

Alpine Fault quake expected

Scientists say that a major earthquake along the 600km Alpine Fault is inevitable in our lifetimes, and communities around the South Island are planning their emergency responses as part of Project AF8 (Alpine Fault magnitude 8).

The Alpine Fault

Scientists estimate a 30 percent likelihood in the next 50 years of a magnitude 8 or higher (M8+) earthquake along 400km of the Alpine Fault, a strength about three times greater than the 7.8 Kaikoura quake in 2016. Geologically, this is a high probability. They expect land on one side of the fault to move up to ten metres east or west in seconds, and to be lifted up to three metres.



The Alpine Fault is the on-land boundary between the Pacific and Australian Plates, a break in the earth's crust where plates move in opposite directions about 45mm a year relative to each other. This is about the same speed as fingernails grow, making it one of the fastest moving fault lines in the world.

The Pacific Plate has a very active boundary (known as the ring of fire), the site of 75 percent of the earth's volcanoes and 90 percent of the world's earthquakes.

The Pacific Plate under the eastern side of New Zealand is moving south-westwards, while the Australian Plate moves north-eastwards. The boundary also twists, with the Pacific plate diving under (subducting) the Australian plate in the sea off the North Island, the two plates grinding past each other along the Alpine Fault, and the Australian Plate diving below the Pacific Plate at the bottom of the South Island. This opposing plate movement builds enormous pressure, which can only be released through earthquakes.

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How scientists study the fault

Scientists documented 24 regular M8 quakes along the fault over the last 8,000 years, averaging every 330 years. The shortest gap between quakes was 140 years, and the longest 510. The last one was in 1717, 302 years ago, so a big one is coming.

Scientists from GNS Science/Te Pū Ao, Victoria University, the University of Otago, Italy, Israel, and the United States work together on this research.

Two special Fiordland sites - John O'Groats River, north of the mouth of Milford Sound, and Hokuri Creek, a river terrace near Lake McKerrow (below) - show alternating brown peaty and grey silty layers caused by earthquakes regularly blocking streams.

- Scientific methods at sites included -
- Radiocarbon dating of seeds and leaves in earthquake layers to determine the age of ruptures. Radiocarbon in dead plants decays at a steady rate, enabling reliable estimates of when plants died.
 - Examining micro-fossils to determine the environment when layers were deposited.
 - Measuring gaps in historic stream beds to see how far the fault has moved horizontally.
 - Examining sedimentary layers along the fault line to determine the length of the fault that ruptured.

- Drilling a borehole more than 1km into the fault, and inserting observation equipment.
- Dating the previous M8 Alpine Fault earthquake from Māori oral



history and the narrowed growth rings it produced in trees between the 1716 and 1717 growing seasons.

- Running computer simulations of likely damage from a M8 quake, building in the properties of the two crusts, their rock types, stresses along the fault, the direction of the rupture, and the movement of seismic waves.

This data was reviewed by overseas experts before being published in scientific journals. Some data, such as a 700km relative shift in the sides of the Alpine Fault in 25 million years, went against established theories. Associate Professor Simon Lamb, from Victoria University, said the research team tested and checked the data from different directions to make sure they hadn't missed anything.

Effects of an M8 Alpine Fault quake

There will probably be no warning of the most likely M8 earthquake. From an epicentre in Fiordland, it will roar up the West Coast to Marlborough at 4km/second, with shaking lasting over two minutes as far away as the lower North Island.

Around 10,000 people are likely to be cut off immediately, with many injured or killed as bridges rupture, roads are blocked, electricity and phone lines are broken, and cell phone towers topple.

Unreinforced buildings in the Lakes district and West Coast towns may fall, railway lines will bend, and landslides may cause tsunamis on the West Coast, inland lakes and rivers. Flash flooding is likely, and water, sewerage, health and social services may be disrupted for months. Overseas help will be needed, including to evacuate thousands of tourists.

An M8 earthquake will make landslides more likely after storms, and debris in West Coast rivers will cause abrupt changes of course. Mining, dairying and other industry will be disrupted, while communications, transport and power infrastructure may be affected for years.

Project AF8 (Alpine Fault magnitude 8), a partnership of scientists with South Island disaster management groups, is planning for these disastrous effects. A South Island Alpine Fault Earthquake Response (SAFER) Framework was released in 2018. More workshops are planned for South Island centres.

Nga Kupu (linked to audio files)

Āinga whakararo - Subduction

Horo whenua - Landslide

Kaha - Magnitude (of quakes)

Kirinuku - Earth's crust

Papaneke - Tectonic plate

Ripa hapa - Fault line

Rū - Earthquake

Waipara - Sediment

From Te Aka Māori Dictionary

Links to the curriculum

New Zealand Curriculum

- Level 1 & 2 Science: Nature of Science (NoS) – Understanding about science
- Planet Earth & Beyond (PE&B) – Earth Systems; Interacting systems
- Level 3 & 4 Science: NoS – Understanding about science
- Level 5 - 8 Science: NoS – Understanding about science; PEaB – Earth Systems

Te Marautanga o Aotearoa

- Taumata 1/2 & 6: The Natural World - Earth Science/Papa-tū-ā-nuku
- Taumata 4: Philosophy & History of Science.

Te Whariki

- Wellbeing / Mana atua



Road damage after the 7.8-magnitude Kaikōura earthquake.
Photo: Scott Hammond/Stuff

Resources and references

These sources supplied information for this article, and provide further material for students.

- [The science behind the AF8 project](#) (videos)
- [Dr Simon Lamb on the speed of Alpine Fault movement](#) (news item and video)
- GNS scientists [drilling into the Alpine Fault](#) (video) and webpage.
- GNS Science [on Alpine Fault earthquakes](#) (webpage)
- Te Ara on the [Pacific ring of fire](#) (webpage).



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