Magnitude 7.0 FIJI
Wednesday, November 9, 2022 at 09:51:04 UTC

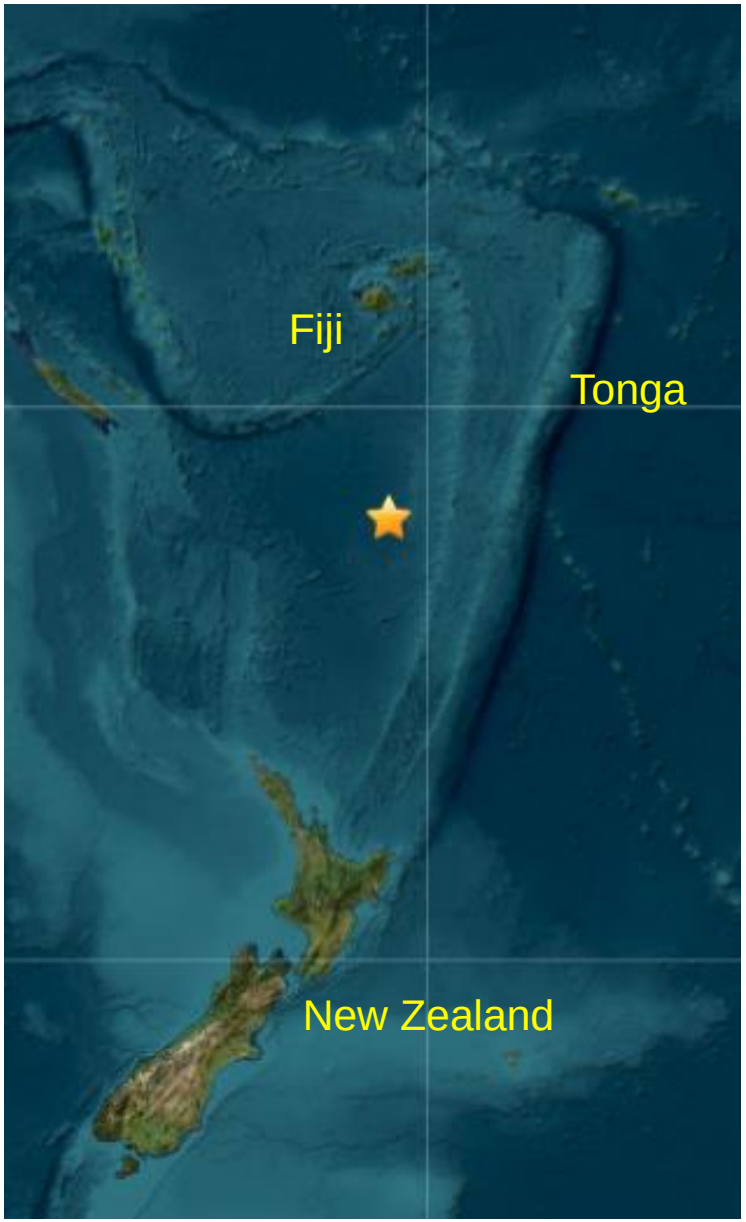
A very deep M6.8 occurred south of the Fiji Islands at 09:38 UTC at a depth of 628 km (390 miles).

The earthquake was followed by this M7.0 earthquake at 09:51 UTC at a depth of 665 km (413 miles). Once this larger earthquake occurred, the M6.8 is considered a foreshock.

This mainshock was then followed by a M6.6 aftershock at 10:14 UTC at a depth of 623 km (387 miles).

The epicenters were located about 845.4 km (525.3 miles) SW of Vaini, Tonga, and 870.2 km (540.7 miles) S of Suva, Fiji.

There is no risk of a tsunami from earthquakes at this depth.



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The Modified-Mercalli Intensity (MMI) scale is a ten-stage scale, from I to X, that indicates the severity of ground shaking. Intensity is based on observed effects and is variable over the area affected by an earthquake. Intensity is dependent on earthquake size, depth, distance, and local conditions.

MMI	Perceived Shaking
X	Extreme
IX	Violent
VIII	Severe
VII	Very Strong
VI	Strong
V	Moderate
IV	Light
II-III	Weak
I	Not Felt

