter-particle bonds. Our results suggest that in order to observe a compaction band in a sandstone with a common stable grain structure, particle crushing is essential.

We have therefore focused on the understanding of crushing localisation in a sand as this is the simplest case. In the strain-controlled simulation a compaction band will exhibit itself as an instability (a drop in the stress-strain curve) due to a surge in the number of crushing events. In the stress-controlled simulation, the compaction band will exhibit itself as an increase in the deformation rate as the sample can no longer accommodate the applied stress rate. As this is usually the case of naturally induced loadings, one can see that localised crushing in a compaction band can be catastrophic.

Compaction bands are also very important as flow barriers. Local crushing and subsequent pore collapse in bands might block flow almost completely or channel it in specific directions. This becomes more significant if compaction bands form during oil extraction due to the reduction of pore pressure that causes an effective stress increase. Our simulations have allowed us to obtain an insight as to what the micromechanism involved in their formation is, how they might be triggered by a single crushing event, and how some properties of the granular material might affect the propagation of the initial crush into a compaction band.