

## Professional Internship Programme and Overseas Research Visit Fund - GNS Science New Zealand – Ben Clarke

From September to December 2018 I was funded by the ORVF and PIP to travel to New Zealand and work with GNS sciences volcanology team; the research group responsible for monitoring volcanic activity in New Zealand. Hosted by Agnes Mazot, Geoff Kilgour and Nico Fournier, I took part in day to day activities, in addition to individual projects to contribute to the work of the organisation.

The first project was to re-develop a programme used by staff at GNS science to process data from volcanic gas monitoring flights. The current programme was an unstable excel macro, that was cumbersome, proprietary, time consuming and often failed. Working with Eleri Clarke, I re-developed the programme in Python. This project took 6 weeks, resulting in a programme that was far more stable, easier to use, takes around half the time to run, improved upon error calculations and is entirely open-source. The programme is now being employed by GNS science in their day to day activities and has been shared with the United States Geological Survey for use by their volcanic observatories. By developing this programme, I significantly advanced my coding skills, as well as project management, and user-lead software design. In order to understand how the data is collected, I was taken on a gas monitoring flight around White Island volcano, and on numerous excursions monitoring volcanic degassing into hydrothermal lakes around North Island.



During the remainder of my internship I undertook three separate projects with Geoff Kilgour. Firstly, I lead a sampling expedition to find tephra produced by Mayor Island volcano, a poorly understood volcano with similarities to the one I study in Ethiopia. I collected tephra, characterised their geochemistry and physical properties, ultimately to understand the potential hazards this volcano poses to New Zealand airspace. The next project involved calculating the dynamics and eruption volumes from the then ongoing eruption of Ambae volcano in Vanuatu. Using field data of pumice deposits around the island, I calculated the volume of erupted material, wind conditions, and the probable variability in the height of the eruption column during the eruption. These constraints provide important information for physical models of how the eruption played-out, and how it is likely to behave in the future. This information will inform future hazard assessments of the volcano and will be published later. The final project focussed on magma storage prior to the most recent Ambae eruption. Using a thermodynamic model, I calculated the crystallinities of magmas in a wide parameter space of storage conditions, ultimately indicating what conditions are required for a future eruption to occur. This forms part of an ongoing project which will be published and used to help assess the probability of future eruptions. During my internship, I also travelled to Victoria University in Wellington and gave a talk as an invited speaker to discuss the findings of PhD and its relevance to volcanic hazards in New Zealand.



Working at GNS science in New Zealand was an exceptionally valuable experience: Working in a different country, in a non-university setting developed my general experience of work. But most importantly, working within a volcanic observatory has also helped to clarify what scientific research stakeholders require in order to reduce vulnerability to volcanic risk. This will help to shape future research proposals throughout my academic career. Working with a wide range of groups and scientists has also developed links with many potential future collaborators.