VISG NEWSLETTER
VOLCANIC IMPACT STUDY GROUP

ISSUE NO.17 SEPTEMBER 2019

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VISG CO-ORDINATOR'S NOTE

Natalia Deligne, GNS Science

The past two months I've had the opportunity to be a visiting scientist at the US Geological Survey - Hawaiian Volcano Observatory (HVO). It's been a humbling experience. I've gasped at the devastation and profound changes to the landscape wrought by last year's eruption, which had concurrent activity at the Kīlauea summit and Kīlauea's Lower East Rift Zone. It was one thing to follow by watching HVO updates during my lunch hour last year, another thing to appreciate the scale of what must have happened in person. In addition to working with HVO staff, I've met local government staff in full recovery and planning mode, and with local and state civil defence personnel who worked tirelessly to keep everyone safe during the eruption. I look forward to sharing my experience when I'm back in Aotearoa.

There are numerous events coming up this quarter – see ***Upcoming Events***. I hope to see many of you at the National Lifelines Utility Forum, and encourage you to attend the back to back annual **DEVORA Forum** and in the Inaugural **Resilience to Natures' Challenges (2) Urban Theme Forum** in November. The **Volcano Short Course** will be in Auckland this spring, providing an opportunity to learn or refresh your knowledge of volcanoes and their impacts and what to prepare for in Aotearoa New Zealand.

This quarter's ***Research Spotlight*** by PhD student Nicole Allen provides an overview of Nicole's research on syn- and post-eruption building habitability. She is making full use of the University of Canterbury's Volcanic Impacts Lab and Volcanic Ballistics Cannon Lab – I hope you will be able to see them if you partake in the Research Day following the National Lifeline Utilities Forum.

Have a good spring!

NEWS

Around late October, **RiskScape** will be holding **a series of workshops** around the country and distributing a **survey** to **capture user requirements** for **RiskScape 2.0** – this will inform the development of the user experience. For more information, contact Kristie-Lee Thomas (k.thomas@gns.cri.nz).

Phase 2 of the **Resilience to Nature's Challenges** (RNC) National Science Challenge is now underway. This 5-year programme of work encompasses an exciting and cohesive body of research that aims to support New Zealand's resilience transformation through co-created research emphasising the needs of end-users and their unique challenges. Underpinning this holistic approach is the recognition that knowledge and understanding of New Zealand's natural hazards alone is not enough to ensure resilience. Research outputs must be targeted and functional for end-users to translate into tangible resilience practice. The programme is divided into 10 themes, and volcanic impacts research will feature in several of these, most notably the Volcano, Built, Rural and Urban themes. For more information please visit: https://resiliencechallenge.nz/ or contact any of the theme leaders (see website).

The **New Zealand Volcano Science Advisory Panel** (NZVSAP) met in August 2019. NZVSAP facilitates provision of authoritative, trans-disciplinary volcanic science advice integrated across agencies during a crisis, and leads collaborative planning and coordination for multiagency science research response during volcanic events. It has Health, Agriculture and Lifelines sub-groups that provide technical volcanic-hazard specific advice and research as needed during unrest and eruptions. These sub-groups are also tasked with contingency planning for the way that this advice and research activity will occur during a crisis.

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RESEARCH SPOTLIGHT

How will an Auckland eruption effect building habitability?

Nicole Allen,
University of Canterbury

A functioning city requires habitable buildings to shelter residents; natural hazards can make buildings uninhabitable for the short-term or potentially permanently. As a recent example, the Canterbury Earthquake Sequence disaster resulted in a total housing stock reduction of 6.2% (11,500 buildings) in Christchurch. This resulted in a population shift, with many people moving to outer suburbs of the city or further afield. The majority of the damage caused in Christchurch was arguably due to liquefaction, rather than ground shaking, which had not been considered in pre-2010 loss assessments. This disaster highlights two main challenges with assessing the potential impacts of natural hazards: the complexities surrounding post-event building habitability, and our poor (to date) consideration of multi-hazard impacts.

Left: Volcanic ballistic projectile (VBP) penetrating clay roof tiles. Right: VBP, at velocity expected to penetrate clay tile, is cushioned by 3cm of fine ash. Experiment and image credit George Williams.

