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Subduction megathrust earthquake preceded by a foreshock

POSTED ON [OCTOBER 10, 2018](#) BY [JASON PATTON](#)

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An earthquake with a magnitude of [M = 7.0 earthquake](#) struck today in New Britain, Papua New Guinea. New Britain is an island northeast of the Island of Papua New Guinea and Australia. While the earthquake struck on a subduction zone, the Pacific Tsunami Warning Center states that there is no tsunami threat.

Tectonic Hazards

Hundreds of millions of people globally live along plate margins called subduction zones. These plate boundaries are formed as the result of millions of years of plate convergence. Earthquakes that occur along subduction zone megathrust faults are compressional earthquakes (aka thrust or reverse).

Earthquake size is related to the material properties of the earth surrounding the slipped fault, the size of the fault that slipped (the area), and the amount that the fault slipped (distance). Earthquakes occur in specific depth ranges depending upon the conditions. Typical plate boundary earthquakes due to brittle failure along a fault extend to several tens of kilometers into the Earth. Because subduction zone megathrust faults dip into the earth at an angle, the fault area that can slip can be larger than for strike-slip faults. Megathrust earthquakes can therefore have magnitudes larger than strike-slip (shear) earthquakes.

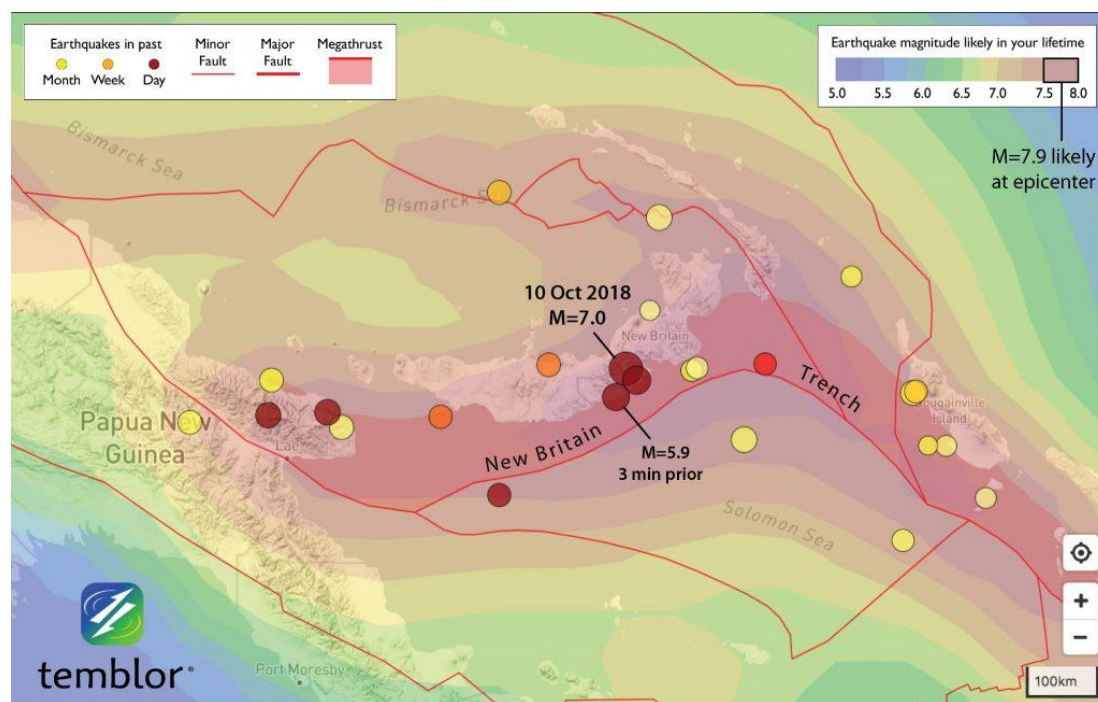
Do you live along a subduction zone or other plate boundary fault? What about another kind of fault?

To learn more about your exposure to these hazards, visit [temblor.net](#).

Several governments and non-governmental organizations prepare estimates of seismic hazard so that people can ensure their building codes are designed to mitigate these hazards. The Global Earthquake Model (GEM) is an example of our efforts to estimate seismic hazards on a global scale. Temblor.net uses the Global Earth Activity Rate (GEAR) model to provide estimates of seismic hazard at a global to local scale (Bird et al., 2015). GEAR blends quakes during the past 41 years with strain of the Earth's crust as measured using Global Positioning System (GPS) observations.

