MEETING 8 – April 14th 2022

Paper in discussion: Pankhurst et al. (2022) Rapid response petrology for the opening eruptive phase of the 2021 Cumbre Vieja eruption, La Palma, Canary Islands. Volcanica. 5(1): 1-10 https://doi.org/10.30909/vol.05.01.0110

Guest Speakers:
Dr Emma Liu (BST) -
https://www.ucl.ac.uk/earth-sciences/people/academic/dr-emma-liu

Abstract: How and why magmatic systems reactivate and evolve is a critical question for monitoring and hazard mitigation efforts during initial response and ongoing volcanic crisis management. Here we report the first integrated petrological results and interpretation provided to monitoring authorities during the ongoing eruption of Cumbre Vieja, La Palma, Canary Islands, Spain. The first eruptive products comprised simultaneous Strombolian fountain-fed lava flows and tephra fall from near-continuous eruption plumes. From combined field, petrographic and geochemical analyses conducted in the 10 days following sample collection, we infer low percentage mantle melts with a variably equilibrated multimineralic crystal-cargo and compositional fractionation by winnowing during eruptive processes. Hence 'rapid response' petrology can untangle complex magmatic and volcanic processes for this eruption, which combined with further study and methodological improvement can increasingly assist in active decision making.

BROAD QUESTIONS

- How can we conduct responsive petrology efficiently and effectively in the event of an eruption?
- What is restingolite?
- Why was the initial phase explosive?
- Why did certain vents emit more ash than others?
- How unique was Cumbre Vieja? Is it more analogous to arc volcanoes?
- What information is most informative to decision-making?
- What might be the most effective and accessible way to communicate the rapid results obtained by this research team?
- What are the outstanding challenges to responsive petrology?
- What are the emerging insights into the magmatic processes prior to and during the La Palma eruption?

SPECIFIC QUESTIONS

- How can we mitigate against processes of transport fractionation when collecting tephra samples?
- What volcanic hazards are given priority for scientific attention in an eruption event?
- Is the applicability of R-R-P largely contingent on the ease of access to the eruption site? How can we work with local authorities to prepare for potential future eruptions to ensure swift and smooth access for external scientists?
- Could you measure/monitor changes in volatile emissions as the eruption was proceeding, then link this to petrological observations?
- When resources (people, time and instrumentation/finances) are limited, what should be prioritized?
- How might the insights from petrology be integrated with other monitoring data (e.g., seismicity, deformation)?
  - different approaches are potentially capturing information on processes occurring over different timescales and at different depths, so how do we integrate these?
- What do these early data suggest regarding the melting and storage conditions of the magmas feeding the La Palma eruption?
- How can we make the time from sampling to data interpretation even more efficient?
- How might we prepare/train for an eruptive scenario?
  - Would trial mobilization/response exercises be useful so procedures and roles are established prior to a crisis situation?

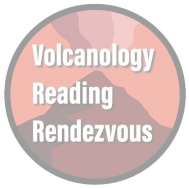
KEY POINTS/OBSERVATIONS

- Petrology would be useful to understand if an eruption was waning – although no models currently exist that are able to do this, it would be useful for monitoring to understand if new magma is involved in an eruption
- There also appears to be a lack of models for interpreting petrology in an immediate response scenario
- Attendees were struck by the fact that these analyses could be done so quickly, and within the timescale of an eruption, and thought that improving the efficiency of the process (i.e., logistics, more local facilities) would help the technique in the future
  - some attendees were part of the response team in La Palma and suggested that an 'interim' lab technician team would have sped up the process of analysis immeasurably, with lab preparation becoming a significant bottleneck in the response chain
- Method potentially needs applying to another really well studied system to put the data into context
  - or perhaps a system that is not so 'unique' as La Palma proved to be?
- Spanish abstract is fantastic for improving the accessibility of the article – the option to publish articles in other languages is something to be encouraged
- The 'La Palma tsunami' hypothesis was brought up as an example of when hazard communication can go wrong, and how damaging the effect of exaggerated science can be not only on perceptions of risk of a region, but the people who live in the volcano's shadow
  - e.g., drop in tourism when the 'Mega Tsunami' documentary came out caused lasting problems for residents
  - dispelling myths and sensationalist claims took valuable time and resources from INVOLCAN

RESOURCES/FURTHER READING

Carracedo, J., Rodríguez Badiola, E., Guillou, H., de laNuez, J., Pérez Torrado, F. J. (2001) Geology and volcanology of La Palma and El Hierro, Western Canaries. *Estudios Geológicos* **57**: 175–273

Day, S. J., Carracedo, J. C., Guillou, H., Gravestock, P (1999) Recent structural evolution of the Cumbre Vieja volcano, La Palma, Canary Islands: volcanic rift zone re-configuration as a precursor to flank instability. *Journal of Volcanology and Geothermal Research* **94**: 135–167.



Klügel, A., Galipp, K., Hoernle, K., Hauff, F., Groom, S. (2017) Geochemical and Volcanological Evolution of La Palma, Canary Islands. *Journal of Petrology* **58**(6): 1227–1248

Klügel, A., Hansteen, T.H., Galipp, K. (2005) Magma storage and underplating beneath Cumbre Vieja volcano, La Palma (Canary Islands). *Earth & Planetary Science Letters* **236**(1-2): 211-226

Pankhurst, M. J., Morgan, D. J., Thordarson, T., Loughlin, S. C. (2018) Magmatic crystal records intime, space, and process, causatively linked with vol-canic unrest. *Earth and Planetary Science Letters* **493**: 231–241

Re, G., Corsaro, R. A., D'Oriano, C., Pompilio, M. (2021) Petrological monitoring of active volcanoes: A review of existing procedures to achieve best practices and operative protocols during eruptions. *Journal of Volcanology and Geothermal Research* **419**: 107365

Rollinson, G. K., Andersen, J. C. Ø., Stickland, R. J., Boni, M., Fairhurst, R. (2011) Characterisation of non-sulphide zinc deposits using QEMSCAN®. *Minerals Engineering* **24**(8): 778–787

Ward, S. N., Day, S. J (2001) Cumbre Vieja Volcano; potential collapse and tsunami at La Palma, Canary Islands. *Geophysical Research Letters* **28**(17): 3397–3400

White, J.D. L., Schmincke, H.-U. (1999) Phreatomagmatic eruptive and depositional processes during the 1949 eruption on La Palma (Canary Islands). *Journal of Volcanology and Geothermal Research* **94**(1-4): 283–304