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The effect of temperature on the fragmentation efficiency.

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Rapid decompression of highly viscous, silicic magma can itself lead to disastrous volcanic explosions. Experiments on natural samples allow the determination of key parameters and characteristics of magmatic fragmentation, a key of explosive eruptions.
In this study we analysed the effect of experimental temperature on the grain-size distributions of artificial pyroclasts of three different sample types: Mount Unzen dacite (35 % connected porosity, Lipari Pumice (44 % connected porosity), Montserrat pumice (67 % connected porosity). The pyroclasts were generated in a series of rapid decompression experiments at room temperature and 850°C; for Lipari pumice an additional temperature step of 425°C was introduced. For all three sample sets and experiments were conducted at 10 MPa applied pressure; for Lipari samples an additional pressure step of 5 MPa was added, for Unzen samples further experiments were performed at 15 MPa and 20 MPa. The grain-size distribution was retrieved by dry-sieving (particles >63 μm) and laser-diffraction grain-size analysis (particles <125 μm).

For all three sample sets a more or less pronounced influence of the temperature to the grain-size distribution and thus the efficiency of fragmentation can be observed. At 850°C the samples tend to create coarser grain-size distributions. On the other side fragment samples at high temperature at relatively lower applied pressures compared to cold samples. An increase in temperature results in a reduction of the gas density and the sample's tensile strength, and ultimately when crossing glass transition temperature the addition of a ductile component. We will discuss our results in the light of these changes in physical properties. Additionally we traced a high amount of molecular water being dissolved into the Lipari pumices, however this does not seem to alter the grain-size distribution.

The data presented in this study are thought to be base of a larger to-be-built dataset to understand and quantify the processes and the causes of the temperature dependent fragmentation behaviour.