VISG
VOLCANIC IMPACT STUDY GROUP
NEWSLETTER

ISSUE NO.13 SEPTEMBER 2018

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VISG CO-ORDINATOR'S NOTE

by Natalia Deligne

Thank you to those who participated in the successful joint **ALG-VISG seminar** on 1 June, and thank you ALG for organising! From talking with fellow attendees, we learned a lot from each other and thought about how we can make Auckland more resilient to both local and regional volcanic eruptions.

The VISG research team is gearing up for the 10th edition of the **Cities on Volcanoes** conference, which will be held in Naples, Italy, in the beginning of September. Naples and Auckland have the dubious distinction of being two of the ten cities in the world where over a million people live within 5 km of a volcano that has erupted in the last 10,000 years. I'm sure upcoming newsletters will share knowledge and provide reflections on this conference.

Speaking of conferences, see ***Upcoming Events*** for information on the **11th Annual DEVORA Research Forum** in October. All are welcome.

Finally, this quarter's ***Research Spotlight*** is by Dr. Marco Brenna, a Lecturer at the University of Otago. His research on Auckland magma ascent rates was highlighted by several media outlets in July, and we're fortunate that he can explain it to us here.

Have a good spring!

NEWS

The joint **ALG-VISG seminar** on 1 June was a great success, with over 50 people attending from the lifelines, CDEM, academic, and private sectors.

Four updated VISG posters in the Volcanic Ash Impacts poster series were launched at the joint ALG-VISG seminar. The updated posters provided advice for **Wastewater Managers, Water Supply Managers, Roading Managers,** and **Building Managers** before, during, and after volcanic ashfall events. The remaining posters in the poster series are currently being updated.

2018 joint ALG-VISG seminar. Photo credit: Tom Wilson.

VISG researchers participated in the 1st International Association for Volcanology and Chemistry of Earth's Interior / Global Volcano Model workshop ***From volcanic hazard to risk assessment*** at the University of Geneva in June 2018. This workshop brought 40 researchers from Europe, North America, Singapore, Japan, and New Zealand to evaluate the state of the art of risk assessment in volcanology, investigate current gaps, and identify research priorities. A resulting document should be published in the next few months.

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RESEARCH SPOTLIGHT

A journey from mantle to Auckland on the magma express

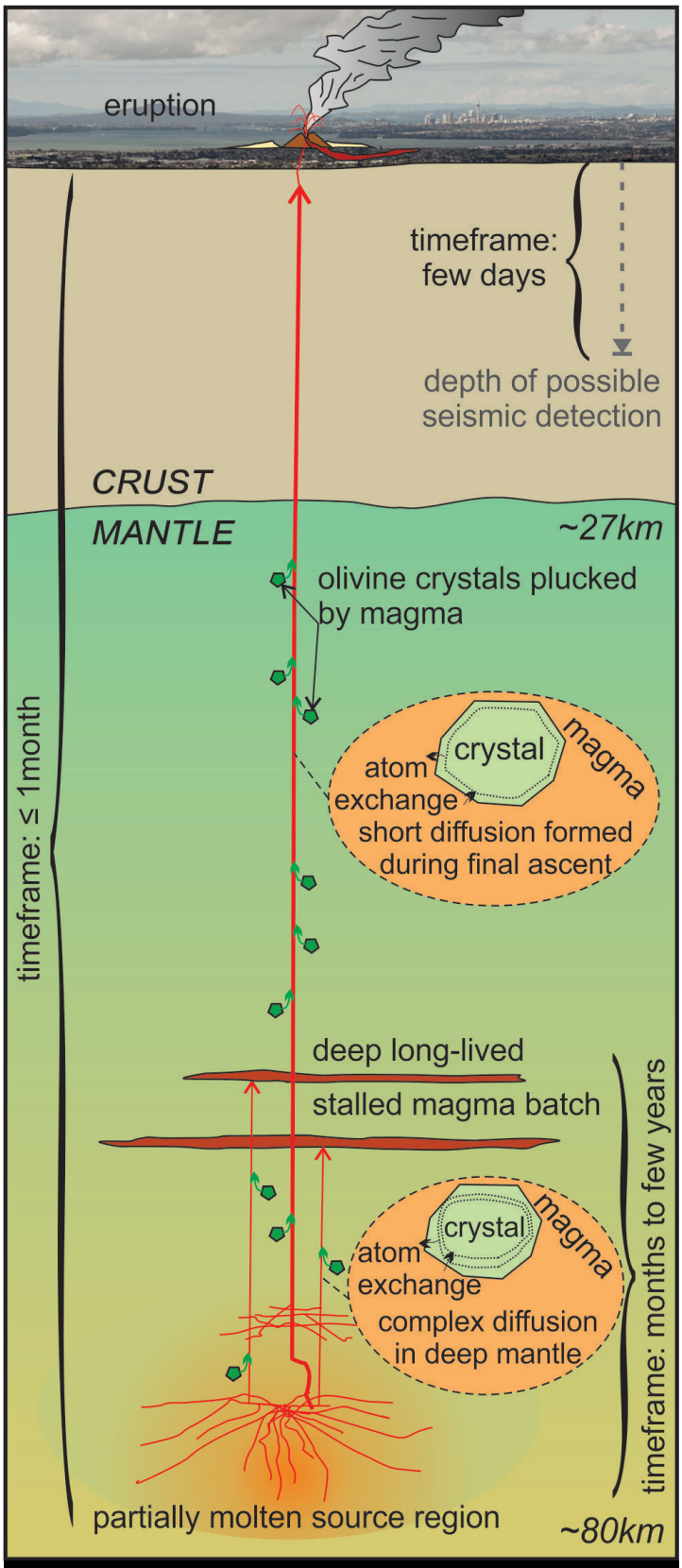
By Dr. Marco Brenna, Geology Department, University of Otago