Auckland is home to around 1.6 million people and, like Christchurch, is exposed to natural hazards which have the potential to cause damage to, or destroy, Auckland's housing stock. My research concerns one such hazard (which actually consists of many hazards): a local volcanic eruption from the Auckland Volcanic Field (AVF), which is situated beneath the Auckland metropolitan area. The AVF has erupted at least 53 times in the last 190,000 years, and will erupt again, although we do not know when or where. AVF eruptions include a wide range of hazards, including potential combinations of the following: tephra fall, lava flows, volcanic ballistic projectiles (large flying volcanic rock fragments, which I will abbreviate as VBP), pyroclastic surges, and the construction or excavation of a new edifice. All of these hazards have the potential to affect building habitability.

Traditionally, volcanic hazard impact assessments focus on the impacts of a single hazard or consider several hazards independently. Unfortunately, volcanic hazards can occur concurrently and multiple hazards can interact with each other, which can compound or minimise cumulative impacts. For example, real-world observations and laboratory testing (see photos) indicates that in isolation, buildings can be structurally damaged by high loads of volcanic ash (>2kPa, approximately

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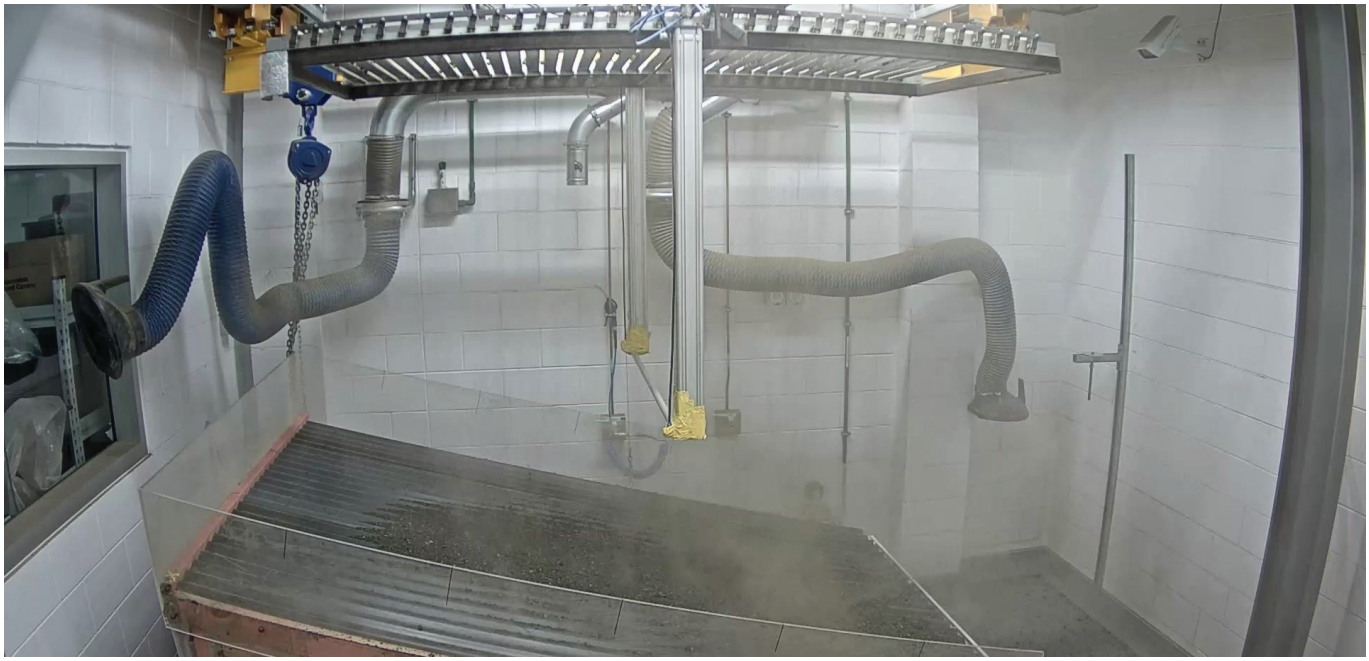

Ash load experimentation using the ash dispersal system and ash collected from the Pupuke eruption of the Auckland Volcanic Field. Experiment and image credit Nicole Allen.

