Magnitude 7.8 Earthquake Near Vanuatu
Wednesday, October 7, 2009 at 22:03:15 UTC
3:03:15 PM Pacific Daylight Time

Epicenter: Latitude 13.052°S, 166.187°W (indicated by stars on maps below).
Depth: 35 kilometers.

As determined by the US Geological Survey National Earthquake Information Center (NEIC), a magnitude 7.8 earthquake occurred Wednesday afternoon Portland time in the Northern New Hebrides Trench between Vanuatu and the Solomon Islands. Just 15 minutes later, a second earthquake of magnitude 7.7 occurred about 60 km north of the first earthquake. At this trench, the northeastern corner of the India-Australia Plate subducts beneath the Pacific Plate (Map A on left). The 1990-to-present earthquake history within the yellow square of Map A is shown on Map B where the yellow star indicates the location of the M7.8 October 7 earthquake. This earthquake occurred about 260 km south of Lata, Santa Cruz Islands and 295 km north-northwest of Luganville, Espiritu Santo, Vanuatu (Map B). The NEIC tectonic summary states: “The Torres Islands, Vanuatu earthquake of October 7, 2009, occurred on or near the plate boundary between the Australia and Pacific plates. In the region of the earthquake, the Australia plate moves to the east-northeast with respect to the Pacific plate at a velocity of about 91 mm/year. The Australia plate thrusts under the Pacific plate at the New Hebrides trench and dips to the east-northeast. The October 7 earthquake’s location, depth, and focal mechanism are consistent with the earthquake having occurred as thrust-faulting associated with subduction along the Australia-Pacific plate boundary.” Major earthquakes that occur at shallow depths below the seafloor are candidates for producing tsunamis. The Pacific Tsunami Warning Center issued a tsunami advisory for the South Pacific region and Hawaii but the tsunami watch was later cancelled when the DART tsunami detection buoy observed a wave of only 0.1 feet and the tide gauge at Luganville observed a wave of just 0.3 feet height.
The record of the M7.8 Vanuatu earthquake on the University of Portland seismometer is illustrated below. Portland is about 9600km (6000 miles, 86.6°) from the location of this earthquake.

Following the earthquake, it took 12 minutes and 38 seconds for the P waves to travel from the Vanuatu earthquake to Portland. P waves are body waves, compressional waves that travel through the Earth’s mantle. The S waves started arriving 23 minutes 12 seconds after the earthquake occurred. S waves are also body waves, but they travel as shear waves through the Earth’s mantle. SS waves are S waves that bounced once off the Earth’s surface between the epicenter and Portland. SS waves are expected to arrive 28 minutes and 54 seconds after the earthquake and look prominent on the seismogram. However, the M7.7 earthquake that occurred 15 minutes after the M7.8 event has produced a complex seismogram. The P wave arrivals for the second earthquake arrived in Portland at almost exactly the same time as the SS waves from the first earthquake. This complicates the interpretation of the seismogram, since the arrivals are overprinted.

The surface waves traveled from the earthquake to Portland around the perimeter of the Earth. Because the distance around the perimeter is longer than the distance through Earth’s mantle and the speed of surface waves is slower than body waves, it takes surface waves much longer than body waves to travel from an earthquake to a distant seismic station. In this case, the first surface waves from the Vanuatu earthquake started arriving at the University of Portland about 37 minutes after the earthquake occurred.