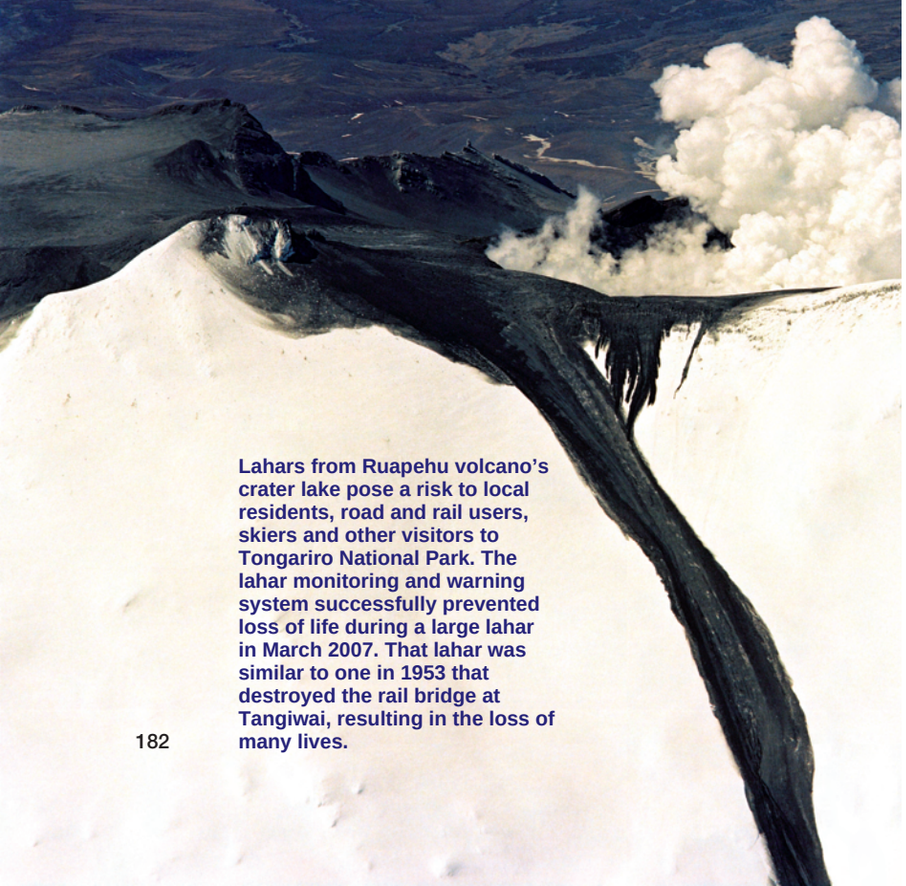
Hazard Watch

Jan Harris

To better prepare Civil Defence and the public for when disaster strikes, the nation-wide GeoNet service monitors earthquakes, volcanic unrest, land instability and tsunamis.

Before the establishment of the GeoNet Project, GNS Science operated a sparse nation-wide network of seismographs—instruments for determining accurately the magnitude (M), source, location and other characteristics of earthquakes—at just 30 locations around New Zealand, with the most closely-spaced arrays centred in the earthquake-prone Wellington region and the volcanically active Taupo Volcanic Zone in central North Island. Instruments capable of recording the strongest ground shaking from earthquakes—strong motion recorders—were deployed at 280 locations.



Lahars from Ruapehu volcano's crater lake pose a risk to local residents, road and rail users, skiers and other visitors to Tongariro National Park. The lahar monitoring and warning system successfully prevented loss of life during a large lahar in March 2007. That lahar was similar to one in 1953 that destroyed the rail bridge at Tangiwai, resulting in the loss of many lives.

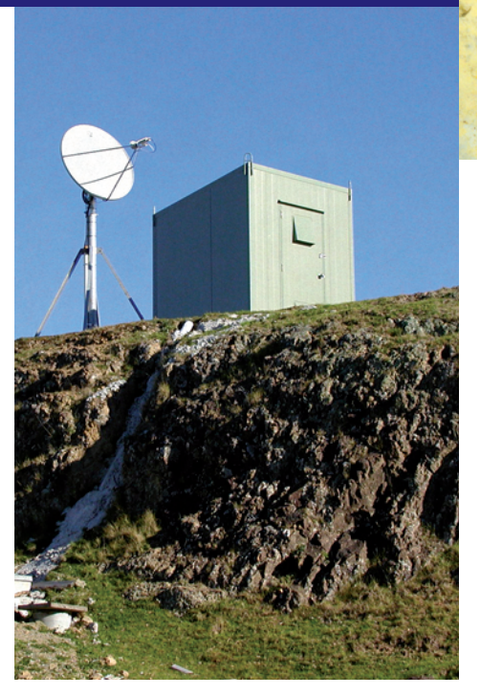
The GeoNet Project, initiated in 2001, is operated by GNS Science and funded by the Earthquake Commission (EQC). The monitoring network had its origins in a seismology capability review following the failure to locate quickly enough a M7.1 earthquake off East Cape in February 1995.

The concept was broadened to include volcanic hazards following the eruption of Ruapehu volcano in September 1995. Proposed was a multi-hazard monitoring and surveillance system, world class in design and operation, but scaled to the needs of New Zealand. The vision was a nation-wide focus—a non-profit public good initiative with GNS Science and university staff collaborating in research, and with partners in the information services and clients in the hazard assessment services.

