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Strombolian eruption dynamics: insight from small scale experiments and Stromboli, Yasur and Mt. Erebus

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Most of the commonly used models to simulate volcanic eruptions assume a steady state or a stationary mass flux for the input of mixtures of ash and gases into the atmosphere. Here we review Doppler radar retrieved tephra velocities from 2 small scale experiments as well as 3 different volcanoes (Mt. Erebus, Yasur volcano, Stromboli volcano) spanning a wide range of compositions and typical eruptive activity. In the Waakiki experiments (in collaboration with the LMU Munich, U. Küppers) and in Würzburg (in collaboration with B. Zimanowski) the release of volcanic ash was achieved either by fragmenting material in a shock tube (Waakiki) or by accelerating ash through the release of highly pressured gas (Würzburg). Both experiments show very similar behavior in terms of the eruption velocity. Furthermore the so called h-value (Alatorre-Ibargüengoitia et al., 2010, doi:10.1016/j.epsl.2009. 12.051; 2011, doi:10.1016/j.epsl.2010.11.045) seems to represent the size (length) of the pressurized volume.
Mt. Erebus – being the only volcanic system where a direct view onto the magma surface was possible – reveals mainly two types of eruptions: (I) a straight acceleration of the magma surface, and (II) two acceleration phases (Gerst et al., 2013, doi:10.1002/jgrb.50234). At Yasur and Stromboli volcano eruptions occur in pulses and vary between ash rich and ash free explosions. Pulse frequencies are dependent on the eruptive regime and vary between 0.5 and 2 seconds at Stromboli and over a slightly wider range at Yasur. The intriguing observation is that in case of a direct view onto the magma surface (i.e. at Erebus) we do not observe pulses, but quite often two acceleration phases. When the source of the eruption surface is not visible, and gas and tephra are transported an unknown length through a conduit, the eruptive regime is quite often pulsed. We will discuss the inferences of these observations with respect to slug flow processes in the conduit.