VISG
VOLCANIC IMPACT STUDY GROUP
NEWSLETTER

ISSUE NO.9 SEPTEMBER 2017

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VISG CO-ORDINATOR'S NOTE

by Natalia Deligne

Spring is just around the corner... and with it will bring **a trio of volcano-related events** of interest to lifelines and CDEM: the Volcano Short Course (held in Wellington for the first time), the **VISG seminar** (focused on Volcano Ash Laboratory Testing), and the (10th!) **DEVORA forum**. I hope you can join us for all or some of these events – details are in ***Upcoming Events.***

This quarter's ***Research Spotlight*** is by Sophia Tsang, who recently spent 10 weeks in Hawai'i gathering lessons from the 2014 Pahoa crises where an inhabited area was threatened by lava flows.

Sophia is now moving into the next stage of her PhD, where she will be conducting experiments to explore the ***impact of lava flows on buried infrastructure***. She will melt basalt, pour it over a variety of substrates, and determine the thermal gradient below lava flows. She would love to talk to you about your buried infrastructure as she designs her experiments, in particular how deeply you bury your infrastructure and what materials use if you have multiple permissible materials. Her contact details are in the ***Research Spotlight***.

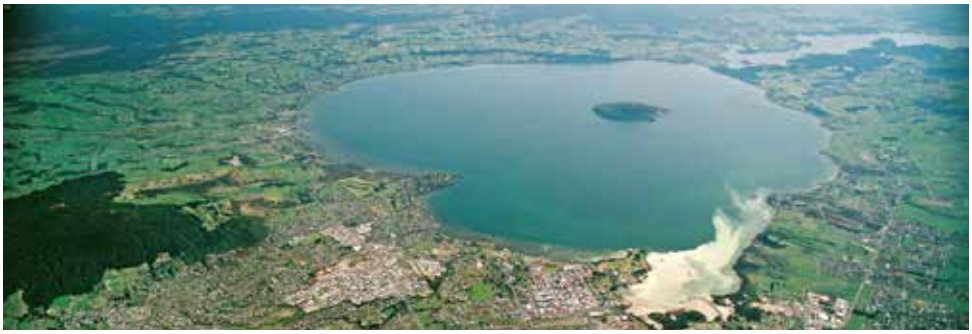
NEWS

Plain language summaries for the public and stakeholders of **DEVORA research findings** are available via **Fact Sheets** (covers a topic) and **Field Notes** (summarises one scientific paper). These are available the dedicated webpage http://www.devora.org.nz/our-research-explained/.

The 25th anniversary episode of **Shortland Street featured a volcanic eruption!** GNS science was consulted to ensure that the scenario was as realistic as possible, and volcanic (non-human) aspects of the show were covered in the media in subsequent days.

University of Canterbury PhD student **Josh Hayes** was awarded a **Claude McCarthy fellowship** to support his attendance at the International Association of Volcanology and Chemistry of Earth's Interior **(IAVCEI) 2017 Scientific Assembly.** At this conference, he presented the development of Auckland Volcanic Field eruption scenarios. Several other VISG researchers presented at the **IAVCEI meeting.**

In **2021**, the **world's volcanologists** will descend on **Rotorua** for the next meeting of the IAVCEI Scientific Assembly.



RESEARCH SPOTLIGHT

Preparing for a Lava Flow Inundation: How Utilities in Pāhoa, Hawai'i Responded to a Lava Flow Forecast

by Sophia Tsang, PhD candidate, University of Auckland (stsa972@aucklanduni.ac.nz)

Growing up, I was told that when you choose where you live you are also selecting which natural hazard(s) you want to deal with. Now that I live in Auckland, one of my potential hazards are volcanic eruptions. Fortunately, the Auckland Volcanic Field (AVF) hasn't erupted recently, but that also makes forecasting impacts and planning harder. One way to evaluate how Auckland's infrastructure may respond to an AVF eruption is to learn from eruptions abroad. Earlier this year, I had the opportunity to learn from Hawaiians how communities can respond to lava flows threatening their towns.