10-50cm thickness depending on ash density) and by VBPs with high impact energies (>400J to perforate sheet metal). However, lower ash loads can actually cushion the structure against VBPs and hence, offer some protection to the building.

An eruption in New Zealand's largest city would render many residential buildings uninhabitable during or after an eruption. Researchers estimated that 139,900 residential properties would be affected by the Māngere Bridge DEVORA scenario, costing a total of NZD$8.7b (see VISG newsletter 3 to learn more about the Māngere Bridge scenario and VISG newsletter 14 to learn more about the DEVORA suite of scenarios). An affected building is not necessarily uninhabitable: as we saw in Christchurch, many buildings were damaged but not red-tagged. We are still working on understanding how and why buildings are affected by volcanic hazards.

I am conducting experiments on the impacts of the interactions between ash fall and VBPs on residential buildings. The University of Canterbury has two purpose-built laboratories for testing the impacts of ash fall (Volcanic Impacts Lab) and VBPs (Volcanic Ballistics Cannon Lab). The Volcanic Impacts Lab is outfitted with a bespoke ash dispersal system, designed to simulate realistic ash loading conditions by evenly distributing ash on any experimental object . The Volcanic Ballistics Cannon Lab houses a high-pressure air cannon, which can fire VBPs into experimental objects below it. I will use both laboratories to test the vulnerability of timber-framed buildings with sheet metal roofs as well as how the interaction between ash fall and VBPs affect the overall impact sustained by a building. My experimental phase is underway in the Volcanic Impacts Lab, where I am assessing roof damage caused by vertical impact loading of tephra. In the future I will also conduct experiments to assess damage from wet tephra, damage caused by VBPs, and damage caused by VBPs and tephra loading combined. My research will advance our understanding of how buildings are impacted by multiple volcanic hazards and what will cause housing to become uninhabitable – considering aspects such as physical damage or access to services. My research provides the required science to later decrease building vulnerability, so that houses are more resilient and remain habitable during and after a volcanic eruption. ◇

RESEARCH HIGHLIGHT

Tephra clean-up after the 2015 eruption of Calbuco volcano, Chile: a quantitative geospatial assessment in four communities

Josh Hayes from the University of Canterbury and coauthors from New Zealand and Argentina published a paper in Journal of Applied Volcanology.

This paper presents an overview of the clean-up efforts undertaken in one Chilean and three Argentinean communities after the 2015 Calbuco eruption (see the June 2018 VISG newsletter). Paper authors narratively reconstruct clean-up efforts in these four communities, and compare these volume and clean-up operation duration reconstructions with estimates based on an adapted geospatial modelling approach developed by lead author Josh Hayes. This paper demonstrates the utility of using simple geospatial data to develop assessments for tephra clean-up for use in response and recovery planning. ◇

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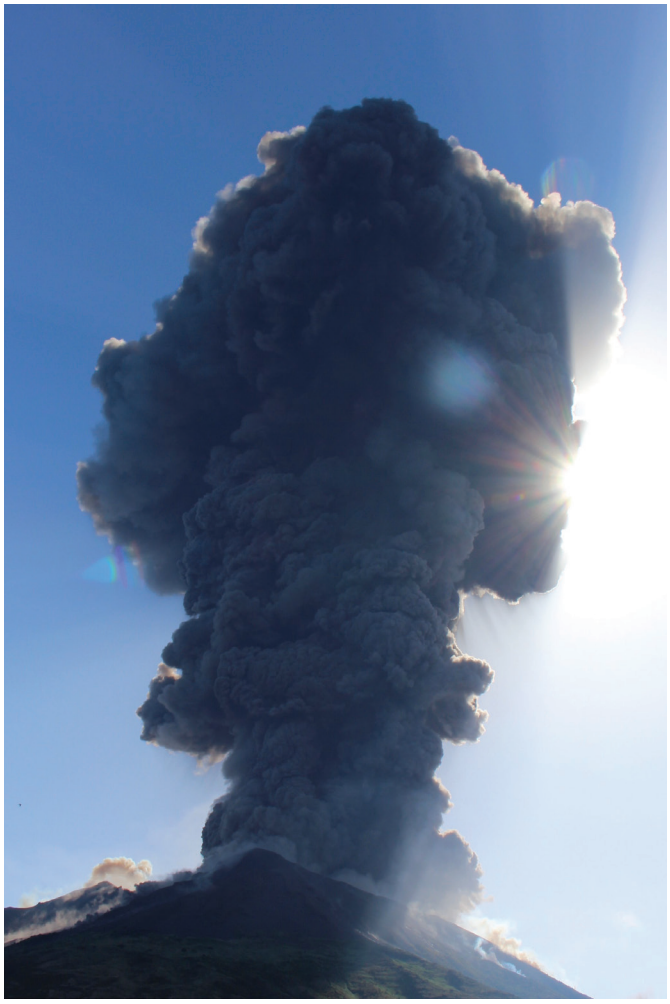
GLOBAL ERUPTION ROUNDUP