Did early European settlers around the Waitemata Harbour in the 1840s know that they were choosing the location of their capital city right on top of an unsettled portion of upper mantle? Whether or not tales of ancient cataclysms (Rangitoto in the 15th century) made it to early pākehā ears, New Zealand's largest city now faces the possibility of another eruption within its bounds. Forecasting when that might occur remains beyond current scientific capabilities, but we are dealing with matters of "when" rather than "if". Preparedness is therefore the main tool at our disposal to minimize impact. In addition to understanding impacts and consequences once an eruption is underway, it is critical that we investigate how much time will likely elapse between the onset of seismic unrest - indicative of magma making its way to the surface - and the ensuing eruption. This knowledge will help constrain what timescales (hours? days? weeks?) we consider in our response plans.

To our aid come tiny crystals that were passengers carried by the magma that fed past eruptions in the Auckland Volcanic Field. I am referring specifically to olivine crystals (see photo) that originally resided in the mantle (30–80 km below the surface of the Earth), and were entrained in ascending magma that led to a past Auckland eruption (see Figure). During their journey to the surface, the crystals exchanged atoms with the rising (also called 'host') magma by diffusion processes, and consequently, the chemistry of the rims of each crystal became modified. The wider this modified rim (called a 'diffusion rim'), the longer the crystal had to exchanged atoms with the host magma. I used high precision microscopic methods to measure the width of diffusion rims for 50 crystals from Pupuke, Mangere and Three Kings volcanoes. The results of this painstaking work let me estimate how long crystals spent travelling from their initial home in the mantle to the surface, where the magma erupted to form a new Auckland volcano.

My results indicate that past Auckland magmas have risen from the mantle in one month (low end) to a few weeks (high end). This might sound like plenty of time to arrange an emergency response, but, remember that we are unlikely to detect the beginning of the magma's journey to the surface. GeoNet will be able to detect that something unusual is happening only when the magma is in the crust much closer to the surface – somewhere between 10 and 20 km below the surface. By then, the magma will have already covered three quarters or more of its journey to the surface. As a consequence, our warning time is likely to be much shorter – a few days at best.

I also detected complex diffusion patterns in some of the crystal passengers. These patterns indicate that some crystals did not just board their train (the magma) to go directly to the surface, but rather got off at different levels within the mantle, mingled with their surroundings for a few months to years, and took later connections



Schematic diagram illustrating the likely plumbing scenario beneath a single volcano of the Auckland Volcanic Field. The mantle source region beneath the wider Auckland area is partially molten and capable of generating pulses of ascending magma.

