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The Influence of Physical Parameters on the Fragmentation Efficiency

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Volcanic ash, though usually emplaced relatively slowly, can severely harm areas much larger than the direct entourage of a volcano where all other, potentially highly energetic eruptive products come to deposition. Together with volcanic gas/aerosols, the impact can even be a global one and cause significant human or economic loss. The influence of various physical properties (e.g. overpressure, porosity) on the fragmentation behaviour is known from several studies (e.g. Spieler et al., 2004; Kueppers et al., 2006). Here, in a further approach to better constrain the factors governing the generation of volcanic ash, we performed rapid decompression experiments to reveal the influence of textural parameters (e.g. bubble number density, crystallinity) on the pyroclast generation. All experiments have been performed at well-constrained physical conditions (850 $ˆ\circ$ C and pressures of up to 50 MPa). We used natural samples from Unzen (Japan), Merapi (Indonesia), and Popocatepetl (Mexico) volcanoes with up to 35.5 vol.% open porosity and up to 75 vol.% phenocryst/microlite content. The generated pyroclasts of more than 70 experiments have been sampled at high yield and sieved at half- $ˆ\Phi$ steps. We used several approaches to characterize the fragmentation efficiency: Grain-size distribution, surface increase, and fractal analysis. The grain-size distributions of all samples irrespective their origin consistently showed a positive correlation of the amount of generated ash particles with the applied potential energy for fragmentation (PEF, from open porosity and applied pressure). The generated surface was negatively correlated with the open porosity of the sample as the bubble wall thickness decreases with increasing porosity. Additionally, we speculate that large, already cracked phenocrysts (very prominent in Unzen samples) could have

facilitated the degree of disassembling of the samples without opening of new cracks. Fractal analysis was performed using cumulative weight fractions and crossing trends of data sets from each volcano could be clearly observed showing the effect of changing degrees of crystallinity. The achieved results have greatly increased our understanding of energy conversion during explosive, volcanic eruptions. These approaches may be used to reveal further, eventually still hidden information from natural deposits. Especially in the case of volcanoes with long repose periods, experimentally derived correlations may be employed to volcanic deposits and represent another tool to better constrain eruptive conditions and refine hazard assessment.