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Eruption Morphologies from Numerical Simulations

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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. We have performed two-dimensional simulations designed to capture a range of morphologies in an eruptive system, using the finite-volume code Sage, originally developed at Science Applications International. In these simulations, we supply a mixture of basaltic magma, supercritical water, and carbon dioxide at a given pressure and zero velocity into a 2-km deep fill of basaltic country rock. We vary the supply pressure and the material properties of the country rock in a parameter study. All simulation runs are followed until the volatile-rich mixture breaks out at the surface. Pipes are produced at high pressures with softer backgrounds, cone sheets at lower pressures and stiffer backgrounds, while sills are produced in intermediate regimes.