HErupt: Hydrothermal cell pre-Eruptive simulation: An analogue model of bubble formation in explosive magmas

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Project Description:

The impact of volcanic eruptions on society (loss of life, destruction of infrastructure, disruption of airline traffic) is extremely severe and difficult to predict. The chief process controlling eruption dynamics is the liberation of gas from the magma (vesiculation). The forecast of volcanic hazard requires the knowledge of the mechanism yielding magmavesciculation, i.e., nucleation, growth, and coalescence of water and/or CO$_2$ bubbles in the magma, before it erupts. A significant advancement in the understanding of vesciculation happens through the reproduction of the conditions present inside volcanoes via high pressure and temperature experimentation. In recent years, in-situ visualization of bubble formation at magmatic conditions became possible, but its use was hindered by a number of technical flaws and limitations with the experimental apparatuses and techniques used.

This project is part of the new strategic theme of the ES Department targeting use of experimentation at high pressure and temperature to tackle themes of primary societal impact: Energy critical metal retrieval;; Volcanic hazard prediction;; Use of supercritical water in industrial applications.

The proposed experimental investigation will reproduce and characterize vesciculation of explosive magmas using a custom-made Hydrothermal Diamond Anvil Cell (HDAC), following the progresses obtained with this apparatus by Dr. Solferino (1; 2). The focus of the study will be on advancing in-situ experimentations to tackle the following objectives:

- Define and compare the conditions, dominant mechanism, and the rate of bubble nucleation, growth, and coalescence in crystal-free and crystal-bearing magmas (i.e., homogeneous versus heterogeneous bubble formation).
- Determine the effect of carbon dioxide on homogeneous and heterogeneous nucleation.
- Model the effect of magma composition and of decompression rate on the vesciculation process.

This project will train postgraduate students in essential scientific & technical skills required in an academic research environment and geohazard consultancy.

References:
