Simulating discrete volcanic explosions: bench-scale and field-scale detonation experiments

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Discrete volcanic eruptions - those exhibiting non-steady state conditions - are relatively poorly understood volcanological phenomena [Zimanowski et al., 1991; Taddeucci et al., 2009; White and Ross, 2011]. Whereas the nature of the fragmentation zone in steady state, open vent volcanic eruptions has been extensively assessed through the use of both fieldwork and analogue experimentation over the last few decades, the natures of explosion-generating zones in various types of discrete eruptions are open to a wide range of interpretations [e.g. White and Ross, 2011]. The initial mobilisation and entrainment of particles is a process affecting both discrete jets and inception of subsequently sustained ones that has rarely been addressed. A recent set of analogue experiments, both involving bench-scale and field-scale detonations, demonstrate that this initial mobilisation and entrainment may be complex. Our experiments show that different ejected particle populations may take very different trajectories, with movement beginning at very different times, in response to a single driving explosion source. The timing and physical nature of the initial coupling that drives movement may lead to a dynamic segregation of the surrounding, entrained material, with rapid, uneven distribution of momentum during the initial blast generating multiple, upwards-thrusting jets. The implications of these analogue experiments apply not only to discrete volcanic eruptions known to occur in monogenetic volcanic fields, but in any subterranean, discrete explosion within a granular material host.