# MATERIAL STRENGTH AND EXPLOSIVE PROPERTY EFFECTS IN CRATERING AND GROUND SHOCK

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An ongoing experimental program has demonstrated that direct simulation of large scale explosive events can be performed at subscale using the elevated gravity field of a centrifuge.' This technique has allowed determination of the effects of various soil media in a-well controlled situation and over many orders of magnitude in explosive energy. To date cratering experiments have been conducted in desert alluvium, wet and dry sand, and in oil-base clay. Both Lead-Azide and PETN explosives have been used. These various cases incorporate large differences in explosive energy density Q, in soil cohesion c, and in the soil angle of internal friction. Substantial changes in cratering phenomena are found.

A single non-dimensional parameter has been identified that accurately measures the effects of-variations in each of Q, c, and @, together with the-energy E and gravity g. When tile cratering efficiency is plotted as a function of the strength-gravity-scaled yield, all of tile experiments fall on a single straight line.

These results show that, at small actual yields, the cohesion of the soil dominates tile phenomena. At larger yields, the cohesion has little effect but tile angle of internal friction remains as an important variable because of the large overburden. A material such as alluvium, having nonzero values for both c and @ shows cube-root scaling at low yields but become asymptotic to dry sand behavior at large yields. Neither behaves as a zero strength material, and neither shows quarter-root scaling, for yields approaching megatons of equivalent TNT.