Taupo Volcanic Zone, New Zealand
Senior Bursary Award Report
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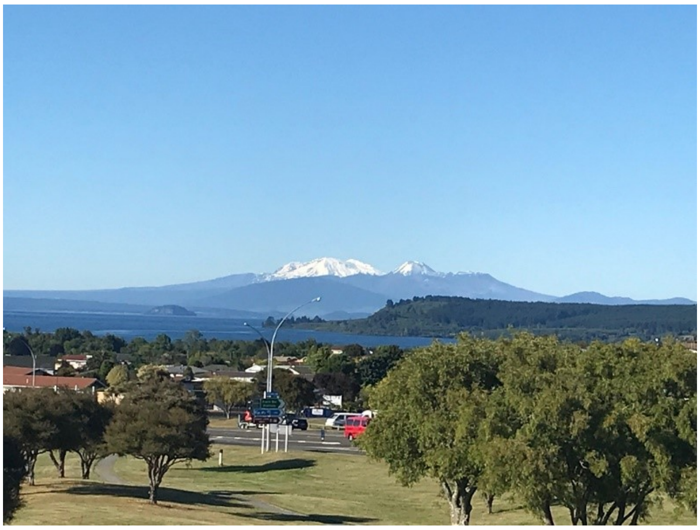
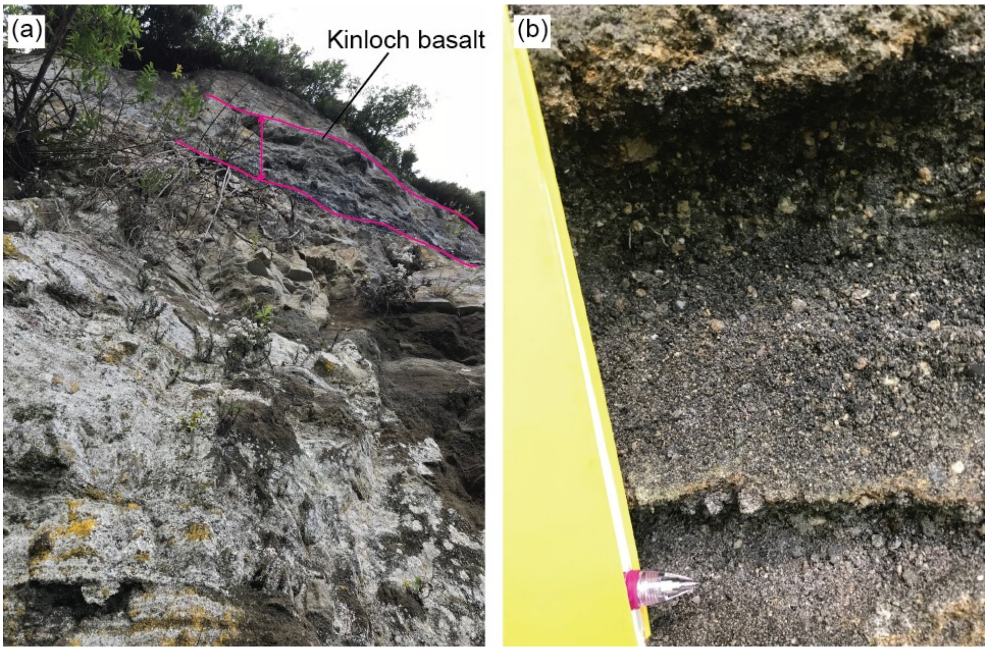


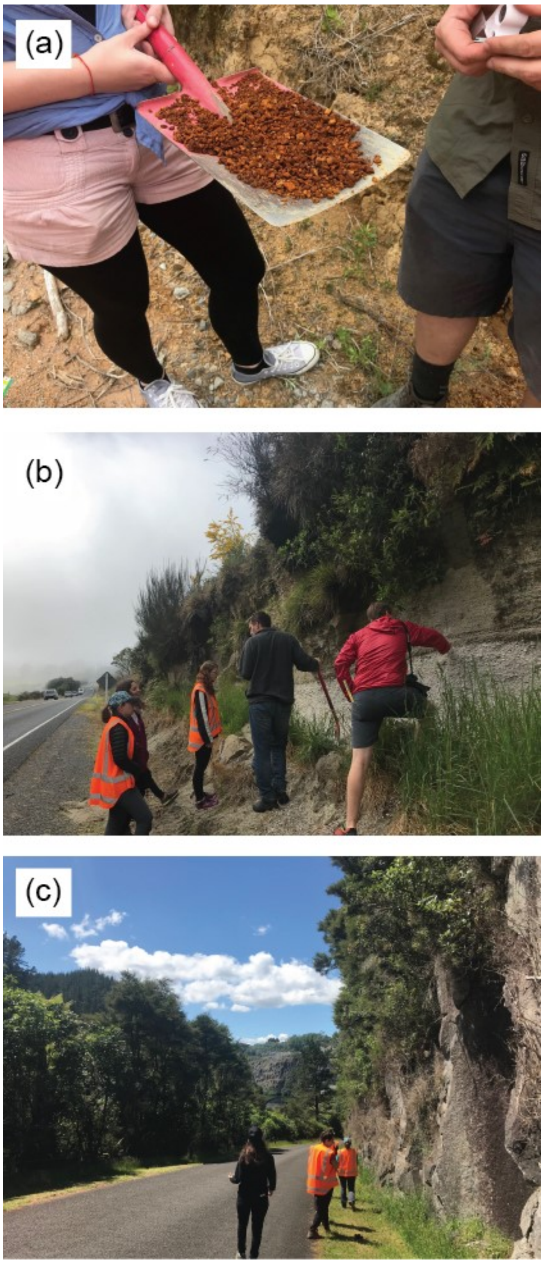
Looking south over Lake Taupo (Taupo caldera) to the Tongariro National Park and volcanic peaks of Mt. Ruapehu, Ngauruhoe and Tongariro