Below is a map prepared using the temblor.net app. Seismicity from the past month, week, and day are shown as colored circles. The rainbow color scale represents the chance of a given earthquake magnitude, for a given location, within the lifetime of a person (technically, it is the magnitude with a 1% chance per year of occurring within 100 km). The temblor app suggests that this region could have an earthquake of M=7.9 in a typical lifetime, and so the M=7.0 was by no means rare or unexpected.

There was a magnitude [M = 5.9 earthquake](#) just 3 minutes before the M 7.0 earthquake, and so, in retrospect, we might consider the M = 5.9 a 'foreshock' to the much larger M = 7.0 earthquake. This happens only about 5-10% of the time, which means that foreshocks are a poor predictor of mainshocks.



Global Earthquake Activity Rate map for this region of the western equatorial Pacific. Faults are shown as red lines and the megathrust faults are shown as pink regions because they dip into the earth at an angle. Warmer colors represent regions that are more likely to experience a larger earthquake than the regions with cooler colors. Seismicity from the past is shown and the location of the M 7.0 earthquake is located near the blue teardrop symbol.

New Britain Tectonics

This area of the world is one of the most active and tortured plate boundaries in the world. There are several subduction zones, oceanic spreading ridges, and transform plate boundary faults that interact to form the island of New Britain, Bougainville Island, and the ocean basins below the Solomon and Bismarck seas.

New Britain is part of a magmatic arc (volcanic island) related to the subduction of the Solomon Sea plate beneath the South Bismarck plate. Below is a map showing the major plate boundary faults in this region. The Island of New Britain is located in the southern part of the South Bismarck plate.

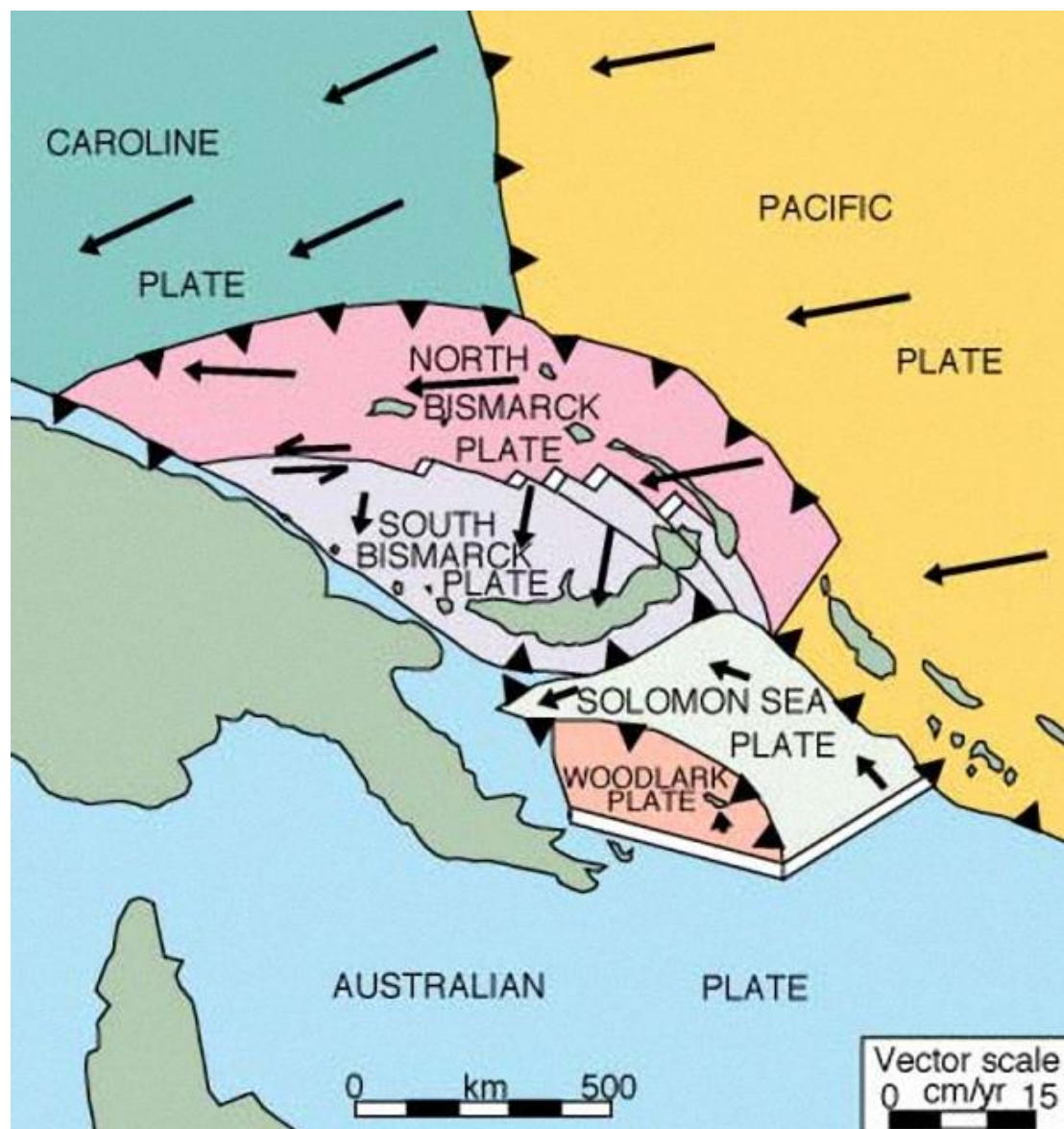
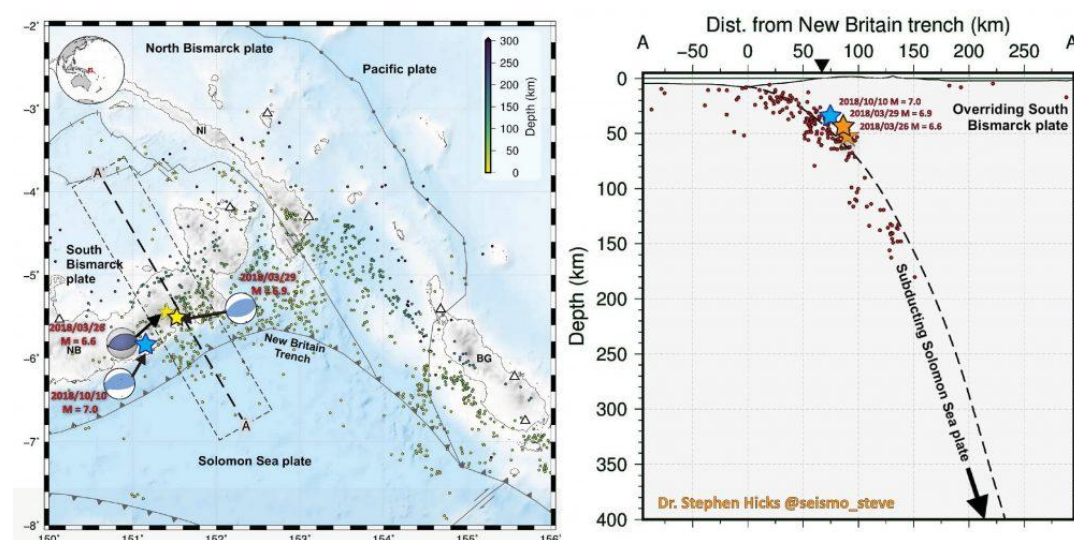


