Chapter 26

Communities coping with uncertainty and reducing their risk: the collaborative monitoring and management of volcanic activity with the *vigías* of Tungurahua

J. Stone, J. Barclay, P. Ramon, P. Mothes and STREVA

Long-lived episodic volcanic eruptions share the risk characteristics of other forms of extensive hazard (such as flood, drought or landslides). They also have the capacity for escalations to high intensity, high impact events. Volcán Tungurahua in the Ecuadorian Andes has been in eruption since 1999. The management of risk in areas surrounding the volcano has been facilitated by a network of community-based monitoring volunteers that has grown to fulfil multiple risk reduction roles in collaboration with the scientists and authorities.

26.1 Inception and evolution

Renewed activity from Tungurahua (1999) prompted the evacuation, via Presidential Order, of the large tourist town of Baños and surrounding communities. Social unrest associated with the displacement and attendant loss of livelihood culminated in a forcible civil re-occupation of the land, crossing and over-running military checkpoints (Le Pennec et al., 2012). This re-occupation prompted a radical re-think of management strategy around the volcanic hazard, shifting emphasis from enforcement to communication (Mothes et al., 2015). This enabled the community to continue their way of life alongside the volcano when it is relatively quiet and to prepare for and rapidly mobilise themselves during acute activity.

To do this, a network of volunteers, formed from people already living in the communities at risk, was created with two main goals in mind: (i) to facilitate timely evacuations as part of the Civil Defence communication network, including the management of sirens, and (ii) to communicate observations about the volcano to the scientists (Stone et al., 2014). These volunteers are collectively referred to as '*vigías*' and their input provides a pragmatic solution to the need for better monitoring observations and improved early warning systems when communities are living in relative proximity to the hazard. As a part of the solution, the communities feel strong ownership and involvement with the network (Stone et al., 2014). The communication pathways, formal and informal are shown in Figure 26.1.

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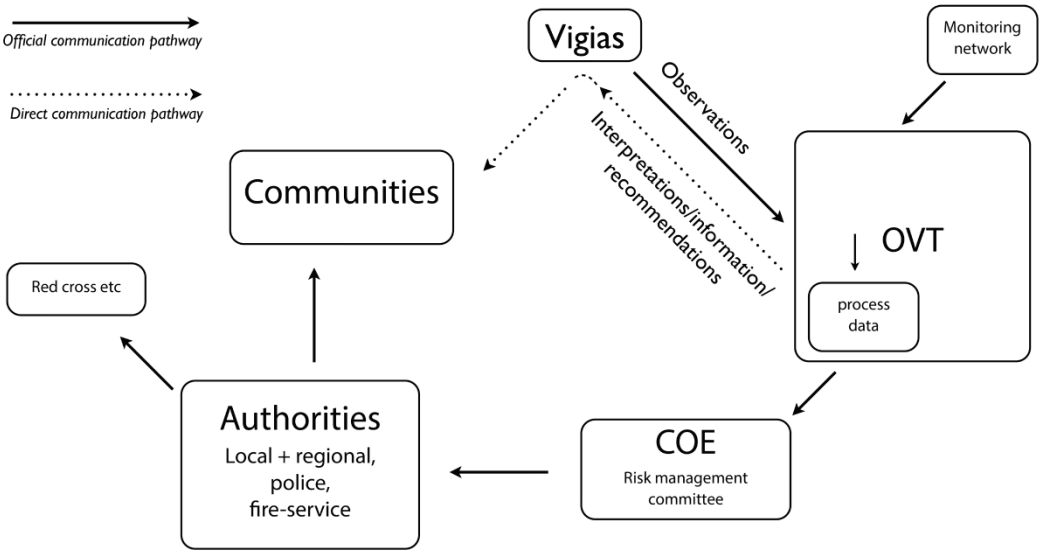

Figure 26.1 The volcanic risk communication network, with its official pathway and the more direct 'vigía mediated' pathway. Adapted from Stone et al. (2014).

26.2 Success and value of the network

The current network consists around 25 *vigías* who use radios with which they maintain daily contact with the observatory (see Figure 26.2). In theory there are up to 43 *vigías,* but not all have radios or actively take part currently. The network has been sustained and has even grown since its inception in 2000. There was a rapid expansion in numbers of *vigías* after the August 2006 eruption. This was a pivotal event, whereby lives saved in the Juive Grande area were attributed to the presence of *vigías* working with the local volcano observatory and lives lost in Palitahua were thought to be in part due to a lack of *vigías* there (Stone et al., 2014). No loss of life has been recorded in recent events in July and October, 2013 and on 1 February 2014 and this can be attributed to the prompt actions to evacuate and reduce risk via the network. Further, community trust in scientific advice and information has reformed since the events of 1999, with vigías acting as intermediaries. Some of the *vigías* now maintain the scientific monitoring equipment near their houses and make daily observations that add considerably to the sum of knowledge of the range and impact of the volcanic behaviour (Bernard, 2013, Mothes et al., 2015), often assisting with visual confirmation of inferred activity seen on the geophysical monitoring network. Apart from reducing volcanic risk, the network has been able to coordinate the response to fires, road traffic accidents, medical emergencies, thefts, assaults and to plan for future earthquakes and landslides. The economic value of allowing affected communities to remain and adapt their existing livelihoods has not, as yet, been determined, but is considered by those communities to be immeasurable.