USGS estimated shaking intensity from M 7.0 Earthquake

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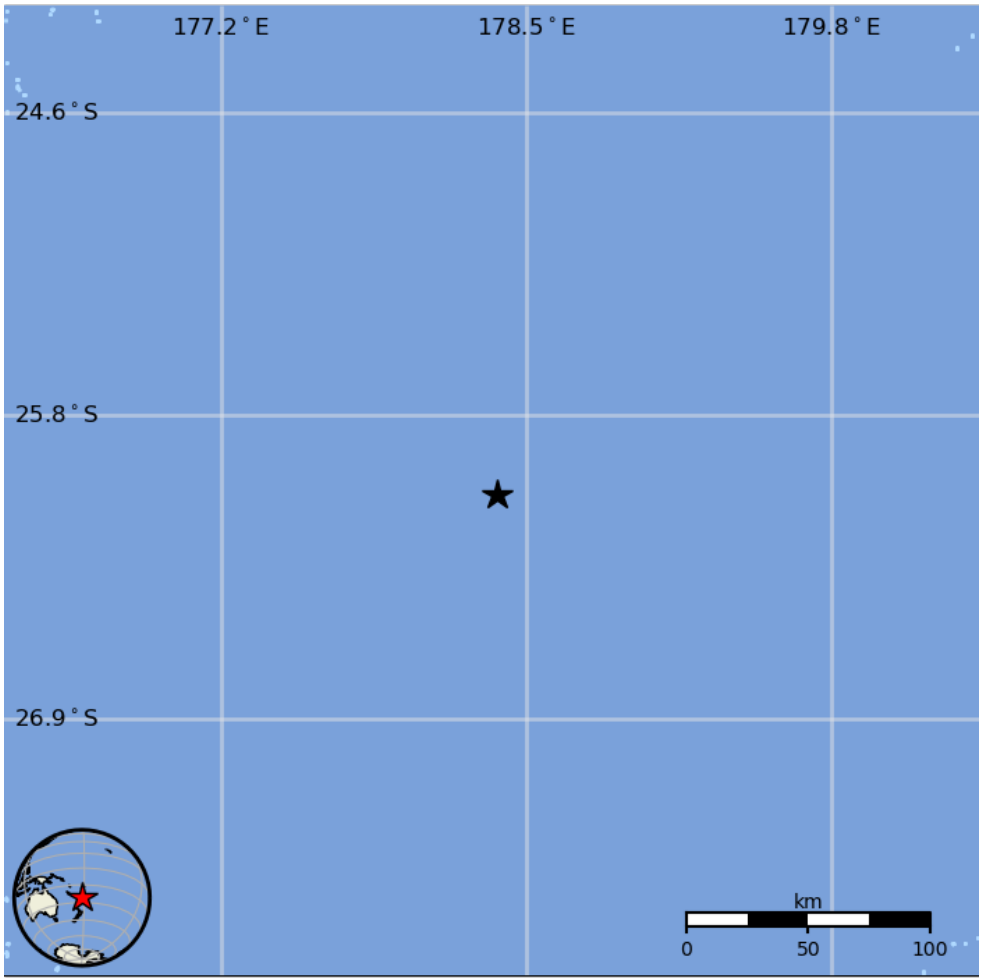
The USGS PAGER map shows the population exposed to different Modified Mercalli Intensity (MMI) levels.

The USGS estimates that no one felt shaking from this earthquake.

MMI	Shaking	Population
I	Not Felt	0 k*
II-III	Weak	0 k*
IV	Light	0 k
V	Moderate	0 k
VI	Strong	0 k
VII	Very Strong	0 k
VIII	Severe	0 k
IX	Violent	0 k
X	Extreme	0 k



The color-coded contour lines outline regions of MMI intensity. The total population exposure to a given MMI value is obtained by summing the population between the contour lines. The estimated population exposure to each MMI Intensity is shown in the table.

