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Two-dimensional numerical modelling of magma in volcanic conduits

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Two-dimensional Finite Element conduit flow models are developed to enable magma properties to be determined at all depths and lateral positions in a conduit. These models show the substantial effect compressibility has on magma flow and its properties. By modelling in two-dimensions, the degree of horizontal parameter variations across a conduit are resolved, specifically the variations of melt and magma shear viscosities.

Within the framework of these two-dimensional Finite Element models a number of assumptions and effects are explored. The assumption of isothermal magma is found to be valid when considering the overall flow behaviour within a conduit, however it is not valid when investigating mechanisms occurring close to the conduit wall, where the effects of cooling must be considered. An example of such a mechanism is brittle failure of melt, which is shown to occur within magma conduits. The effects of brittle failure of melt on conduit flow dynamics is fully explored, and an advanced conduit flow model is produced that incorporates the effects of friction-controlled slip and gas loss as a consequence of brittle failure of melt.