MEDIA RELEASE
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SCIENTIFIC DRILLING PROJECT UNDERWAY ON ALPINE FAULT

An international team of scientists has started drilling a 1.3km-deep borehole into the Alpine Fault in the South Island to find out more about the nature of the fault and the earthquakes it produces.

The ambitious project near Whataroa, north of Franz Josef Glacier, is expected to take about two months to complete. It will enable scientists to install monitoring equipment deep inside the fault to record small earthquakes and measure temperature, pressure and chemical conditions close to where earthquakes are generated.

The goal of the Deep Fault Drilling Project is to improve understanding of earthquake processes by sampling and analysing rock and fluid materials retrieved from what scientists sometimes refer to as 'the earthquake machine'.

Other major faults around the world have been drilled in this way, but it has always been after a big earthquake. This is the first time a major fault has been drilled before it ruptures.

The team plan to intersect the fault at about 1km depth and drill a further 300m into the underlying Australian tectonic plate.

Up to 100 scientists and engineers will be working in shifts around the clock while drilling and sampling are underway.

The project is being jointly led by GNS Science, Victoria University of Wellington, and the University of Otago and involves scientists from other New Zealand organisations and from the United States, United Kingdom, Germany, Canada, France, Italy, Japan, Australia, China, and Taiwan.

It is funded by the International Continental Scientific Drilling Program (ICDP), the Marsden Fund of the Royal Society of New Zealand, the participating scientists own organisations, and a range of other sources.

“We really don't know what we will find once we get deep into the fault zone. No-one has ever drilled this deep into a major New Zealand fault,” said project co-leader Rupert Sutherland of GNS Science.

“Similar projects overseas have shown that a huge amount of information can be extracted from samples retrieved from the heart of the fault zone,” Dr Sutherland said.

“For instance, we are fairly sure that presence of clay minerals and water pressure gradients are important factors affecting the fault's mechanical behaviour, and we plan to collect several types of data that will help us look at this in detail.”

Another project co-leader, Virginia Toy of the University of Otago, said it was always a challenge to get fragile rock samples to the surface, but this project was doing everything possible to ensure good rates of sample retrieval from the borehole.

“Rock and fluid samples from inside the fault will be shared among the science team with some analysed in New Zealand and the rest sent to more than a dozen overseas laboratories for analysis,” Dr Toy said.

“Our collaborations with cutting-edge international laboratories will allow maximum information to be extracted from these hard-won samples.”

The Alpine Fault, which is visible from space, extends for about 650km from south of Fiordland along the spine of the Southern Alps and into Marlborough.

It is among the more active plate boundary faults in the world and is one of the most scientifically appealing faults to study because of its size, fast rate of movement, and accessibility. In between major quakes it remains locked and produces small seismic tremor that can be picked up by sensitive instruments.

Earthquakes of about magnitude 8.0 occur on the fault about every 200 to 400 years, with the average gap between successive large earthquakes being about 330 years.

The fault last ruptured 297 years ago in 1717 and scientists estimate it has a 28 per cent probability of rupturing in the next 50 years, which is high by global standards.

Near Whataroa, it dips beneath the western ranges of the Southern Alps at about 45 degrees, which means it can be investigated with a vertical borehole without the need for expensive angle drilling.

In 2011, scientists drilled two boreholes into the fault to about 150m depth at Gaunt Creek, about 6km southwest of the current drilling site. That was the first substantial drilling investigation on the Alpine Fault.

One of the main findings of the 2011 project was the existence of a finely-ground impermeable layer of rock in the centre of the fault zone, holding back large amounts of fluid on the upper east side of the fault.

This was a surprise as it had not been anticipated from the many surface studies of the fault dating back to the 1970s.

Scientists believe the large difference in fluid pressures on either side of the fault zone could play a role in initiating the first slipping movements as an earthquake begins.

Their hope is that the deep borehole will shed more light on the relationship between fluid pressure, the internal structure of the fault zone, and the mechanics of earthquakes.

Another co-leader of the project, John Townend of Victoria University of Wellington, said a key motivation for the project was to obtain new understanding of how large faults evolve and how earthquake rupture starts and travels along a fault.

“We hope this study and ongoing monitoring of conditions within the fault zone will ultimately lead to a better understanding of how faults slip and generate seismic waves during large earthquakes, and what specifically is likely to happen in a future Alpine Fault earthquake,” Dr Townend said.

“The Alpine Fault appears to save up all its energy for one big showdown every few hundred years. In between its big ruptures, it seems to stay locked and produce mostly minor earthquakes, but what controls this timing behaviour isn't clear.”

It was possible to glean an enormous amount of information about a fault's inner workings by scientific drilling, and by integrating the detailed measurements made at one location with other geological and geophysical results collected over a wider area.

The borehole is being drilled with low-impact techniques used routinely in environmentally sensitive groundwater and geotechnical applications.

Dr Townend added that new knowledge and understanding gained from this project would benefit earthquake science globally and enable New Zealand to better prepare for a future large earthquake on the Alpine Fault.

See two short videos here:
Project overview – 4 min 40 seconds
https://www.youtube.com/watch?v=n9ZPq5FRmnE

Project Safety – 1 min 50 seconds
https://www.youtube.com/watch?v=jQ1xYGy1Cd8

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Contact:
Dr Rupert Sutherland, Project Co-leader, GNS Science, M: 027-273-1164
Dr Virginia Toy, Project Co-leader, the University of Otago, M: 021-127-1012