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Since 1983, Kīlauea Volcano, Hawai'i, USA, has been continuously erupting lava flows. While most lava flows have entered the Pacific Ocean without affecting inhabited areas, on several occasions lava flows have threatened or destroyed communities. Most recently in 2014-2015, the town of Pāhoa was threatened ("the Pāhoa crisis"); thankfully it emerged relatively unscathed. Pāhoa is home to ~1,000 people and is the gateway to the southern half of the Puna District (see map). Highway 130, the sole road connecting Pāhoa to the rest of Hawai'i, services over 10,000 people a day. All major utilities run along Highway 130, causing the entire Puna District to be vulnerable to isolation due to a lava flow "crossing the road".

During my 10 week visit to Hawai'i, I met with the scientists, decision makers, and community members who lived through and responded to the Pāhoa crisis. Now, two years after the crisis ended, people's lives are back to normal. They could thus reflect on their experience with minimal emotional distress. Most of the knowledge gained has been internally kept; one of my aims was to facilitate the global community learning their hard-earned lessons. To do this, I spoke with over 50 people. While the lava flow never crossed the road, many people took preventative measures to mitigate possible impacts. The range of actions spanned from relocation to increased redundancy to improved communications. Here I'll highlight the responses of two infrastructure companies.

Electricity

During the crises, Hawai'i Electric Light Company (HELCO) had two goals: ensuring life safety and maintaining electricity. They undertook four initiatives:

1. Relocation of poles to maximise the span between poles while maintaining an acceptable span were a pole to burn.
2. Collaboration with local volcanologists to "amour the power poles." For less than $10,000 USD per pole, thermal insulation, dry wells, and local cinder were placed around the electric poles (see photo). These structures were intended to preserve the poles long enough after contact with the lava to be able to disconnect overhead wires.
3. Addition of a redundant line along a contingency road built by the government during the crises.
4. Placement of generators within the community threatened by isolation. Generator testing occurred thanks to effective communication with the community.

From the business customer's perspective, Hawai'i Electric Light's commitment to maintain service was highly appreciated. Businesses who evacuated either turned off their power or left it on. The former reported much longer recovery times due to cleaning mould that flourished in the absence of a climate-controlled environment. Customers who left the power on had less cleaning and appreciated the increased security while their buildings were empty.