Image courtesy of the US Geological Survey

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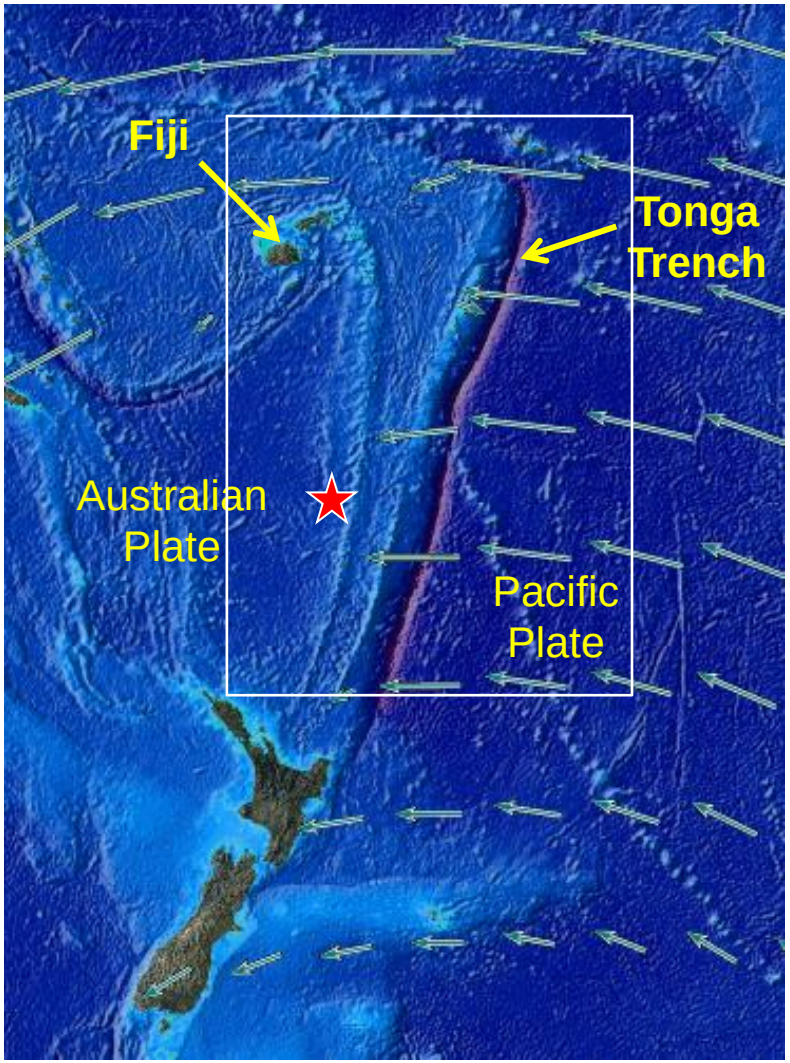
The blue arrows show the motion of the Pacific Plate with respect to the Australian Plate. The epicenter of the earthquake is shown by the red star while the white square outlines the area of historic seismicity shown on the next slide.

This earthquake occurred within the Pacific Plate where it subducts beneath the Australian Plate at this ocean – ocean convergent plate boundary.

Notice that the rate and direction of motion of the Pacific Plate change with distance north from New Zealand. These changes remind us that lithospheric plate motions are actually relative rotations of spherical shells along Earth's surface rather than linear motions of flat plates.



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Regional historical seismicity in the northern Tonga Trench is shown on the map below with earthquakes color coded by depth.

Notice that earthquakes are shallow near the Tonga Trench on the east side of the map area. As the Pacific Plate subducts towards the west beneath the Australian Plate, earthquakes within the Pacific Plate increase in depth from east to west.

This earthquake occurred within the subducting Pacific Plate and fits this general depth pattern.