The Taupo Volcanic Zone (TVZ), New Zealand, is a young hyper-active continental arc with over 25 caldera forming eruptions, from 8 caldera centres in the last 1.6 million years (Wilson et al., 2009), with many of these eruptions being above 6 on the volcano explosivity scale (VEI). An eruption this size today would devastate the North Island of New Zealand. Dispersed between these large eruptions are numerous smaller eruptions of basaltic to dacitic compositions originating from multiple volcanoes throughout the region. It is these smaller eruptions that are most likely to pose the greatest volcanic hazard on a historical timescale. Although smaller, these eruptions still have a huge potential to devastate the local area but also greatly affect the wider region of the North Island of New Zealand. Small basaltic eruptions have the potential to reveal vital clues into the earliest melts formed at the crust/mantle boundary that ultimately provide melt and/or heat to the magma bodies feeding the large caldera forming eruptions. However, the immense volume of erupted rhyolite, often deposited as large ignimbrites blankets the landscape. This results in many of the smaller mafic eruptions being hidden and buried and only exposed by luck at the surface, in cliffs or road cuts for example. Thus, locating mafic eruptions within the TVZ can be complicated and requires local knowledge.



Sampling of basalts in the TVZ: (a) Kinloch basalt that outcrops 20-30 m high in a cliff face, (b) sampling of basaltic scoria

During my time in New Zealand, I was hosted by the Volcano Team at GNS Science, the team charged with monitoring the country's active volcanoes. This is a highly dynamic team, with expertise ranging from gas chemistry, geophysics through to petrology enabling them to provide current up-to-date knowledge of the volcanoes activity. Each week, starts with a volcano team meeting, with the duty volcanologist



Exploring the volcanics of the TVZ: (a) sampling tephra from Major Island, (b) learning about the 1800 Taupo eruption sequence, (c) exploring the changing textures and mineralogy of the Whakamaru Ignimbrite.

(a role that rotates around the team) reporting on any of the previous week activity, updating the team and checking of the volcano alert levels. The GNS Volcano team often provides expertise to volcano observatories in the Pacific region at times of unrest. For example, the Volcano team have recently provided monitoring assistance to Vanuatu Meteorology and Geohazards Department (VMGD) during the eruption of Ambae. Also visiting the GNS volcano team was a group of students, from the UK, Germany, France and Poland keen to gain valuable experience. So I found myself, not only working on my own research, but also being roped in to providing supervision, teaching and mentoring of this group of students along with the GNS scientists. This resulted in several weeks of highly intense fieldwork, analytical work and scientific discussions in a highly vibrant environment.

One of the key issues in volcanology is how long after geophysical signs of unrest are detected in an active volcano monitoring network will a volcano erupt? In order to answer this question, timescales of past eruptions must be understood. Yet, as active volcano monitoring networks have really only been in existence for the last 30-50 years and only at a limited number of volcanoes. In order to gain greater insights into the timescales of volcanic processes we must delve deeper into the geological record and use techniques such as diffusion chronology to determine timescales of processes into the lead up to eruption. Thus, one of the visiting students to GNS was tasked with using diffusion chronology methods to investigate the timescales of magmatic processes during the 2017 eruption of Ambae. The next thing I know, I am charged with teaching diffusion techniques, but also taking a short trip to Victoria University of Wellington (VUW), being given sole use of the electron microprobe laboratory and supervising the student to create a brand new data set on the 2017 eruption of Ambae. This new data will provide timely and important insights into the sub-volcanic plumbing system and hopefully timescales of processes occurring during the recent eruption. This knowledge can then be fed into forecasting of future eruptions at Ambae through GNS and VMGD.

For me personally, one of the most iconic volcanoes within New Zealand and has always fascinated me since I first started to work in New Zealand is Whakaari/White Island. A small volcanic island situated 50 km offshore the Bay of Plenty and within 230 km of Auckland, the main population centre. The island is historically considered New Zealand's most active volcano, the last major eruptive episode having occurred between 1976-2000 generating numerous steam and small (VEI < 3) magmatic eruptions of andesite to dacite. Thus when I was asked by GNS whether I would be interested in looking at the timescales of processes in the lead-up to eruption in the 1977-2000 eruption sequence, I jumped at the chance. Our preliminary results are really exciting, but that is a story for another time and day.

Spending an extended time in New Zealand conducting fieldwork and research has been highly rewarding. I would like to thank The Mineralogical Society for the Senior Bursary which made this trip viable, GNS Science for hosting me, field support and local knowledge, and to the team of scientists and researchers I've been working with for the discussions, field assistance and friendship over the past few months.

References

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