



## Charlemont grant report

Recipient name:	Dr Claire Harnett
Discipline and subject area:	Sciences; Earth and Environmental Sciences
Amount and year awarded:	€2,245 in 2021
Title of project:	Combining analogue and computational models to investigate lava spine extrusion

### Summary of findings:

We carried out a multidisciplinary study that combined analogue modelling, numerical modelling, and remote sensing observations of the 2020 spine extrusion at Shiveluch volcano, Kamchatka. We showed that spine growth was preceded by inflation. By combining the modelling methods for the first time, we showed that it is a complex interplay of parameters that enables spine growth: (1) inclination of the magmatic conduit due to regional tectonic trends; (2) the potential for mechanical heterogeneities in the conduit material; and (3) topographic (un-)buttressing of the growing dome. These parameters control not only the growth of the spine, but also the potential direction of instability. Spine instability results in collapse and generation of large pyroclastic density currents, which can be devastating to surrounding communities. Our results are key for understanding growth and collapse hazards of spines and provide unique insights into the hidden magma-conduit architecture.

### Plans for continuing collaboration:

Two key collaboration opportunities emerged from this project:

(1) My PhD student changed focus of her project from numerical modelling to analogue modelling. She will work closely with both German colleagues (Thomas Walter, Edgar Zorn) to advance the current state of analogue modelling in the context of lava dome and spine extrusion. This will build research capacity within UCD by setting up our own analogue modelling laboratory.

(2) I was invited by Prof Thomas Walter to collaborate on a European Research Council Synergy grant proposal. This is ~10 million EUR. We were unsuccessful in this bid but received positive reviews so will resubmit in the coming round.

### Published work and publication plans:

Published paper:

Walter, T. R., Zorn, E. U., Harnett, C. E., Shevchenko, A. V., Belousov, A., Belousova, M., & Vassileva, M. S. (2022). Influence of conduit and topography complexity on spine extrusion at Shiveluch volcano, Kamchatka. *Communications Earth & Environment*, 3(1), 1-10.

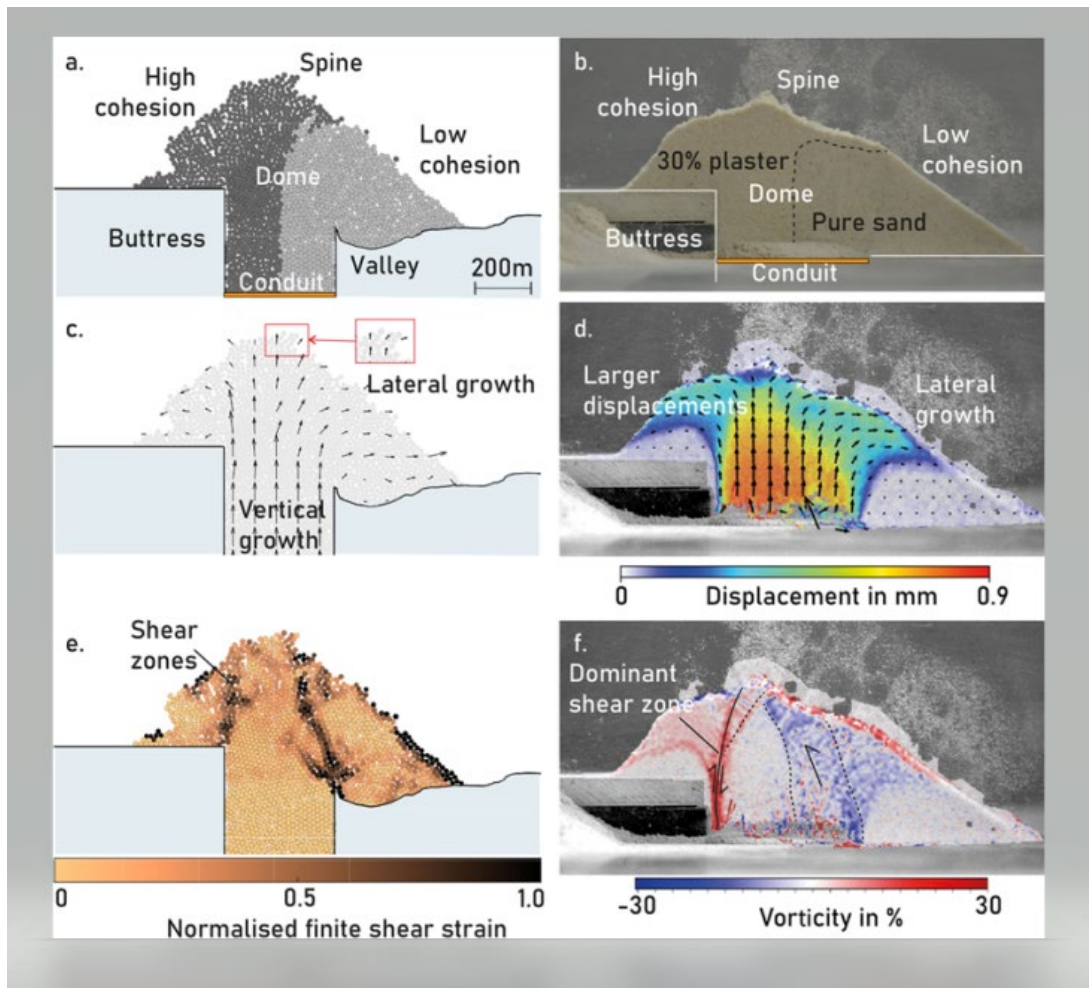
Accepted paper (to be published in coming weeks):

Harnett, C. E., Heap, M. J., Troll, V., Deegan, F., Walter, T., (2022) Large-scale lava dome fracturing as a result of concealed weakened zones. *Geology*.

Planned paper (for submission early 2023):

## Charlemont grant report

Myers, A. J., Harnett, C. E., Holohan, E. P., Ryan, J., Zorn, E., Walter, T., Heap, M. J., Lava dome morphology controlled by viscosity and cohesion: insights from analogue modelling.



### Dissemination and plans for future dissemination:

1. Harnett, C, Heap M, Troll V, Deegan F, Walter T. Large-scale lava dome fracturing as a result of concealed weakened zones. IAVCEI Scientific Assembly 2023.

2. Myers A, Harnett C, Holohan E, Ryan J, Zorn E, Walter T, Heap M. Lava dome morphology controlled by viscosity and cohesion: insights from analogue modelling. IAVCEI Scientific Assembly 2023.

### Collaborations and planned collaborations:

The key international collaboration was with academic project partners Thomas Walter and Edgar Zorn. This has led to further international collaboration with Val Troll and Frances Deegan from Uppsala University in Sweden.

Additionally, my PhD student (Amy Myers) has obtained many academic collaborations within UCD as part of setting up an analogue modelling lab, specifically in the School of Civil Engineering.

### Outreach and engagement activities:

December 2021: Public lecture with Irish Geologists Association



Acadamh Ríoga na hÉireann  
Royal Irish Academy

## Charlemont grant report

Title: Virtual volcanoes: Predicting when a volcano turns deadly on Earth and other planets.

May 2021: Public lecture with Belfast's Geologists Society

Title: Virtual volcanoes and smashing rocks: modelling collapse