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Remotely triggered nonvolcanic tremor in Sumbawa, Indonesia

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Nonvolcanic (or tectonic) tremor is a seismic phenomenom which can provide important information about dynamics of plate boundaries but the underlying mechanisms are not well understood. Tectonic tremor is often associated with slow-slip (termed episodic tremor and slip) and understanding the mechanisms driving tremor presents an important challenge because it is likely a dominant aspect of the evolutionary processes leading to tsunamigenic, megathrust subduction zone earthquakes.

Tectonic tremor is observed worldwide, mainly along major subduction zones and plate boundaries such as in Alaska/Aleutians, Cascadia, the San Andreas Fault, Japan or Taiwan. We present, for the first time, evidence for triggered tremor beneath the island of Sumbawa, Indonesia. The island of Sumbawa, Indonesia, is part of the Lesser Sunda Group about 250 km north of the Australian/Eurasian plate collision at the Java Trench with a convergence rate of approximately 70 mm/yr.

We show surface wave triggered tremor beneath Sumbawa in response to three teleseismic earthquakes: the Mw9.0 2011 Tohoku earthquake and two oceanic strike-slip earthquakes (Mw 8.6 and Mw8.2) offshore of Sumatra in 2012. Tremor amplitudes scale with ground motion and peak at 180 nm/s ground velocity on the horizontal components. A comparison of ground motion of the three triggering events and a similar (nontriggering) Mw7.6 2012 Philippines event constrains an apparent triggering threshold of approximately 1 mm/s ground velocity or 8 kPa dynamic stress. Surface wave periods of 45–65 s appear optimal for triggering tremor at Sumbawa which predominantly correlates with Rayleigh waves, even though the 2012 oceanic events have stronger Love wave amplitudes and triggering potential.

Rayleigh wave triggering, low-triggering amplitudes, and the tectonic setting all favor a model of tremor generated by localized fluid transport. We could not locate the tremor because of minimal station coverage, but data indicate several potential source volumes including the Flores Thrust, the Java subduction zone, or Tambora volcano.