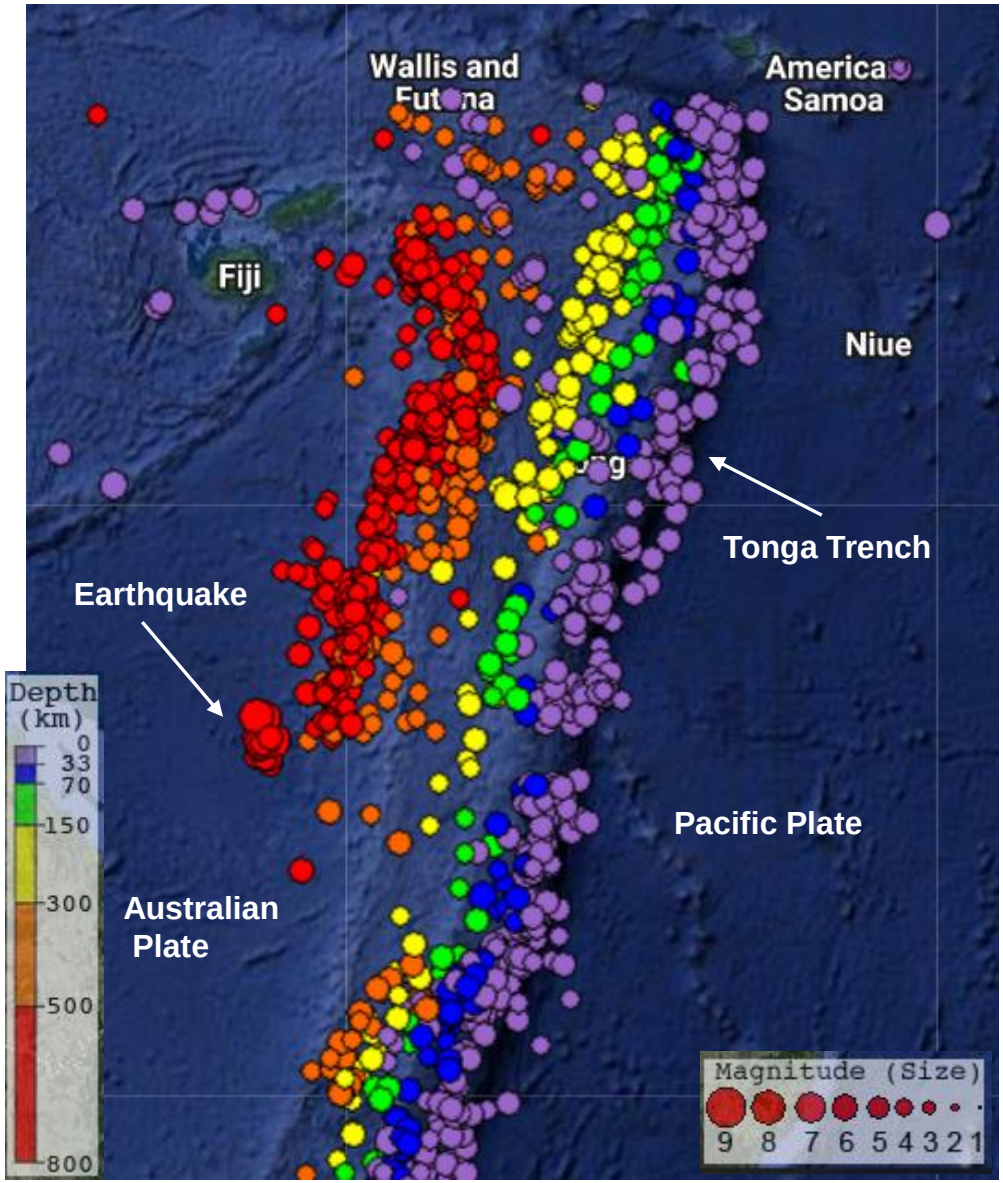

Image from IRIS Earthquake Browser http://www.iris.edu/ieb

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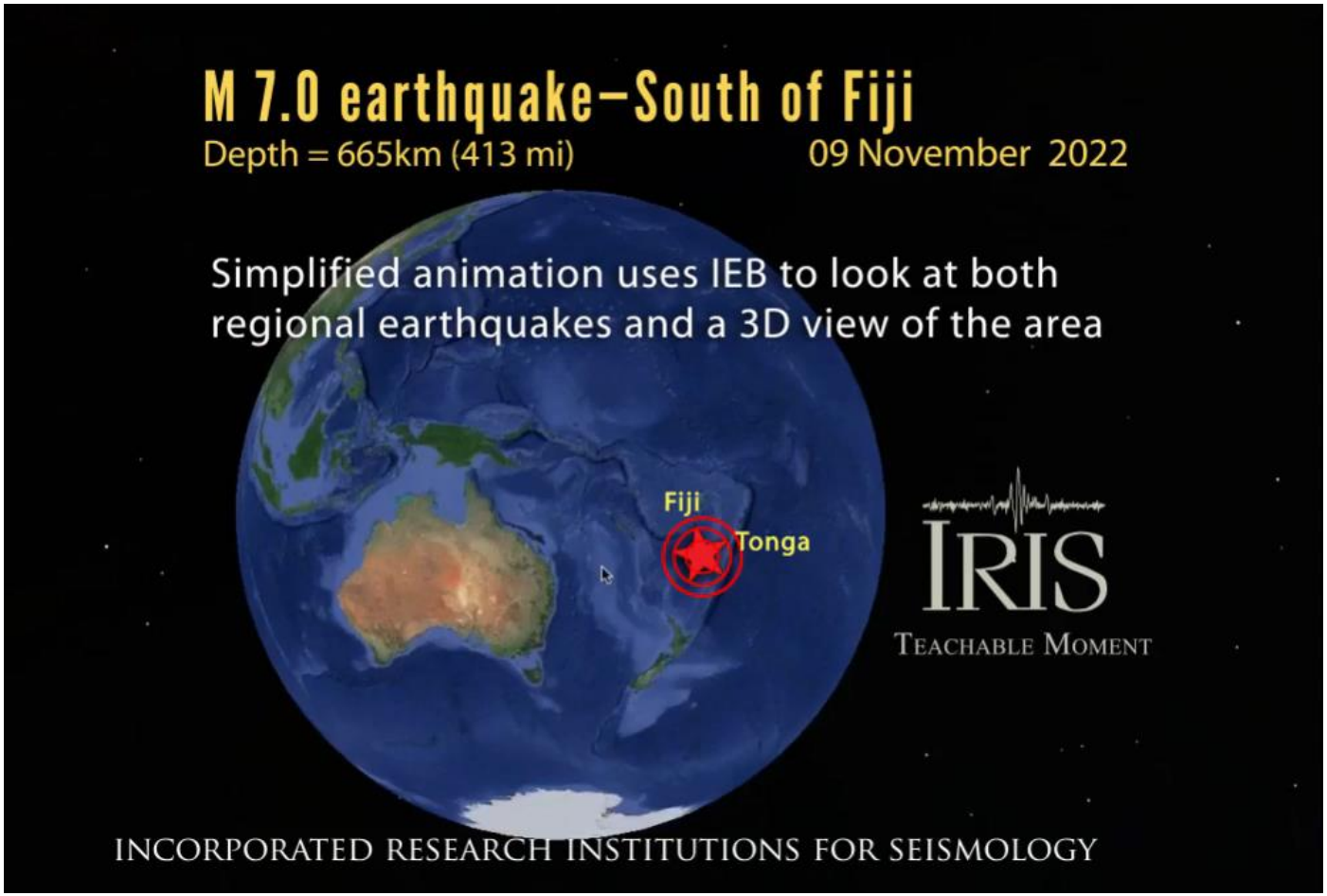
Regional tectonics of this earthquake (click for animation).



