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The Fluid Mechanics inside a volcano

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The style and evolution of volcanic eruptions is dictated by the fluid mechanics that governs ascent of magma. Ascent in turn is influenced by the nucleation and growth of bubbles which provide the driving force for eruptions, the loss of gas from the magma, crystallization, fragmentation, and magma rheology. All such changes in the magma are coupled. We integrate models of all these processes to show when each dominates and how they interact within a conduit. In particular, we show that ascent rate controls eruptive behavior: slowly ascending magmas erupt effusively and rapidly ascending magmas erupt explosively.