Explosive Basaltic Eruptions: Flow Dynamics and Conduit Processes

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Project description:

Background Basaltic volcanism is generally associated with effusive behaviour, such as lava flows. However, explosive behaviour is also observed at many basaltic volcanoes, ranging in style from fire-fountaining, such as is commonly observed on Kilauea Volcano (see Figure 1d), to Plinian basaltic eruptions documented on Etna, Tarawera, and Masaya (see Figures 1a-c). Activity can switch suddenly from effusive to explosive and back again. Valuable data for a number of basaltic eruptions has been reported in the literature, covering eruption rate and style, textural information such as vesicularity and crystallinity, and depositional characteristics such as bed forms, grain size and clast morphology (e.g. Houghton et al, 2004; Sable et al, 2009). It is clear that the eruption style is controlled by the flow processes in the conduit and, in particular, the interplay between *rheology* (i.e. the viscosity of the flow), *permeability* and *fragmentation*. Significant advances have been made on our understanding of these processes in recent years.

Project Aims and Methods The aim of this project is to combine field observations, laboratory studies and modelling to establish what causes basaltic eruptions to switch between effusive and explosive behaviour. Fieldwork will focus on the Plinian phase of the 1886 basaltic eruption of Tarawera, New Zealand, which we will contrast against sub-plinian and effusive eruptions on Etna. The student will spend an extended period of some months based at GNS, New Zealand, to conduct this research and an additional short field season based on Etna, Italy, supported by researchers from INGV (dependent on volcanic activity levels). Laboratory work will consist of a combination of petrological and textural studies of field samples and also rheological measurements of analogue (i.e. non-magmatic) suspensions with similar assemblages of bubbles and crystals (Mader et al, 2013).

Candidate The project would suit a student with a first degree in the physical sciences and a desire to develop a range of different skills (field, lab and modelling). The balance between field, laboratory and numerical modelling can be adjusted to suit the background and interests of the candidate.

References

[1] Houghton et al `The influence of conduit processes on changes in style of basaltic Plinian eruptions: Tarawera 1886 and Etna 122BC.' Journal of Volcanology and Geothermal Research, 137, doi: 10.1016/j.jvolgeores.2004.05.009, 2004. [2] Mader et al `The rheology of two-phase magmas: A review and analysis.' Journal of Volcanology and Geothermal Research, 257, http://dx.doi.org/10.1016/j.jvolgeores.2013.02.014, 2013. [3] Sable et al `Eruption mechanisms during the climax of the Tarawera 1886 basaltic Plinian eruption inferred from microtextural characteristics of the deposits.' From Thordarson et al (eds) Studies in Volcanology: The Legacy of George Walker, Special Publications of IAVCEI, 2, 129-154, 2009.

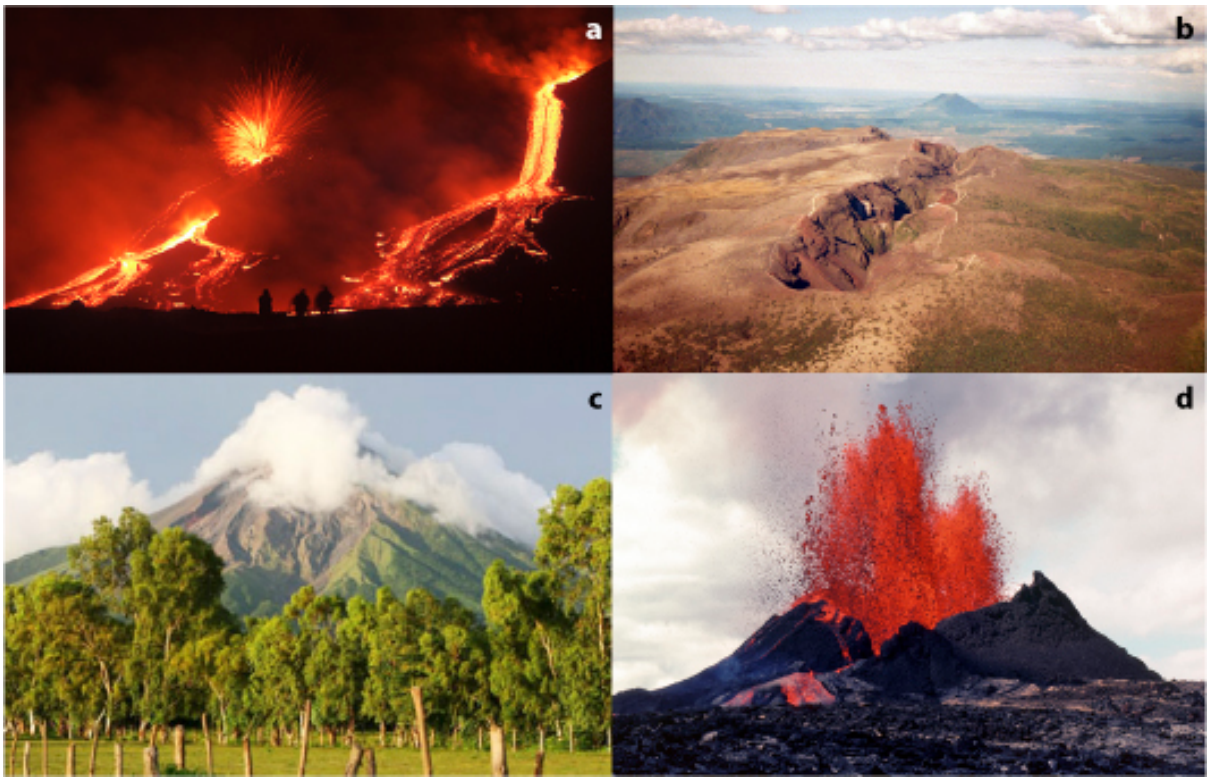

Figure 1: Volcanoes with a history of explosive basaltic eruptions.
(a) Etna, Italy. (b) Tarawera, New Zealand. (c) Masaya, Nicaragua. (d) Kilauea, Hawaii.