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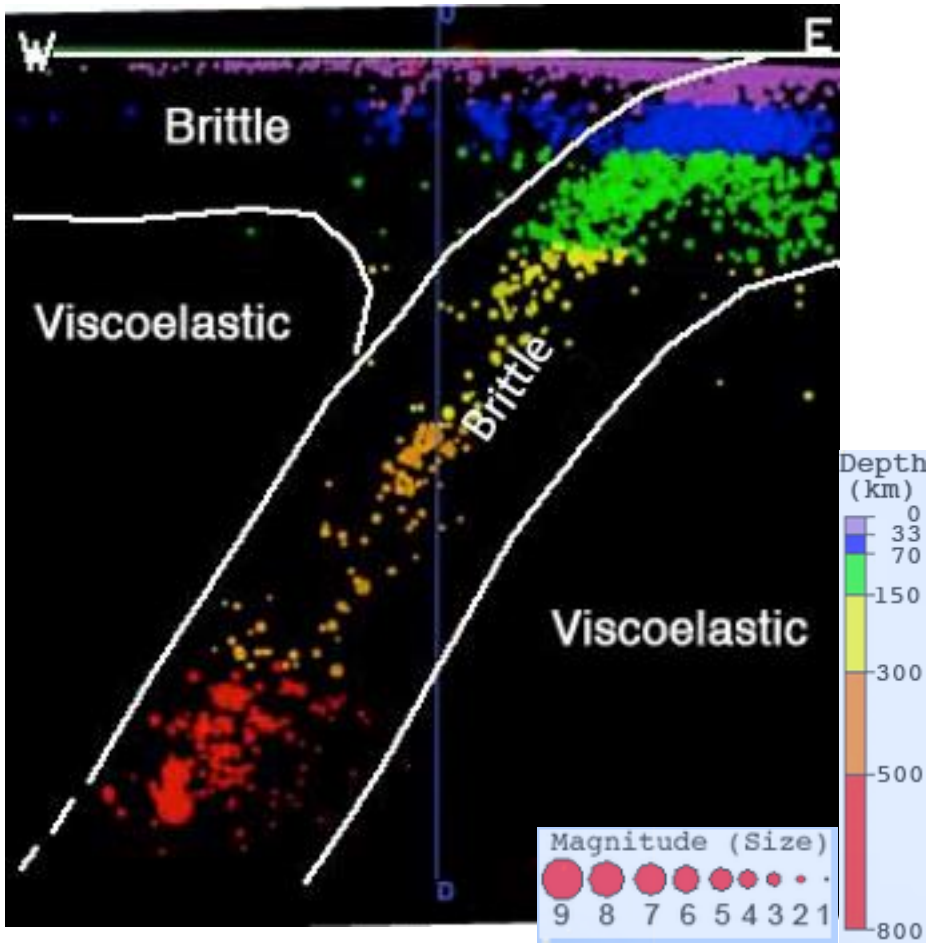
A deep-focus earthquake has a hypocenter depth exceeding 300 km. Deep earthquakes occur exclusively within subducting oceanic lithosphere, especially within old oceanic lithosphere that is subducting rapidly. To produce earthquakes rocks must be brittle. Brittle rock accumulates elastic energy as they bend then rapidly releases that energy during earthquake rupture.

With the exception of subducting oceanic plates, rock in Earth's mantle below about 100 km depth is viscoelastic and cannot rupture to produce earthquakes. Rocks are brittle at low temperatures but become viscoelastic when they reach temperatures of about 600° C. Rapidly subducting cool oceanic plates, however, can remain brittle up to about 700 km in the hot mantle.

The deepest earthquakes are thought to be due to phase changes of minerals in the high pressure and temperature conditions at those depths.



Exploring a three-dimensional view from the IRIS Earthquake Browser.