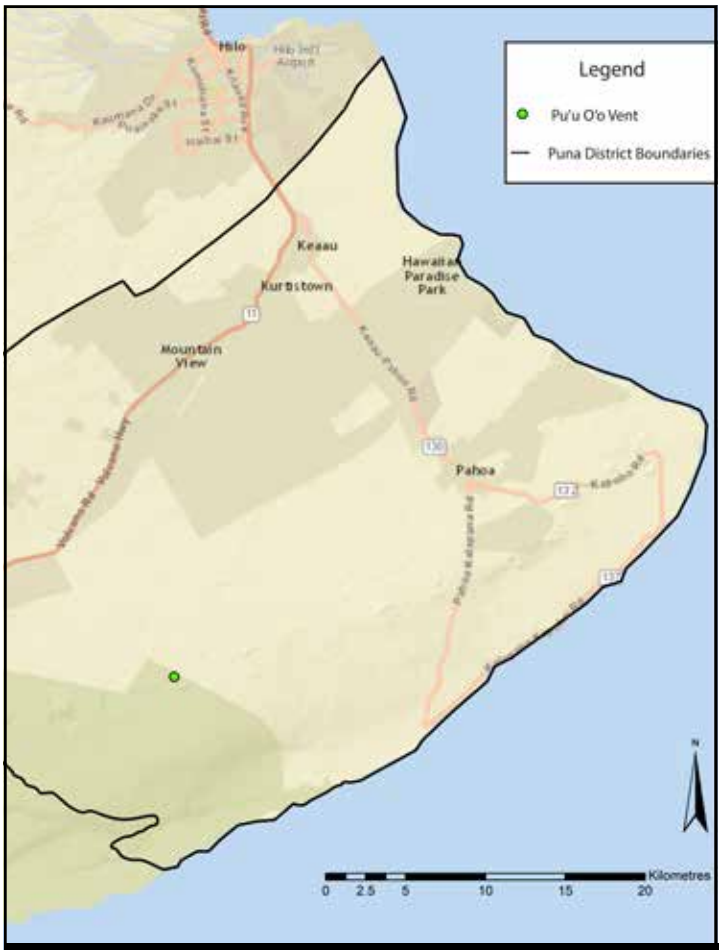

Figure 1: Map of the eastern side of Hawai'i Island, USA. The green circle is the Pu'u O'o cinder cone, the vent for the June 27th lava flow that threatened Pāhoa in 2014-2015. The black line indicates the boundaries of the Puna district. There are very few roads in Puna District. Highway 130 is the only road between Kea'au and Pāhoa and the communities south of Pāhoa.

Water

The Department of Water was concerned that the water in the pipes may boil and disrupt the system. They implemented several preventative measures:

1. Adding valves to the water pipes on both sides of where the lava flow was forecast to cross. The aim was to be able to isolate the pipe under the flow.
2. Constructing additional buried wells to support supply on both sides of the flow.
3. Adding a water tank to the network for first responder use. This was done by connecting a water tank to the main water system.
4. Connecting generators to the network near well sites to address electrical interdependencies.

After the threat was passed, the third preventive measure was discontinued. While all four measures were deemed successful and would be repeated in a similar scenario in the future, the Department of Water expects these measures could be optimised (or eliminated) if they knew temperature versus depth profiles under lava flows.

Over the next few months, I will be compiling actions and lessons from other sectors. I look forward to sharing these with you (although please do get in touch if you want a preview of further details now). Additionally, to guide future responses, I will be using heat transfer models to create temperature versus depth profiles; these will be calibrated with laboratory experiments.

If my research might help you manage a future eruption, I'd love to chat with you about how you might use such data. I would like to optimise my experiments to be as useful as possible to the lifelines community.

Thank you to the Determining Volcanic Risk in Auckland (DEVORA) research programme and the Earthquake Commission for supporting this work.