by Nicole Allen, University of Canterbury

Stromboli, Italy

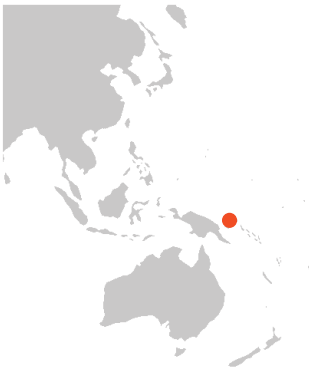
An explosive eruptive sequence occurred from Stromboli on 3rd July, tragically claiming the life of one tourist and injuring another. The eruption was preceded by low-to-medium intensity Strombolian activity and degassing from both the North and South Central crater areas. The eruption consisted of high-energy explosions, a tephra plume 4km high, lateral blasts creating two pyroclastic density currents and lava effusion. Higher than normal intensity Strombolian activity feeding lava flows has continued into August.



Eruption of Stromboli, 3 July 2019. Image credit Sengel.

The eruption ignited fires on the west flank of the island and prompted the voluntary evacuation of 100 people to the nearby island of Lipari. At least one tourist was injured, and one killed, while hiking on the flank of the volcano. The two hikers were caught by fires and hit with volcanic ballistic projectiles while making their way down the volcano. Many residents of Stromboli have lived on the island for generations and are aware of the hazards it poses, so sheltered in their homes and remained calm during the eruption. Damage caused by the eruption is estimated to have been €20 million.

Ulawun, New Britain, Papua New Guinea



An increase in seismic activity from Mt Ulawun's seismic monitoring station prompted the declaration of a stage one activity alert for the volcano on 4th June. Mt Ulawun has a four-stage alert warning system which describes the activity of the volcano as well as preparedness recommendations. Beginning on the 26th June, a large eruption occurred, producing an eruption column 19.2km high and the volcanic activity level was raised to stage two. Volcanic ash was dispersed mostly to the south and the west, and a pyroclastic density current travelled north.

By 27th June the eruption of Mt Ulawun was decreasing in intensity with the alert level lowered to one. By 30th June, over 11,000 people had evacuated from areas impacted by the eruption (mostly within West New Britain). Despite opening at least 10 care centres to house those who had been displaced, it was reported on 5th July, that approximately 16% of displaced persons in West New Britain, and 85% in East New Britain, were staying in makeshift shelters or open spaces. Many care centres reported health concerns including lack of food and water, unsanitary conditions and disease spread. By 12th July, those evacuated from East New Britain were able to return to their homes, but many home gardens and local water sources had been destroyed or contaminated.

On 3rd August another large eruption occurred at Mt Ulawun. The eruption column again rose to over 19km high; the activity level was raised to stage three and then decreased to stage one the following day. Over 8,000 people were still displaced by the previous eruption at this time, and current reports claim 4,000 people remain in care centres as of the 16th August (although these estimates may be low). Residents of care centres are still dealing with poor conditions and lack of aid. ◇