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These olivine crystals contain valuable information on how magma travels to the surface to form an Auckland eruption.

up to the surface. The implication of this is that the magma feeding past Auckland eruptions left the source region in several batches, with some magmas stalling along the way, to be picked up again by later rising magma batches. Therefore, just as crystals have revealed that past eruptions included several batch of magma, future events may involve several eruptive pulses and styles.

My investigation of diffusion rims in mantle olivine crystals carried to the surface by past Auckland magmas has revealed the complexity of deep plumbing processes, as well as the rapid ascent of magma batches that ultimately generated eruptions. The existence of long-lived stalled magma batches and overall rapid magma ascent are a further reminder that we cannot remain complacently under the impression that nothing has happened for the past 600 years, and hence we can sit back and relax. Awareness and preparedness are our best friends.

This project was made possible by funding provided by the Earthquake Commission (EQC).

RESEARCH HIGHLIGHTS

VISG researchers collected field data and supported response efforts at **Ambae volcano,** Vanuatu, in August 2018. The island is now (time of writing: late August 2018) evacuated. The collected data will further understanding of how volcanic ash, gas, and acid rain impact buildings, crops, and water supplies.

Ambae impacts research team. Photo provided by Graham Leonard.

Damaged coconut plantation and buildings in Southeast Ambae. The area received up to 17 cm of ash between 21 and 27 July 2018. Photo provided by Graham Leonard.

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GLOBAL ERUPTION ROUNDUP

by Sophia Tsang (University of Auckland)

Last newsletter, we focused on the eruptions on Kīlauea in Hawaii and Ambae in Vanuatu. In the intervening few months, the eruption in Hawaii has destroyed over 700 homes and built hundreds of acres of new land. Meanwhile, in Vanuatu, the residents of Ambae learned that taro is the local crop most resilient to tephra eruptions, and recently, the island has been evacuated. Although both eruptions are still ongoing, we are going to focus on some new, smaller events this quarter.

Sabancaya, Peru

Sabancaya has been releasing tephra and gas since the end of 2016. In July and August, Sabancaya volcano was intermittently releasing tephra and gas plumes up to 3 km high, leading to its aviation alert level to be set at RED (the highest aviation alert level). During the most active periods in July, up to 24 tephra and gas events were recorded per day. Due to the gas hazard, an exclusion zone of 12 km around the volcano was recommended. No other impacts have been reported thus far.

Krakatau, Indonesia

Towards the end of June, activity at Anak Krakatau (one of Krakatau's cones) began and lasted through the time of writing. Most of the activity took the form of tephra plumes a few hundred metres above the crater. Thus, a 1 km exclusion zone was put in place. Since the both aviation and volcano alert levels remain low, neither flights nor tourism have been impacted.

Piton de la Fournaise, France

At the beginning of July, Piton de la Fournaise began inflating. Within two weeks, four fissures opened and began fire-fountaining up to 20 metres high. A'a lava flows formed and travelled hundreds of metres in a day before their advancement stopped. Over 400 metres of trail leading to the summit were covered by the flows. The volcano has been inflating and deflating since the eruption with no new surficial activity.

Anak Krakatau on 5 August 2018. Photo credit: Olivier Bernard.

MEDIA COVERAGE

University of Auckland PhD student **Sophia Tsang's** research into how lava flows impact buried infrastructure made the news rounds in June: she was interviewed on **RNZ, Newshub Radio**, and was featured in a **New Zealand Herald** article.

Massey University post-doctoral fellow **Dr. Stuart Mead's** current EQC-funded project on the consequences of an Auckland eruption base surge(s) was featured in the **New Zealand Herald.**

University of Otago Lecturer **Dr. Marco Brenna's** research on Auckland magma ascent rates was featured by the **New Zealand Herald** and **Newshub.** For more details, see this newsletter's ***Research Spotlight.***

UPCOMING EVENTS

The free **11th Annual DEVORA Research Forum will be on 25—26 October 2018**. Day 1 (25 October) will be at the Pioneer Woman's Hall (1 Freyberg Place) and will focus on magma generation and ascent, along with novel monitoring techniques. Day 2 (26 October) will be at the Auckland Town Hall Council Chambers and will focus on scenarios, impacts, and social science. ALG members and interested parties are welcome. For further information, contact Elaine Smid (e.smid@auckland.ac.nz).

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