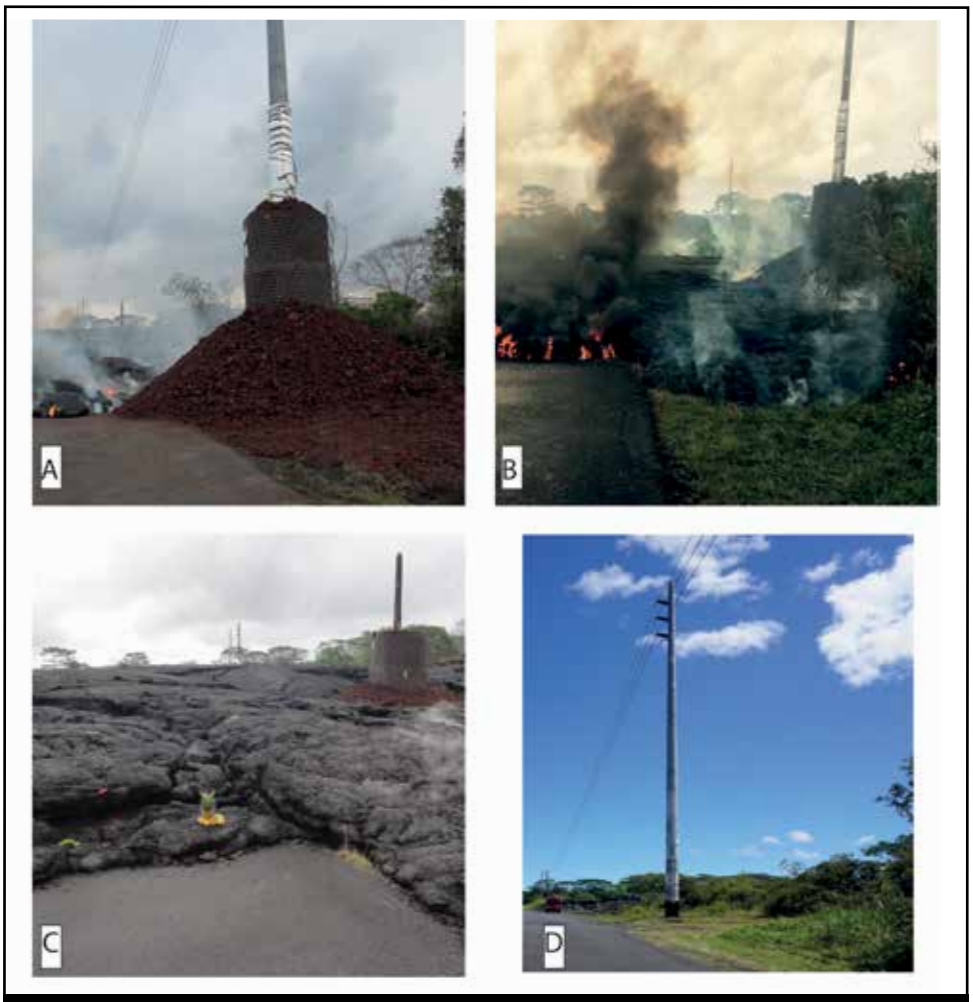

Figure 2: Images of the HELCO power pole protection structure as it was inundated. Image A shows the lava flow approaching the structure. Image B shows the road burning and the lava flow surrounding the structure. By 4 November 2014, the pole had begun burning from below. HELCO disconnected the electric lines and allowed the pole to burn without pulling the electric lines down. Image C shows the remaining pole on 4 November 2014. Image D is from March 2017 and shows the new metal pole that has been installed since the flow ended. Images A through C are courtesy of the U. S. Geological Survey.

RESEARCH HIGHLIGHTS

Graham Leonard (GNS Science) and **Jenni Hopkins** (Victoria University at Wellington) published a pair of papers dating and placing in chronological order 48 of Auckland's 53 known volcanoes. They have found that the rate of volcanism appears to have increased in the past 60 thousand years. Graham's paper is entitled ***High-precision 40 Ar/39 Ar dating of Quaternary basalts from Auckland Volcanic Field, New Zealand, with implications for eruption rates and paleomagnetic correlations*** and was published in the Journal of Volcanology and Geothermal Research. Jenni's paper is entitled ***Multi-criteria correlation of tephra deposits to source centres applied in the Auckland Volcanic Field, New Zealand*** and was published in the Bulletin of Volcanology.

Daniel Blake (University of Canterbury) published a paper entitled ***Impact of volcanic ash on road and airfield surface skid resistance*** in the Sustainability Journal (published as part of a special issue on Dust Events in the Environment). It is freely available at http://www.mdpi.com/2071-1050/9/8/1389/html. This paper presents the results of Daniel's testing of how volcanic ash affects skid resistance for road and airfield surfaces.

A 2014 review paper by Grant Wilson (2015 University of Canterbury PhD graduate) entitled ***Volcanic Hazard Impacts to Critical Infrastructure: A Review*** was the **most downloaded article** for Journal of Volcanology and Geothermal Research in2016. It's been downloaded ~10,500 since its publication in 2014. That's quite an achievement - congratulations Grant and the Canterbury team!

Nicole Allen (University of Canterbury) has started a **DEVORA PhD** project focused on **multi-volcanic hazards impacts** in Auckland.

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GLOBAL ERUPTION ROUNDUP

by Sophia Tsang

In the past few months, there have been several documented impacts of volcanic activity around the world to people and critical infrastructure.