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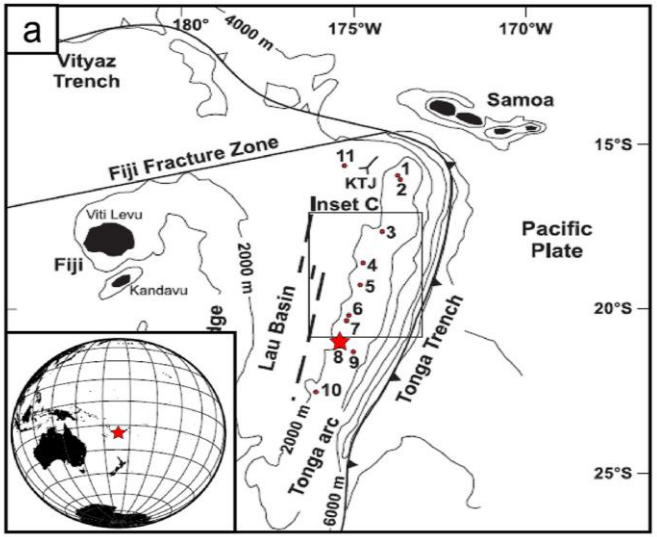
The Tonga Subduction Zone, where today's M7 deep earthquake occurred, stretches across a wide area of the southwest Pacific Ocean. Earthquakes are common there within the down-going Pacific plate as it subducts beneath the Australian plate to the west.

The most remarkable recent event in the Tonga Subduction Zone was the massive January 2022 eruption of the shallow submarine volcano named Hunga Tonga.



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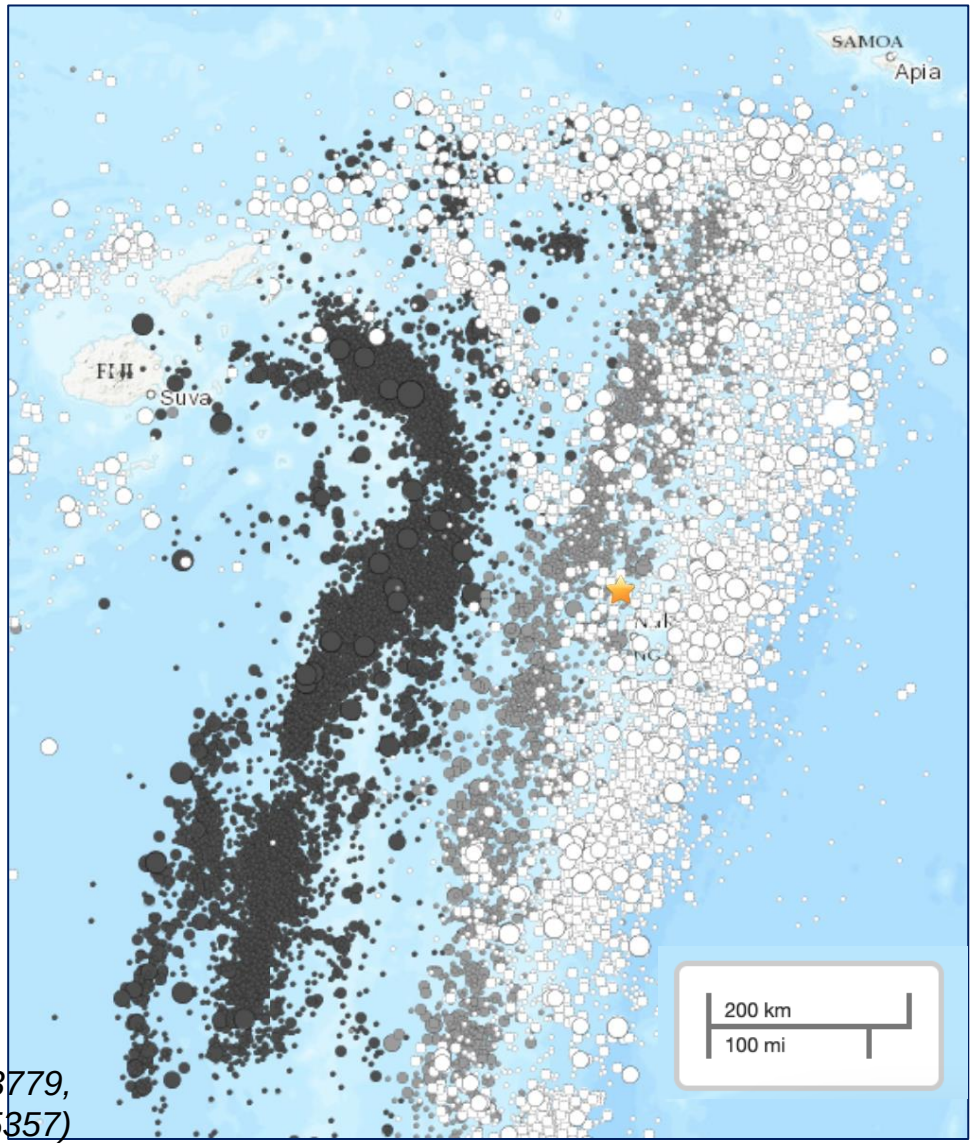
Map showing Hunga Tonga Volcano (yellow star) and historical seismicity (darker colors are deeper events) in the Tonga Subduction Zone
https://earthquake.usgs.gov/earthquakes/eventpage/us7000gc8r/map



