

The Two Tremors: should we be surprised by seismic shifts in Middle Earth?

26 Sep 2003

A recent article in the Guardian newspaper, '[Quake hits Lord of the Rings land](#)', suggests surprise that:

"A world heritage site used as a location for the Lord of the Rings films has been badly damaged by more than 200 landslips after a massive earthquake in southern New Zealand"

Why shouldn't we be surprised?

Not even the [Dark Lord Sauron](#) reclaiming the Ring could have conspired to create the [juxtaposition](#) of such potentially dangerous natural forces at work on and below the Earth's crust in one of the most beautiful environments on the planet; namely New Zealand. The Guardian article lays the blame on 'The Alpine Fault one of the world's most active earthquake zones'.

What is the Alpine Fault?



Look at the map of New Zealand, showing the trace of the Alpine Fault.

If you look at the course of the fault from Blenheim in the north to Queenstown in the south what you are actually tracing is the boundary between the Pacific crustal plate (east) and the Indo-Australian plate (west) where they are sliding past each other. It is a situation similar to the San Andreas Fault in California on the other side of the Pacific Ocean. Like its more famous cousin the Alpine Fault is locked it hasn't ruptured since 1717 but when movements occur to relieve built up stresses and strains they create earthquakes.

The Alpine Fault is clearly visible from the air and on the ground. Before geologists understood the makeup of the Earth's crustal plates they recognised that the rocks on either side of the fault did not match and that over time they had moved hundreds of kilometres apart. They could even see on the ground evidence for the movement.

The photograph shows a Geographer standing on the line of the Alpine Fault in the Wairau Valley that runs south-westwards from Blenheim. She is demonstrating its horizontal slipping movement with the ground on the right of the picture moving towards the camera relative to the left. The movement is measurable about 40mm a year or put another way Christchurch is moving away from Auckland at about 4 metres per century!



Geographer standing on the Alpine Fault. The ground on the right is moving towards you!

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What is the likelihood of future severe earthquakes in New Zealand?

The IGNS has identified 14 earthquakes over 7.0 on the Richter Scale since 1848 and the August 2003 event brings the total to 15. They are almost equally split with 8 occurring on the North Island and 7 on the South Island. To try and put the New Zealand situation into perspective let's look at the scales used to measure earthquakes and then compare New Zealand's recent experience with one or two recent major earthquakes.

The Richter Scale measures energy released during an earthquake each point denotes a tenfold increase of ground-shaking over the point below the seismometer and the figure is calculated once distance is taken into account. Earthquakes of 6 or over would usually generate a figure of about VIII on the second scale called the Modified Mercalli Scale, which measures earthquake intensity. On this point on the scale, people would have difficulty standing, up to 30% of buildings would collapse and the ground would start to fracture.

Geologists accept that New Zealand can expect on average an earthquake of magnitude 7 or greater once a decade and a magnitude of 8 once every century. If this prediction is correct then in a populated area the results could be comparable to Kobe (7.2) in 1995 with 6348 deaths and Izmit, Turkey (7.4) in 1999 with over 17,000 deaths. Fortunately the country has a small population and to date most of the historically large earthquakes have occurred in areas of minimal population.

UPDATE

A large earthquake was felt widely across the southern island on 23rd November 2004. The magnitude 7.2 earthquake struck at 9:26 am about 100 km off the southern Fiordland coast at a depth of 33 km, Geological and Nuclear Sciences Ltd (GNS) said.

Many people in the lower half of the South Island reported feeling the quake as a long rolling motion – typical of large, distant quakes. Residents of a number of towns in Southland reporting goods falling off shelves.

People in high-rise buildings as far north as Palmerston North and New Plymouth reported feeling a gentle swaying motion.

The quake occurred in an area called the Puysegur Trench, which marks the boundary between the Australian and Pacific tectonic plates.

"This was a large earthquake in global terms. Had it occurred under or near a population centre, there would be major damage", GNS seismologist Warwick Smith said.

"The location of the earthquake, well offshore, meant that by the time the seismic energy reached land, it was relatively weak", Dr Smith said.

Puysegur Trench is known as a seismically active area, so the quake's location was no great surprise to seismologists. A quake of identical size (magnitude 7.2) occurred in similar location in October 1979.

