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Morphology and dynamics of explosive vents

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Eruptive processes in nature produce a wide variety of morphologies, including cone sheets, dykes, sills, and pipes. The choice of a particular eruptive style is determined partly by local inhomogeneities, and partly by the gross overall properties of the country rock and the physical properties of the eruptive fluid. In this study we report on experimental and numerical designed to capture a range of morphologies in an eruptive system. Using dimensional analysis we link the experimental and numerical work together and draw implications for field studies. Our experimental work uses silica flour in a Hele-Shaw cell, with air as the eruptive fluid. A phase diagram demonstrates a separation between two distinct morphologies, with vertical structures occurring at high pressure or low depth of fill and diagonal ones at low pressure or high depth of fill. In the numerical work the eruptive fluid is a mixture of basaltic magma, supercritical water, and carbon dioxide, and the ambient material is a fill of basalt with varying material properties. In the numerical work we see three distinct morphologies: vertical pipes are produced at high pressures and softer backgrounds, diagonal pipes at lower pressures and stiffer backgrounds, while horizontal sills are produced in intermediate regimes.