Geophysical Research Abstracts, Vol. 7, 08931, 2005
SRef-ID: 1607-7962/gra/EGU05-A-08931

The extrusion of spines during dome forming eruption

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Dome forming eruptions are often characterized by the extrusion of spines (Montagne Pelée, 1902, Soufrière Hills 1995-97, Unzen 1994). These extrusions may occur intermittently more than once during the construction of the dome. Their height is typically of order of tens of meters with an aspect ratio H/r between 0.5 and 3. Spines usually form when the mass flow rate of the eruption is low. It is critical to understand the formation of these spines not only because it can generate dangerous instabilities but also because it gives insights into the magma flow behaviour in the upper part of the conduit. We use a 2-D FEM code to investigate the conditions for which the ratio RV of horizontal velocity component / vertical velocity component is reduced. When this ratio is small it indicates that the conditions are favorable for spine formation. The code takes into account the microlite growth due to the decrease in pressure during ascent. We found that RV is reduced of a factor of 2 at the exit of the conduit when (1) the bubble expansion is delayed due to high bulk viscosity coefficient (2) the microlite content increases (3) if the conduit length increases due to its extension through the preexisting constructed dome. On the contrary, pressure build-up at the exit due to lava accumulation favors spine destabilization.