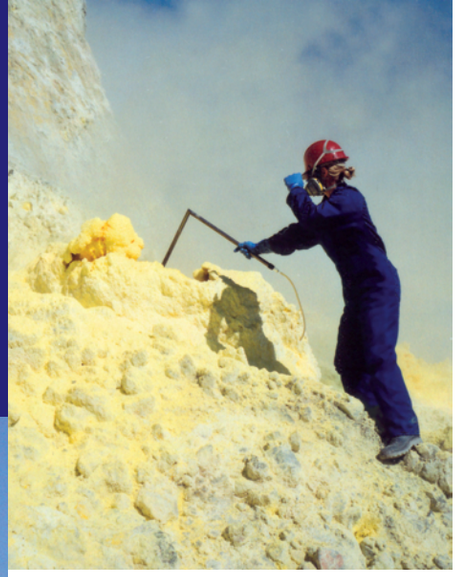
GeoNet now provides a broad-based around-the-clock monitoring system and a modern data management centre. The national network of broadband seismographs and strong-motion accelerographs comprises 38 sites—increasing to 46 sites by 2010—each linked to the GNS Science data centres by a satellite telemetry system. This network will be supplemented by regional networks of 126 additional sites in areas of special interest such as the earthquake-prone Wellington region and the volcanically active Taupo Volcanic Zone. The new network provides high quality data for earthquake research and for aiding the nation-wide emergency response to large earthquakes.

Staff from GNS Science analyse, locate and archive c. 14,000 earthquakes each year in and around Zealandia. The seismic waveform data and the located earthquake sources are made freely available to the global geoscientific community through the data centre pages of the GeoNet website (www.geonet.org.nz). For the 200 or so significant earthquakes felt in New Zealand each year, GeoNet provides accurate location and magnitude information within one hour of their occurrence—a reaction time that is critical to planning an emergency response. It is intended in the future to reduce this to 10–15 minutes.

Any organisation may use the basic GeoNet data to provide customised packages of added-value information



▲ GeoNet provides continuous monitoring of seismic activity throughout New Zealand. This site at Puketiti, south of Te Puia Springs near Gisborne city, has been operational since 1989, and was upgraded by GeoNet with satellite telemetry in 2003.



▲ **Volcanic gases are sampled regularly on White Island (Whakaari) volcano in the Bay of Plenty, as part of GeoNet's monitoring of New Zealand's active volcanoes.**

on a commercial basis. Data from a monitoring network is fundamental to a better understanding of earthquake occurrence and effects, and of the processes that cause volcanic eruptions, tsunamis and landslides.

Monitoring Continuous Deformation

GPS equipment measures where and by how much the Earth's crust is undergoing slow deformation. In addition to a nation-wide GPS network supported by Land Information New Zealand (LINZ) to underpin their land surveying system, the Geonet Project has installed 90 continuously operating GPS stations, targeting two regions. One is the eastern side of the North Island where the Pacific Plate is subducting beneath the North Island. A large earthquake on the subduction interface is one of the major geological hazards facing New Zealand. The second area is the Taupo Volcanic Zone, which contains several active rhyolitic caldera volcanoes, and New Zealand's most active on-land andesitic volcanoes Ruapehu and Ngauruhoe [see *Forges of Middle Earth*].

In addition to GPS, geochemical analysis and remote sensing techniques—for example, satellite-based infrared—are used to continuously monitor New Zealand's active volcanoes and to contribute to volcanic eruption warnings [see page 187]. Ground swelling, micro-earthquake activity, and the release of magmatic gases from vents precede most eruptions, providing early warnings of activity and creating valuable time for organising a public response. Once an eruption is underway, monitoring provides vital information on local dangers and regional effects. Governmental authorities, the aviation and tourism industries, the media, and the public, need to be informed of any changes in volcanic activity. The overall activity is indicated by an alert level from 0 to 5 for each volcano—whenever the alert level changes, responding agencies in New Zealand are notified, and they use the level to determine the type and scope of their responses.

GeoNet also provides survey equipment and mobilisation funds for a nation-wide landslide team and maintains rapid response teams of engineering geologists. The latter can be mobilised within 24 hours of a 'major event', defined as a landslide that causes either death or serious injury, subsequent catastrophic events, direct damage costing more than NZ$1 million, economic losses of more than NZ$10 million, threats to public health, or is of significant research interest. Information on unusually large, complicated, or fatal landslides is collected and added to the *National Database of Landslide Locations and Attributes*.

Early Warning

In addition to the national and regional networks, about 200 strong motion accelerographs are installed in buildings and bridges to measure how they perform in earthquakes, leading to safer, cost-effective design and construction practices [see *Sound Foundations*]. The newly installed Etna instruments, which have a much higher resolution and are more robust than the instruments they replaced, spend much of their time in a quiescent state and are triggered only when ground shaking is detected above a certain threshold. Once they are triggered, data are transmitted by cellular phone to the GeoNet data centres in Wellington city and at Wairakei, near Taupo.

An additional benefit of receiving data rapidly from a modern network is the monitoring and analysis of seismic waves generated by offshore earthquakes to give an indication of whether the ocean floor has been sufficiently disturbed to have generated a tsunami [see *Come Hell or High Water*].

Maintaining in New Zealand a high-quality, complete, and freely-available archive of earthquake, earth deformation, and volcanic eruption records will ensure that future developments will contribute to the aim of reducing risk and maintaining New Zealand-based research programmes for the benefit of all New Zealanders.

▼ **Seismograph, GPS, and strong motion accelerograph sites are spaced regularly across the high-risk Wellington region.**