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Ash production through brittle cataclasis during dome emplacement

Lori Kennedy and Kelly Russell
Earth and Ocean Science, University of British Columbia, Vancouver, British Columbia, V6T 1Z4

Fine-grained gouge (< 5 microns) is generated along shear zones during the emplacement of dacite domes during the most recent volcanic activity at Mount Saint Helens. Here, we present grain size data from both the natural fault rocks from Mount Saint Helen's and experimentally generated gouge. Our triaxial rock deformation experiments were run at confining pressures (Pc) of 0, 25, 50, and 75MPa, at room temperature and strain rates of $\sim$1 x 10-4/s. We performed experiments that were terminated after failure and experiments on frictional sliding of the gouge. Our starting material has low (6-8%) porosities, a uniform bulk composition (65 wt% SiO2) and is highly. The dacite experiments show a progressive increase in peak strength (100-700 MPa) with increasing Pc and all cores show brittle behavior, characterized by a rapid stress drop. Run products contain macroscopic fractures with deformation extremely localized around the shear fractures. Experimentally deformed dacites show extreme grain size reduction and the production of gouge. Gouge material can reach < 1 micron in diameter. Frictional sliding experiments generated more gouge than experiments stopped after failure. However, there is little modification of the finest grain sizes (<20 microns) because of frictional sliding. We propose that the large stress drop at failure generates the fine-grained gouge and subsequent sliding does not further reduce the grain size. The amount of energy required to produce the fine-grained material is calculated and we compare this to the energy required to generate volcanic ash from fragmentation.