Visiting honours student Sébastien Valade (left) and Dr Jérôme Lecointre test and record lahar flow with an experimental model.

Testing behaviour of clay-laden lahars

Unlike the watery lahars and debris flows that threaten the Ruapehu region, not much is known about the heavy clay-rich lahars typical of volcanoes like Taranaki.

Vulcanologist Dr Jérôme Lecointre, with visiting engineering geology student Sébastien Valade from the Institut Géologique Albert-de-Lapparent near Paris, are studying the physical behaviour of this type of potentially-devastating lahar.

Known as cohesive debris flows, the muddy lahars often begin as an avalanche of volcanic debris on the characteristically steep and unstable flanks of stratovolcanoes, also known as andesitic cones.

Dr Lecointre, a researcher in the Volcanic Risk Solutions group in the College of Sciences' Institute of Natural Resources, and Mr Valade have built a 3m artificial flank on which to test and record the flow of muddy lahars they create from different compositions of industrial clay, sand and gravel.

The mixture is released from a spring-loaded gate and recorded in real-time by wireless cameras located above the model and connected to a laptop. It is the first time New Zealand earth scientists have attempted to recreate in the laboratory this type of lahar, unusual in its complex, time-dependant rheological behaviour.

Dr Lecointre says the heavy clay-based flows are surprising because although they behave like a visco-plastic medium, they travel fast, and then stop suddenly.

They flow like a big plug, do not transform or dilute once they are flowing, and stop suddenly and cleanly. They can travel further than ordinary lahars, and the area they cover can be quite enormous, Dr Lecointre says.

The researchers can apply the physical rules of dimensional analysis when modelling the flow in a controlled experiment, and can adjust the slope of the run, and the composition of the mix.

Dr Lecointre says the clay is the main factor in the mix. Smectite clay acts like a sponge, to swell and store large amounts of water to double in volume. It's typically the result of a volcano's hydrothermal fluids changing the mineral composition of the surrounding rocks to form smectite.

Active geothermal systems developed in andesitic volcanoes generate a lot of these acidic fluids that alter large chunks of the volcano, making it unstable. The Ketetahi hot springs, on the northern flank of Tongariro, mark one of these very active areas.

He says volcanic cones are also unstable because they are made of pyroclastic debris (loose rocks) and an earthquake can trigger an avalanche that transforms quickly into a lahar.

A clay-rich lahar was generated on Mt Tongariro 55,000-60,000 years ago and there are similar deposits, characterised by the same type of clay present, on Mt Ruapehu. It is difficult to predict the occurrence of such lahars however, because they can occur without volcanic activity, which is usually monitored.

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