Deep fault drilling project

15 December 2014

It rains a lot in the tiny south Westland town of Whataroa. Every year, this region gets some of the highest rainfall totals recorded anywhere in the World and Whataroa is one of the wetter parts. The town is nestled beneath almost the highest part of NZ's Southern Alps, an imposing mountain range that presents an abrupt barrier to the moisture-laden westerly winds after their unimpeded journey across thousands of miles of the vast Southern Ocean. The resulting deluge happens quickly, often, and all year round. Under this constant barrage, the mountains are being worn down at some of the highest erosion rates on record and yet, remarkably, they are maintaining their lofty elevation. The reason for this paradox is that these mountains are being pushed up—and shunted sideways—by forces below just as quickly as they are being worn down by forces above.

In the spring of 2014 a team of scientists, postgraduate students and a support crew descended on Whataroa. Their mission: to probe into the depths of these mountains to find out more about the underlying forces of unimaginable power which have shaped not just this majestically rugged region, but much of the New Zealand landscape as well. Our land of rugged relief exists largely because of the ongoing collision between two tectonic plates and the Alpine Fault marks the surface expression of the confrontation. Extending some 600-km from Milford Sound to Marlborough, this fault is New Zealand's flagship contribution to the world of geophysics. And now a sizeable portion of that community, drawn from 12 different nations have gathered in south Westland under the leadership of a team of New Zealanders from GNS Science, Victoria University and Otago University.

Their audacious mission is three-fold. First, they must drill down to – and hopefully through - the Alpine Fault which is estimated to lie at around 1 km depth beneath the Whataroa Valley. As the drilling proceeds, the team are monitoring a wide range of physical and chemical properties of the rock, gases and fluids encountered along the way. This is critical for maintaining the drilling momentum because constant adjustments need to be made as different conditions are met. These measurements are also revealing potential resources including geothermal waters that may be hot enough to become a viable energy source. But for the scientists, the most exciting purpose of these measurements is to be able to see how these various physical and chemical properties change as the drill hole approaches and breaches the fault itself. Some of the changes are predictable and will be used to identify the approaching fault, such as the smearing out and re-crystallisation of quartz grains which only occurs with the high temperatures associated with active faults. But what other changes will occur? Well, that's the point. Nobody knows for sure.

The second phase of the operation will kick in when the drilling approaches the Fault itself – at the time of writing, they are at 850 metres depth so it may not be far off. In this second phase they will closely sample the rock around the Fault—characterising the various deformation properties that occur in and around an active major fault zone. This is getting to the heart of the operation: the rocks will tell the story of what happens when the fault ruptures in a large earthquake and what is likely to happen when the next 'big one' occurs.

The final phase is probably the most ambitious. Once the drilling is completed, the plan is to install seismographs in the drillhole, down around the fault itself, to monitor the 'heartbeat' of the fault. And maybe, in time, these instruments may be able to provide us with something that was once thought to be impossible—an early warning system that detects the precursory signals of a big earthquake. Imagine even a one minute warning in advance of a major earthquake? Enough time maybe to get people out of buildings and into safe muster areas. According to the scientists leading the team, the instruments they plan to install might just be able to provide this kind of life saving opportunity. They have estimated from geological records that huge ruptures of the Alpine Fault—equating to magnitude 8 earthquakes—have occurred on average every 300 years or so in recent millennia, which means the next one may be due soon!

So this is a big deal for New Zealand. But it's not just about the Science, important as it is for us to better understand the processes that give rise to earthquakes and to establish a highly sensitive monitoring system right at the heart of our most dangerous fault. And it's not just about the exciting discoveries being made along the way: the geothermal energy and other potential resources. There is also an unfolding story of human endeavour to be told. Just to get this audacious project up and running required an enormous amount of persistent and skilful lobbying of funding sources by the three lead scientists, Dr Rupert Sutherland of GNS and Victoria University, Dr John Townend of Victoria University, and Dr Virginia Toy of Otago University.

Sadly, New Zealand lacks the sort of science investment required to finance a project of this scale. So the scientists have made the most of the local funding sources—the Royal Society of NZ's Marsden Fund and their respective institutions—and various funding sources from the international geological community. But that's just to get started.

Because they are operating on a shoestring, they are having to scrimp and save along the way. They do this by using local drilling equipment and expertise rather than buying in a more expensive operation from overseas. And by training a select band of postgraduate students drawn from all over the world to do the skilful grunt work required across the relentless and demanding 24/7 shift work. These budgetary compromises have led to inevitable delays but they have added an intriguing dimension to the project: a collective team spirit and determination to overcome the odds, the exhausting demands of the operation—and the relentless south Westland rain.

More information: You can follow the progress of the Alpine Fault drilling operation here: rupertsnztectonics.blogspot.co.nz/

Provided by Victoria University

APA citation: Deep fault drilling project (2014, December 15) retrieved 23 October 2019 from https://phys.org/news/2014-12-deep-fault-drilling.html