Managing the risk and perception of rapid onset phreatic eruptions: The challenge of public preparedness through hazard maps, warnings, signage and public education

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Rapid onset, often phreatic eruptions, are by their nature difficult to forecast. The eruption mechanism usually relates to destabilization of a hydrothermal system which can occur with no or very little warning, especially when the system is long-established as in calderas or at the vents of frequently active cones.

This creates a substantial challenge for public preparedness. In New Zealand this has led to increased work on hazard models, especially for ballistics and pyroclastic density currents. Social science has included 15 years of survey and observation data on warnings to characterize and quantify human response at Ruapehu and Tongariro volcanoes.

Geophysical monitoring through the GeoNet project has become iteratively more intensive and diverse, covering 12 active and potentially active volcanic areas. Monitoring and eruption forecasts through Volcanic Alert Bulletins are provided by the volcano monitoring group at GNS Science. Volcanic Alert Levels are also used and they have been updated in the last 5 years based on social science evidence, to include two unrest levels and hazard descriptors (Potter et al., 2014).

Risk awareness and self-protection advice is provided through signage, public education, and hazard maps. Automated warnings are used on Ruapehu where detection of an eruption leads to lahar warnings for the Whakapapa ski area, which may be affected within minutes. Evacuation drills are conducted annually, and a persistent minority of people do not move to safety, or move quickly enough, from year to year. While the majority of risk in this case is mitigated through warning, a residual risk is hard to eliminate.

Expectation management is, therefore, critical amongst scientists, decision makers, emergency managers, national park officials, tourism providers and communities. It is important to understand the level of overall risk, and how much reduction can be expected from forecasts (and how much cannot be expected). The role of education and self-protective actions must be widely understood. This includes finding natural shelter, shelter in buildings,

considering shelter structures, and using carried protection such as backpacks. There is also a new national interagency volcanic hazard mapping framework in development for New Zealand – with a link to safety maps for rapid onset eruptions (Figure 1).

The relationship with New Zealand's economically-important tourism industry is critical and it is impossible to remove all risk while maintaining access. Therefore, substantial effort is being put in to calculate that risk and discuss acceptable or tolerable risk. Often the people exposed to most risk are tourism operators themselves because of the large number of days per year they are working or living in at-risk places. Surveys and behavioural science focused on tourists and industry personnel have shown that the training and leadership of staff is critical to optimal safety of both the staff and tourists.

Fig. 1 2019 Revised hazard map with key communication messages, partners and user-centred design. Text highlights that eruptions may occur with little or no warning.

Main References

Leonard, G.S., et al, 2014. Integrating multidisciplinary science, modelling and impact data into evolving, syn-event volcanic hazard mapping and communication: A case study from the 2012 Tongariro eruption crisis, New Zealand. JVGR, 286, pp.208-232.

Potter SH, Jolly GE, Neall VE, Johnston DM, Scott BJ. 2014. Communicating the status of volcanic activity: Revising New Zealands volcanic alert level system. JApVolc. 3(13).