Sheveluch - Russia

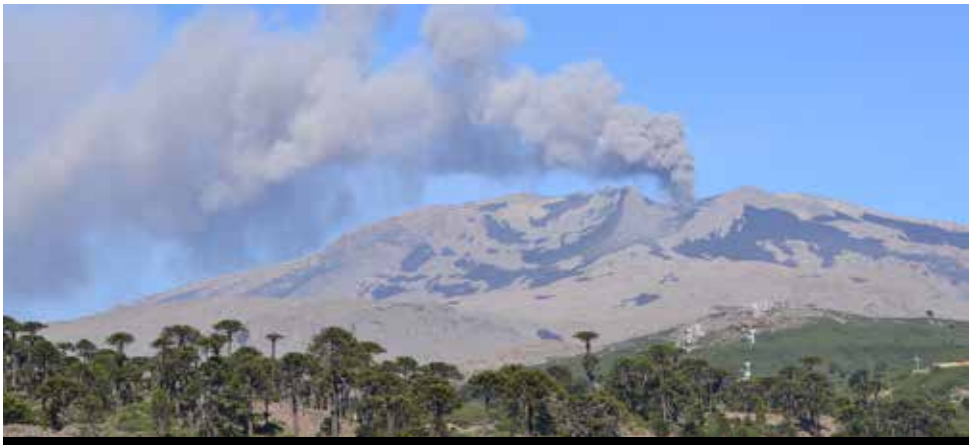
In June, Russian volcano Sheveluch erupted with a sustained 12 km tephra plume, leading the Tokyo VAAC to raise the Aviation Colour Code to Red. Although the area around immediately surrounding Sheveluch is sparsely populated, the tephra was blown hundreds of kilometers away. Residents within 240 km of the volcano were cautioned to stay inside using a loudspeaker system. The speaker system also warned residents not to bring clothes worn outside into their homes to prevent tephra from entering dwellings.

Popcatepetl - Mexico

Popcatepetl in Mexico released a 6.7 km tephra plume in early July. Authorities reminded people to sweep their roofs and bag the tephra so that it would not infiltrate the water system. Additional recommendations included wearing a mask or damp cloth when outside and closing outdoor water supplies. A 12 km radius exclusion zone was put into place in case of a subsequent eruption.

Dieng Volcanic Complex - Indonesia

A phreatic eruption at Dieng Volcanic Complex in Indonesia took visitors by surprise in July. There were 17 people within 15 m of the crater's edge when 50 m of tephra were released. Ten of the spectators were rushed to the hospital with injuries and burns. The military and police were used to evacuate 100 m around the crater in case of further eruptions. A helicopter sent to aid in the evacuations crashed before arriving; everyone on board perished.



Dieng Volcanic Complex, Indonesia

MEDIA COVERAGE

The pair of papers by **Graham Leonard** and **Jenni Hopkins** placing 48 of the 53 known **Auckland eruptions in order** (see Research Highlights) received quite a bit of coverage! They were featured in the NZ Herald, RNZ, Newshub, XinhuaNet, Stuff, Business Scope, and Radio Live.

Research by **George Williams, Tom Wilson**, and others at the University of Canterbury on the **consequences of ballistics** (flying volcanic rocks) on building materials was featured by **TVNZ** (https://www.tvnz.co.nz/one-news/new-zealand/watch-safe-your-house-if-volcano-erupts-nearby) and **RNZ** (http://www.radionz.co.nz/national/programmes/ourchangingworld/audio/201847343/will-your-roof-withstand-flying-volcanic-rocks).

UPCOMING EVENTS

The annual **Volcano Short Course**, organised by GNS Science, will be held in **Wellington** on **11-12 October 2017**. For more information, contact Daryl Barton (d.barton@gns.cri.nz) or https://www.gns.cri.nz/Home/News-and-Events/Events/Volcano-Short-Course-2017.

The annual **Volcanic Impact Study Group (VISG) seminar** will be held on **2 November 2017** from 10 am – noon at the University of Auckland, Room 340 in Building 423 at 22 Symonds Street. This year we will celebrate achievements of the Volcanic Ash Testing Laboratory (VATLab) and have a facilitated discussion on future research directions for VATLab. The event is free, but for catering purposes please RSVP to Natalia Deligne (**N.Deligne@gns.cri.nz**) by 26 October.

Save the date for the **10th Annual DEVORA Research Forum**. It will be held on **7 November** at the **University of Auckland Science Centre.** Once the programme is set, a formal invitation will be sent to Lisa Roberts to distribute to all ALG members. If you wish to receive the invitation directly, please contact Elaine Smid: **e.smid@auckland.ac.nz** to be added to the DEVORA email list.

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