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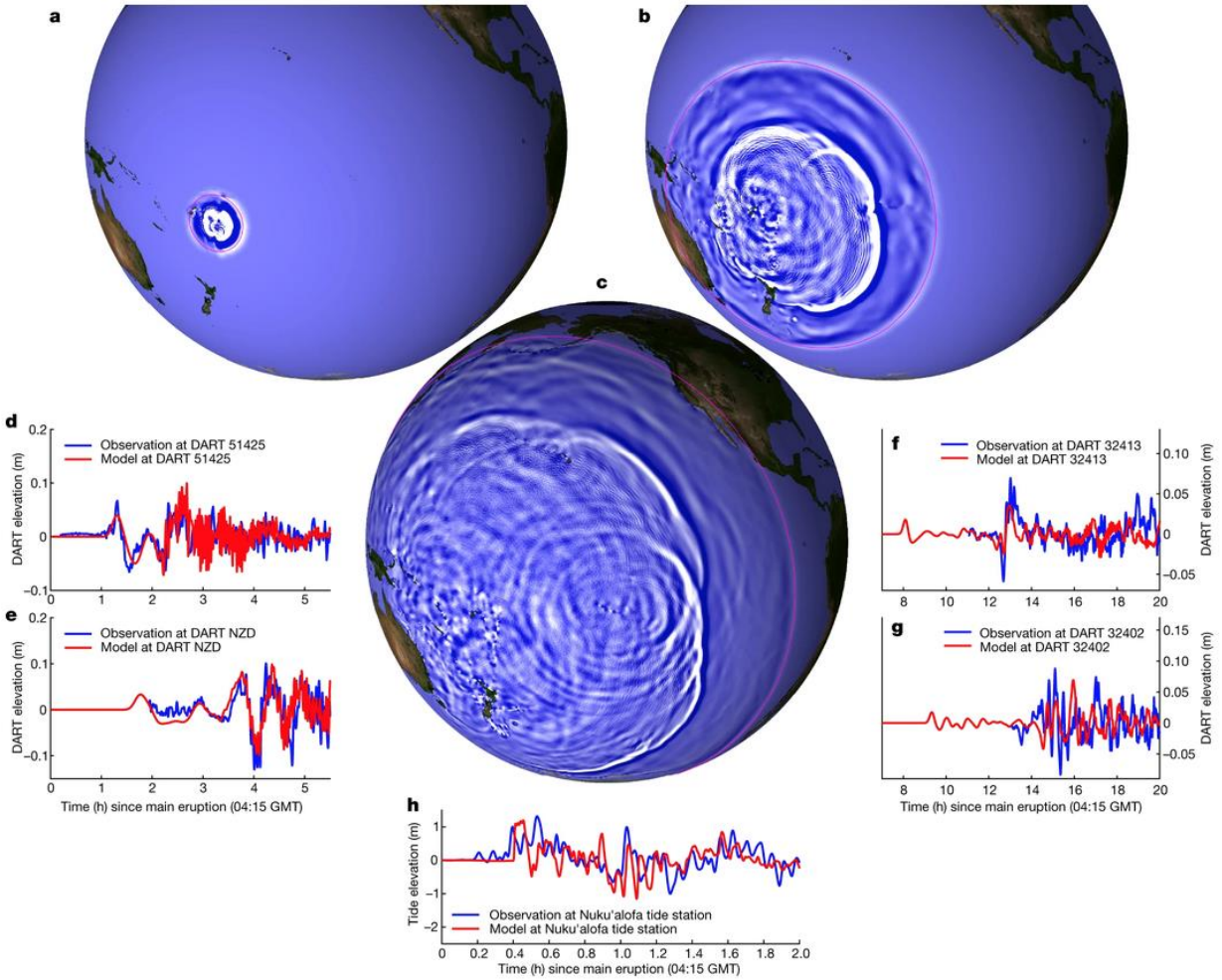
The blast from Hunga Tonga not only generated a tsunami that spread across the Pacific Ocean but was strong enough to jiggle the atmosphere from the surface to the ionosphere (48 km (30 miles) above the surface) creating atmospheric waves that propagated around the planet several times!