Plate tectonic map from Oregon State University. The Solomon Sea plate subducts beneath the South Bismarck plate to the north, the Pacific plate to the east, and the Australia plate to the south. There are oceanic spreading ridges shown as double

black lines. Some of these ridges are offset by transform (strike-slip) faults between the South and North Bismarck Sea plates. Arrows represent the relative direction and speed of the different plates.

Earlier this year, there was an earthquake about 20 miles from today's earthquake. [Dr. Stephen Hicks](#) is a postdoctoral research fellow in seismology from the University of Southampton who has been studying the geometry of the subduction zone in associated with the New Britain Trench. Here is his [tweet](#) regarding the M = 6.6 earthquake in March 2018. This was a foreshock to an M = 6.9 earthquake a few days later.

Below are the two panels that show earthquake epicenters on the left and earthquake in cross-section on the right. The location for the M = 6.6 is shown as an orange star on the cross section and a yellow star on the map. We have added the location of the M = 6.9 earthquake using the same color scheme. We also added the location for the M = 7.0 earthquake from today as a blue star.



Seismicity map and cross section (modified from [Dr. Hicks, 2018](#)). Epicenters are shown on the map, with the earthquakes selected for the cross section is outlined as a dashed rectangle labelled A-A'. Hypocenters along cross section A-A' are shown relative to distance from the trench axis.

Take Away

A subduction zone megathrust earthquake with a magnitude M = 7.0 happened along one of the most seismically active subduction zones, the New Britain Trench. The magnitude and depth are the probable reasons that the Pacific Tsunami Warning Center announced that there is no tsunami threat from this earthquake, locally or globally. There was a M = 5.9 foreshock several minutes prior to the mainshock. This subduction zone has a potential for a larger earthquake.

References

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More can be found about the seismotectonics of this region [here](#).

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