Steady-state shear resistance and viscosity of brittle dense grain flows appear to be independent of grain material and normal stress

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Despite their importance in planetary-surface processes there has been little experimental research on high-stress grain flows in which grain breakage is widespread, such as occurs in rock avalanches, fault rupture and post-impact-crater evolution. In this study, eight different brittle materials were subjected to high-speed rotary shear at fast shear strain rates and normal stresses between 0.3 and 1 MPa while shear resistance and thickness of the shearing layer were monitored. We report variation of shear resistance and viscosity of these grain flows during very large strains. Shear resistance of all the materials reached a similar steady-state value independent of applied normal stress and material composition. Viscosity for all the materials also reached similar steady-state values at all applied normal stresses but was inversely proportional to shear speed . When initial values of shear resistance and viscosity were above the steady state values, the materials weakened to the steady state, but when the initial values were less than the steady state, the materials strengthened with increasing shear strain to reach the same steady state.

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