So far, the communities have responded dynamically to the risk from the volcano, allowing them to live in close proximity and evacuating rapidly when necessary. Tungurahua is capable of producing far larger eruptions than those seen in the last 14 years (Hall et al., 1999), but the trust developed by the network should engender the capacity for action should such an eruption be forecasted, and crucially allows the people to manage their risk in the mean-time, when long-term relocation is simply not an option.

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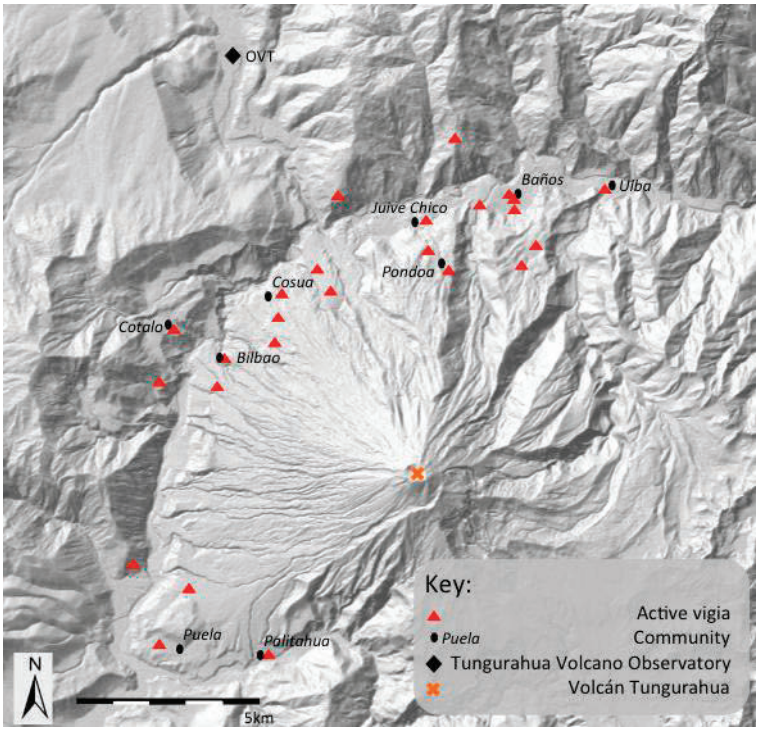

Figure 26.2 Map showing the locations of vigías relative to the volcano and communities significantly affected by volcanic hazards (adapted from Stone et al. (2014)).

26.3 Requirements of the network

Even now, the network still consists of volunteers; and the main requirement from all stakeholders is just the time needed to maintain shared goals and values. The voluntary aspect of the network is vitally important and the motivations of those involved are to help reduce risk to their communities. Nonetheless, its success is due to the willingness with which time is given by *vigías*, observatory scientists (and those in civil protection during its early years) to listen and to share. While some initial *vigías* were drawn from those already involved with Civil Defence (26%), many were also recruited by scientists due to their location relative to the volcano (21%), for their position in the community (26%) and ultimately through other *vigías* (5%). The *vigías* were given basic training from the scientists about what to observe, how to describe phenomena and how to communicate with the local observatory. The largest infrastructural investment was in a VHF radio network, upgraded by another volunteer, and the distribution of handheld radios. Radio communication is a key ingredient in developing relationships and is strictly and professionally observed: every night at 8pm, someone from civil protection calls on the joint (OVT, Civil Defence) radio system and asks the *vigías* to report in. If activity changes then communication frequency increases. Initially, if a *vigía* missed several radio checks they were told to participate properly or not be part of the team. Similarly a sense of shared pride in the role comes from the uniforms provided, initially, by civil defence.

26.4 Sustainability of the network

The network is entering into its fifteenth year; and like conventional geophysical monitoring instruments, relationships continue to function only with regular maintenance; in this instance through contact and discussion. Although the actual financial requirements are small; those that

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are required (maintenance of the radio network; uniforms) become important symbols to all for the value of the network; long-term neglect of this funding represents a significant threat.

The clear value that the transmission of timely messages to evacuate also reinforces the value of the *vigías and the scientists* to the wider community, providing a strong incentive to volunteers to continue. There is less evidence for whether these motivations would persist in the absence of a volcanic threat but this type of network is exceptionally well suited to extensive hazards and risks.

26.5 Risk reduction for more than 14 years

The sustained involvement of *vigías* (community-based monitoring volunteers) has allowed communities surrounding Tungurahua to live with dynamically changing risk. The network of *vigías* have greatly assisted the monitoring efforts of scientists providing visual observations and by maintaining equipment. Frequent interactions with the scientists have fostered strong trust-based relationships, allowing the *vigías* to act as intermediaries between scientists and the communities during risk communication. These activities have undoubtedly saved lives and helped to preserve livelihoods in the area. The nature of long-lived episodic volcanic eruptions, and thus their similarity to other extensive hazards, means that this type of approach could reduce risk in the case of flooding, landslides and droughts.

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