NASA scientists estimated that the Tongan eruption was 500 times as powerful as the nuclear bomb dropped on Hiroshima, Japan. The sound of the eruption was reportedly heard by people in Alaska, over 10,000 km from the volcano.



Lynett, P., McCann, M., Zhou, Z. et al. Diverse tsunamigenesis triggered by the Hunga Tonga-Hunga Ha'apai eruption. Nature 609, 728–733 (2022). https://doi.org/10.1038/s41586-022-05170-6

Duncombe, J. (2022), The surprising reach of Tonga's giant atmospheric waves, Eos, 103, https://doi.org/10.1029/2022EO220050. Published on 21 January 2022.

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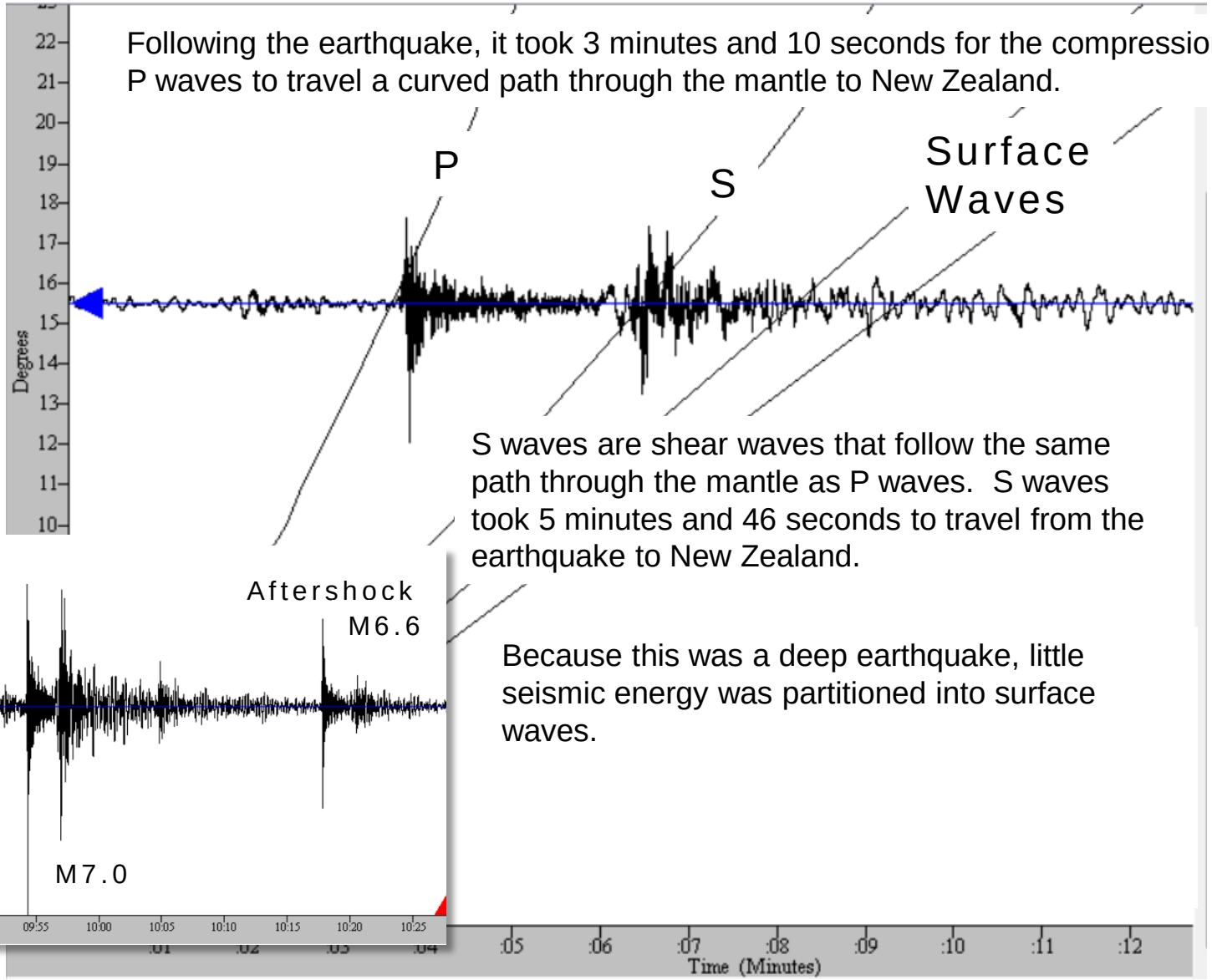
The record of the earthquake in South Karoni, New Zealand (SNZO) is illustrated below. New Zealand is 1731 km (1076 miles, 15.6˚) from the location of this earthquake.



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