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# The Masaya Triple Layer: A petrological approach to constraining the dynamics of an episodic, highly explosive basaltic Plinian eruption

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Basaltic volcanism is the most common style of volcanic activity on Earth. The low viscosity of basaltic magma enables efficient gas-melt separation during magma ascent, resulting in the effusive to mildly explosive eruptions we expect and frequently observe at these volcanic systems. Conversely, to achieve magma fragmentation and produce a highly explosive Plinian eruption, a magma viscosity of $10^6$ Pa s must be attained (Papale, 1999; Namiki and Manga, 2008), exceeding the range expected for basaltic compositions (100-1000 Pa s) (Takeuchi, 2015). However, at several instances in geological history, basaltic volcanoes have been found to produce explosive Plinian eruptions, resulting in significant human and environmental impacts on local to global scales (Houghton et al, 2004). Masaya caldera, Nicaragua, is a unique example in producing several Plinian eruptions, notably the episodic Masaya Triple Layer (2.1 ka), which deposited 3.4km$^3$ of volcanic material over the present-day location of Nicaragua's capital Managua (Costantini et al, 2009; Pérez et al, 2009). In examining Masaya caldera, we have a great opportunity to test hypotheses on the triggering mechanism of basaltic Plinian volcanism, using an example with recurrent activity.

We present new data and insight into the evolution of the Masaya Triple Layer eruption, using several petrological techniques to decipher the pre and syn-eruptive conditions, aiming to constrain a model for this event. By combining EPMA analysis, thermometric models and Raman spectroscopy we can infer the pre-eruptive condition, with magma last stored at high temperature and shallow pressure, with a $H_2O$ concentration of 2 wt.%. Micro-textural analysis and calculation of crystal-size distributions indicates that rapid syn-eruptive crystallisation played an important role in the dynamics of the Masaya Triple Layer eruption. Extensive, rapid microlite crystallisation induced a significant increase in viscosity and consequently magma rheology during ascent, increasing the potential to reach the fragmentation threshold. Constraining the dynamics of the atypical Masaya Triple Layer eruption is of critical importance to vulnerable populations living in proximity to the potentially highly explosive caldera. Furthermore, in understanding the explosive transformation of Masaya caldera, we are able to further our understanding of the most poorly understood and hazardous style of basaltic volcanism.

Costantini. L. et al., 2009. Bulletin of Volcanology. 71: 337-355.

Houghton, B.F. et al., 2004. Journal of Volcanology and Geothermal Research, 137: 1-14.

Namiki, A. and Manga, M. 2008. Journal of Volcanology and Geothermal Research, 169: 48-60.

Pérez, W. et al., 2009. Journal of Volcanology and Geothermal Research, 179: 191-205.

Papale, P., 1999. Nature, 397. Takeuchi, S. 2011. Journal of Geophysical Research, 116.