Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Determining the impact of mush dynamics on the style of volcanic eruptions at the active Campi Flegrei caldera, Italy

Supervisors

Dr Mike Stock (Trinity College Dublin), Dr Victoria Smith (University of Oxford), Dr Roberto Isaia (INGV, Vesuvius Observatory)

Closing Date

Friday 5 March 2021

Funding Status

Fully funded project

About the project

Dynamic processes operating within crustal magma systems control the composition, style and timing of volcanic eruptions at the Earth's surface. For over a Century, our conceptual understanding of magma system architectures has centred around "magma chambers" – isolated bodies of liquid rock, hosted within the solid crust beneath a volcano. However, volcanology is currently undergoing a paradigm shift, whereby this simple model of magmatic systems is being called into question. Rather than discreet bodies, geological datasets are increasingly converging on a new "transcrustal mush zone" model of magma system architecture, where magmas are stored throughout the entire crust beneath a volcano but are largely in a solid-dominated (mush) state. Liquid melts only occupy the pore space between crystals and small melt-rich pockets (sills that are 100s m long and 10s m thick). These mush zones have different physical/chemical properties to magma chambers surrounded by solid rock, impacting the processes operating during magma ascent, and necessitating re-evaluation of our understanding of magmatic processes and eruptions triggers. Although interactions between ascending magmas and mush must affect volcanism at the Earth's surface, linking these processes is difficult due to a paucity of suitable study sites.

This project will investigate interactions between ascending magmas and mush before recent eruptions of Campi Flegrei caldera (Italy). Recent Campi Flegrei eruptions have covered a diversity of styles and compositions, and the volcano has been identified as hosting a transcrustal mush-type magmatic system. Specifically, the project will:

- Develop an innovative method integrating geochemical data, thermodynamic models and statistical techniques to quantify the amount of mush which has been disaggregated and incorporated into ascending magmas.
- Undertake a multidisciplinary study of minerals in eruption deposits, applying geochemical and textural analyses to identify mush-derived crystals and using these to constrain the mush rheology.
- Apply state-of-the-art petrological models to understand the depths and timescales of magma storage, integrating these with geophysical datasets to construct a comprehensive picture of the Campi Flegrei magmatic system.

By comparing the petrological features of successive eruption deposits, it will be possible to place first-order constraints on how crustal magmatic processes impact the timing, composition, and style of volcanism at the Earth's surface.

The student will initially work with rock samples in the supervisors' collection. However, it is hoped that there will be opportunities for fieldwork and additional sample collection in the Neapolitan region, depending on COVID travel restrictions. Full training will be provided in all necessary analytical and modelling techniques at Trinity College Dublin and the University of Oxford (UK), including SEM, LA-ICP-MS, EPMA and XRF. Working with the INGV Vesuvius Observatory, the results will be used to support on-going volcano monitoring efforts, improving hazard assessment in a densely populated part of Europe.

We seek an enthusiastic and motivated individual to undertake this project within the active Geochemistry research group at Trinity College Dublin. The applicant should have a strong background in Earth or physical sciences, including a BSc, MSc or MSci in a relevant subject. No specific laboratory or modelling experience is required but the applicant should have some prior knowledge of igneous petrology. Experience in geochemical analysis and/or data manipulation is desirable.

For all enquiries, please contact Dr Michael Stock, Michael.Stock@tcd.ie

Application procedure

To apply, the following documents should be submitted to Michael.Stock@tcd.ie in advance of the closing date:

- A personal statement, demonstrating the applicants experience and motivation for undertaking this project (max. 2 A4 pages).
- The applicants CV.
- Two academic references (these can either be submitted by the applicant or confidentially by the referees).

Shortlisted applicants will be invited to interview in March 2021 and will be informed of the outcome within one week. On receiving an offer, the successful applicant will be required to submit supporting documentation (e.g. degree transcripts) to the TCD Academic Registry.

Funding notes

This studentship is funded for 4 years by a Trinity College Dublin Provost's PhD Award 2021 and is open to EU, UK and overseas applicants.

The project start date is September 2021.

References

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- Edmonds, M., Cashman, K.V., Holness, M., and Jackson, M., 2019. 'Architecture and dynamics of magma reservoirs', *Philosophical Transactions of the Royal Society A*, 377, 20180298.
- Smith, V.C., Isaia, R., and Pearce, N.J.G., 2011. 'Tephrostratigraphy and glass compositions of post-15 kyr Campi Flegrei eruptions: implications for eruption history and chronostratigraphic markers', *Quaternary Science Reviews*, 30, 3638-3660.
- Stock, M.J., Humphreys, M.C.S., Smith, V.C., Isaia, R., Brooker, R.A., and Pyle, D.M., 2018. 'Tracking Volatile Behaviour in Sub-volcanic Plumbing Systems Using Apatite and Glass: Insights into Pre-eruptive Processes at Campi Flegrei, Italy', 59, 2463–2492.