An earthquake of this magnitude would be capable of generating a damaging tsunami.

"The absence of a tsunami at Bluff indicates that there was no substantial vertical movement of the ocean floor at the epicentre."

Immediately after the earthquake thousands of people visited the GeoNet website www.geonet.org.nz, and many reported how they felt the quake.

The preliminary Modified Mercalli (MM) shaking levels (using Roman numerals), the definition of their effects on people, and the localities that experienced them, are shown at [GeoNet](http://www.geonet.org.nz). This is a very good example of the applied use of this scale.

Middle Earth Quake

1. For an updating article on the earth's crustal plates called 'Our Jigsaw Earth' go to the QCA 'Innovating with Geography' website:

http://www.qca.org.uk/geography/geography_matters/new_developments/jigsaw.htm

2. All the information on the websites quoted in this Feature is readily printable for classroom use.

3. New Zealand can provide excellent case study material of hazardous landforms with easy access, up-to-date, often real time websites such as www.geonet.org.nz. Today current A2/AS Geography specification such as:

- **AQA A 'Geomorphological Processes and Hazards,**
- **Edexcel B Option 5.2 'Living with hazardous environments',**
- **OCR A 5.5.4 'Hazardous Environments'; and**
- **WJEC Unit GG1 'Global Tectonic Processes, Hazards and Responses'**

require candidates to provide up-to-date information in their answers. Questions like the example below could easily be answered with reference to New Zealand:

'Explain with examples why some regions and countries are zones of multiple hazard impact.' Edexcel B, A" Unit 5 written paper June 2002

Middle Earth Quake

1. Run the 'Deformation Map Movie' from the Geography in the News' Feature article 'The Two Tremors: should we be surprised by seismic shifts in hobbit land?' or from

<http://www.gns.cri.nz/store/download/plates.html>

Can you explain what is going to happen to the shape of New Zealand in the next 4 Million years?

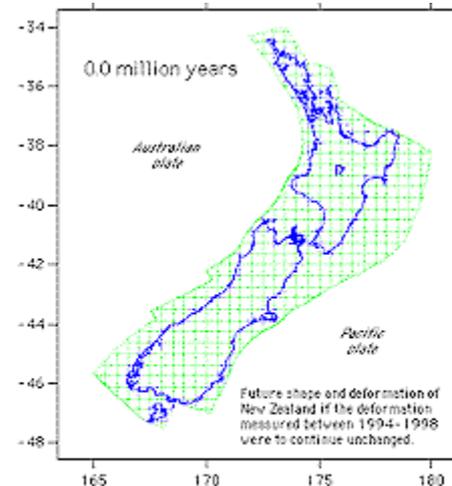
3. Read the Guardian article 'Quake hits Lord of the Rings land' at:

<http://www.guardian.co.uk/international/story/0,3604,1030380,00.html>

What does the article tell you about how geologists today are monitoring movement on the Alpine Fault on a daily basis?

4. Go to www.geonet.org.nz and write a 150 word 'news in brief' report on the location and strength of the latest New Zealand earthquakes from this real time website. Come up with your own 'Lord of the Rings' related headline such as 'Elfquake' or 'The Two Tremors'.

Is there still ongoing seismic activity to the southwest of Te Anau the nearest settlement to the 22nd August 'quake'?



Animation shows the future shape and deformation of New Zealand

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5. Explore the impact of the 22nd August 'quake' by looking at the Media release dated 27th August 2003 'Fiordland quake triggers over 200 landslides' at

<http://www.gns.cri.nz/news/release/200landslides.html>

Why did geologists consider it important to map and log the size of all landslides created by these quakes?

6. The New Zealand tourist industry is now as important as traditional exports of wool and butter. How might it have been affected by the earthquakes and why do you think the people of Te Anau asked for a meeting with the Government's geologists?

7. What would happen if an earthquake of magnitude 6.0 or over occurred near one of the large urban areas such as Wellington, the capital city of New Zealand? Use the 'Colliding Plates' case study from 'Geography in the News' Feature article or from

<http://www.rgs.org/category.php?page=4educre10>