

Tectonic tremors in southern Chile, observed in three space-time windows

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In southern Chile, tectonic tremors occur along the subduction interface between the Nazca and South American Plates. While several studies investigated this phenomena, the whole picture of tremor activity is yet unclear because of the lack of wide and continuous observation networks. So far, three space-time windows are available for tremor observation.

The first is a temporary observation by the Chile Ridge Subduction project 2004-2007 (Gallego et al., 2010). Thousands of tremors were detected and located beneath the Chonos Archipelago, using an envelope correlation method (Ide, 2012; Idehara et al., 2013). The southern limit of tremor distribution delineated by a potential slab window suggested in this region (Russo et al., 2010) and gradually increasing tremor depths (20-40 km) to the north support tremors occurrence on the upper surface of very young Nazca Plate. Tremor often migrated at ~10 m/s in the subduction direction and at ~0.1 m/s in the along-trench direction, which are similar to observations in various tremor regions worldwide. The sensitivity to tidal shear stress in the subduction direction is very high, and the tremor rate is proportional to an exponential function of shear traction.

The second window was open in 2009, by a joint observation of ocean bottom seismometers (Abe, 2009) and a temporary land network. The ocean bottom network detected tremors near the subducting ridge (Sáez et al., 2019) and the land network captured the southern part of the tremor distribution studied with 2004-2007 data. These two distributions of tremors and the plate boundary between the Nazca and Antarctica Plates probably demarcate the locked region in this subduction zone, where the rupture of the 1960 Valdivia earthquake was arrested.

Despite a rapid improvement of seismic observation in Chile in this decade, these tremor zones cannot be monitored well by current permanent observation networks. The only exception is a seismic array deployed around Aysen volcanic region. We can monitor some tremor activity near the northern end of the deep tremor region, with a little more extension to the north. The northern limit of this tremor zone, especially the occurrence of tremors beneath Chiloe Island has not determined yet.

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