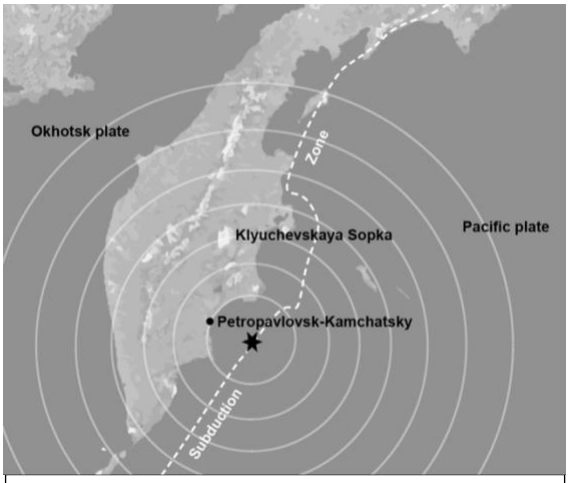
Russian events on the Pacific Ring of Fire



Kamchatka Peninsula showing quake origin, volcano, subduction zone & plates .[J Rankine]

An earthquake measuring 8.8 Mw struck eastern Russia on Tuesday 29 Jul at 11:25am local time (same time zone as NZ). It occurred off the coast of the Kamchatka Peninsula, 119 km from the regional capital, Petropavlovsk-Kamchatsky. The quake was fairly shallow, at a depth of 20-35 km and was preceded by 50 earthquakes 5.0 Mw or bigger – we can expect as many aftershocks if not more.

This is a particularly active tectonic region. The Kamchatka Peninsula and eastern Siberia sit on the Okhotsk plate (which can be considered part of the North American plate). The Pacific plate subducts northwest beneath the Okhotsk plate at a rate of about 80 mm/yr, making it one of the fastest convergent margins in the world. The Aleutian trench and Kuril-Kamchatka Trench are nearby. This earthquake occurred on the subduction zone, over a wide area rather than at one point. Such earthquakes are called megathrust earthquakes and have the potential to cause widespread devastation as was seen in Chile 1960, Alaska 1964, Sumatra 2004 and Japan 2011.

A kindergarten damaged by the earthquake in the capital city. [Russian Emergency Ministry]

This Russian event is one of the largest earthquakes since 1900, but not unusual for this area. Over the last 125 years, 7 earthquakes measuring 8.3 or higher have struck the peninsula. The largest, in 1952, was a magnitude 9 earthquake that ruptured 600 km of the subduction zone interface and set off tsunami 9.1m tall in Hawaii.

With this history it is no wonder tsunami alerts were triggered across the world.

Tsunami are caused when sudden movement on the sea floor displaces water above. These waves travel to the nearest coast and out to the deep ocean. Here, tsunami can travel at more than 800km/h, about as fast as a pass -enger aeroplane. At sea, the distance between waves is very long and the waves aren't very high – rarely more than a metre. But as a tsunami enters the shallow water near land, it slows down, often to about 30-50 km/h. The distance between waves shortens, and waves grow in height, which can effectively create a wall of water at the coast.

One of NZ's DART buoys [GNS]

Many coastal countries have a system to monitor assess and issue warnings about tsunami. Deep-ocean Assessment and Reporting of Tsunami (DART) buoys have been deployed around NZ. DART sensors on the sea floor detect changes in water pressure and signal a buoy at the surface which in turn signals a satellite. The resultant message to GNS is analysed and actioned if necessary.

The height of tsunami waves is affected by several factors. The local shape of seafloor near the coast where it

Mike Stone

arrives and the shape of the nearest land have an impact as do the initial depth of the earthquake. Shallow depths often mean greater displacement of the seafloor and so a bigger tsunami wave. It may be, that as more measurements are received over time the earthquake is found to have a deeper origin.

Klyuchevskoy volcano erupting 29 July. [Alexander Piragis]

This time, waves of 3 to 5m were recorded around the Kamchatka Peninsula, flooding the local port, sweeping vessels from moorings and moving some buildings off their foundations. Evacuations to higher ground were ordered on many Pacific islands – Japan, Hawaii and others, but the warnings were later downgraded. Waves in Japan reached 1.3m and in Hawaii were recorded at up to 1.7m

450 km north of Kamchatka's capital, lies the northern hemisphere's largest active volcano, known as Klyuchevosky or Klyuchevskaya Sopka. This stratovolcano is one of over 300 cones on the peninsula. Two hours after the massive earthquake nearby this volcano began erupting – there were several explosions with an ash plume 6km high and lava descended the western slope. The volcano last erupted 2 years ago, spewing a dust and ash cloud 12 km high and 1600 km long.

This seismic and volcanic activity is characteristic of the Pacific Ring of Fire.

Pacific Ring of Fire [Courier Mail].

References: Al Jazeera, USGS, Reuters, BBC, LiveScience, Science Media Centre.

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