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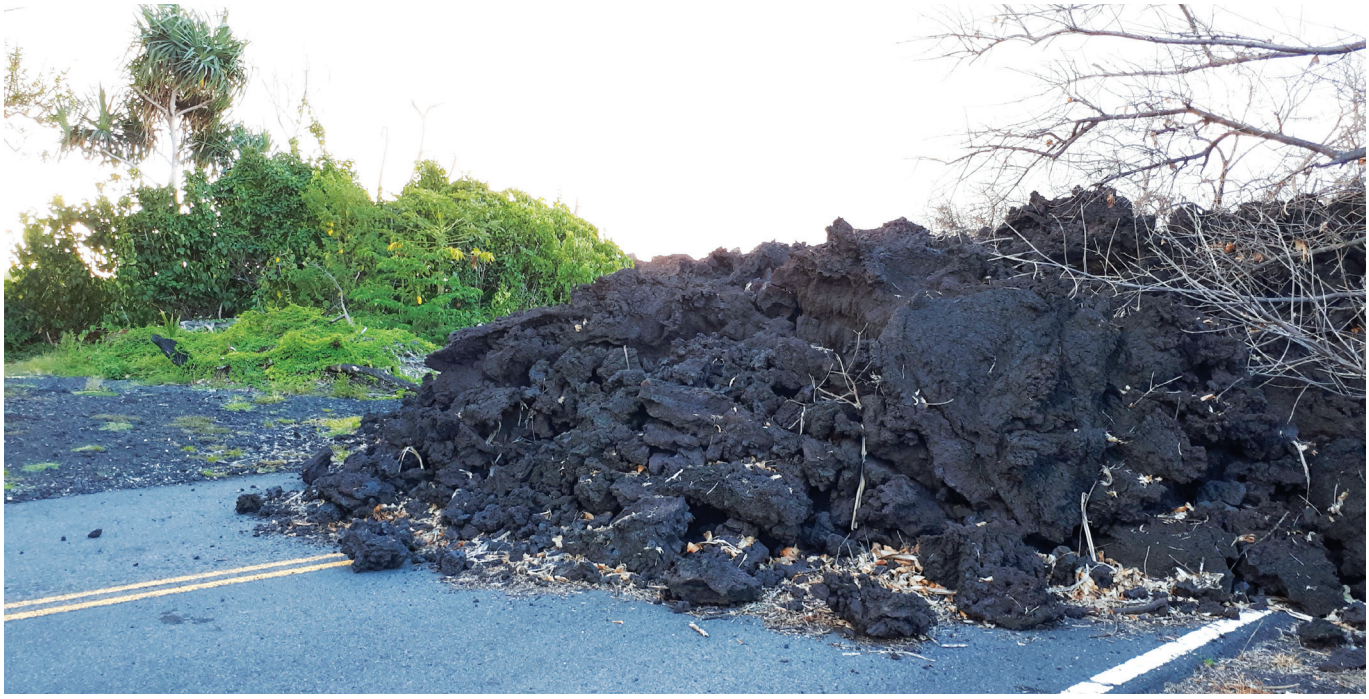

Road covered by a lava from the 2018 Lower East Rift Zone eruption, Hawai'i. Photo credit: Natalia Deligne.

MEDIA COVERAGE

Prime TV aired **Beneath New Zealand** in June 2019, which focused on New Zealand's volcanism past, present, and future; the third episode focused on Auckland and featured a number of DEVORA researchers and findings. **RNZ, NewsHub**, and other outlets interviewed DEVORA researchers to learn more.

UPCOMING EVENTS

The free **12th Annual DEVORA Research Forum** will be on **21 November 2019** at the **University of Auckland**. The forum will feature updates on the latest research concerning the Auckland Volcanic Field and provides an opportunity to guide future research directions. ALG members and interested parties are welcome. For further information, contact Elaine Smid (e.smid@auckland.ac.nz).

DEVORA

The **1st Annual Resilience to Natures' Challenges (2) Urban Theme Forum** (part of the National Science Challenge) will be on **22 November 2019** at the **University of Auckland**. The forum will feature updates from the three research workstreams: Smart Resilient Cities, Resilient Urban Communities, and Pathways to Governing for Resilience. ALG members and interested parties are welcome and will provided with opportunity to guide future research directions. For further information, contact Kate Kenedi (katelk@auckland.ac.nz).

RESILIENCE TO NATURE'S CHALLENGES | Kia manawaroa – Ngā Ākina o Te Ao Tūroa | National SCIENCE Challenges | Urban

The **Annual Volcano Short Course** will be in Auckland this spring. For more information, contact Brad Scott (b.scott@gns.cri.nz).

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