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Properties of granular analogue model materials: A community wide survey

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We report the material properties of 26 granular analogue materials used in 14 analogue modelling laboratories. We determined physical characteristics such as bulk density, grain size distribution, and grain shape, and performed ring shear tests to determine friction angles and cohesion, and uniaxial compression tests to evaluate the compaction behaviour. Mean grain size of the materials varied between (c. 100 and 400 micrometer). Analysis of grain shape factors show that the four different classes of granular materials (14 quartz sands, 5 dyed quartz sands, 4 heavy mineral sands and 3 size fractions of glass beads) can be broadly divided into two groups consisting of 12 angular and 14 rounded materials. Grain shape has an influence on friction angles, with most angular materials having higher internal friction angles (between c. 35° and 40°) than rounded materials, whereas well-rounded glass beads have the lowest internal friction angles (between c. 25° and 30°). We interpret this as an effect of intergranular sliding versus rolling . Most angular materials have also higher basal friction angles (tested for a specific foil) than more rounded materials, suggesting that angular grains scratch and wear the foil., Most materials have a cohesion in the order of 10-100 Pa except for well-rounded glass beads, which show a trend towards a quasi-cohesionless (C <10 Pa) Coulomb-type material. The uniaxial confined compression tests reveal that rounded grains generally show less compaction than angular grains. We interpret this to be related to the initial packing density reached during sieving which is higher for rounded grains than for angular grains. Ring-shear test data show that angular grains undergo a longer strain-hardening phase than more rounded materials. This might explain why analogue models consisting of angular grains accommodate deformation in a more distributed manner prior to strain localisation than models consisting of rounded grains. Also, models build with angular grains will tend to show more dilatancy during shear zone formation than models build with round grains of comparable mean grain size.