

Large shallow earthquakes inside horizontally subducting plates: Mexico, Peru, and Nankai Trough

*Kiyoshi Yomogida¹

1. Department of Earth and Planetary Dynamics, Graduate School of Science, Hokkaido University

In 2017, there are two large intra-plate earthquakes in Mexico, within a subducting young Cocos plate. It is important that these events occur in the plate, but deeper than its trench axis close to the land, completely different from well-known outerrise earthquake. This subduction zone is characterized by a nearly horizontal plate just below its trench axis. There were several large (M7 class) shallow earthquakes in this area (e.g., in 1931, 1994, and 1999), probably intraplate normal-fault earthquakes. A more famous shallow large intraplate earthquake over the world may be the one in the central Peru in 1970 of Ms7.5. This event also occurred within the horizontally subducting Nazca plate and deeper than its trench axis.

Although there are intraplate earthquakes deeper than their trench axis (or landwards) in other subduction zones, large events ($M > 7$) cannot be identified yet. A certain amount of stress should be induced within all the subducting plates upon bendings around their trench axes. Normal subducting plates (dip angle > 15 deg.) may not excite large intraplate earthquakes because their lower half parts are compressional while shallow parts are extensional. The stress field within a horizontally subducting plate may be extensional even near the bottom plane of the plate, which may make a large normal intraplate earthquake possible.

In the world there are another example of horizontally subducting plates in the world besides Mexico and Peru: the Nankai Trough from Kii Peninsula to Ashizuri-misaki of Shikoku. Within the subducting Philippine-Sea plate, there were relatively large intraplate earthquakes probably due to the tearing of the plate, such as 1905 and 2001 Geiyo earthquakes. Although we do not know any large shallow normal intraplate earthquakes close to its trench axis, analogous to the ones in Mexico and Peru, such events may take place only once in hundreds years, so that we may miss such an event by other kinds of earthquakes such as subduction earthquakes with little tsunamis or inland earthquakes.

Since a large shallow intraplate event is likely to cause intensive strong motions due to its mechanism and shallowness (less than 50 km), as known in events in Mexico and Peru, we need to consider a possible large shallow intraplate earthquake in the Philippine-Sea plate. Comparative studies with events in Mexico and Peru will be extremely important, including plate configurations, distributions of slow-slip events or non-volcanic tremors and seismicity.

Keywords: shallow intraplate earthquake, horizontally subducting plate, plate bending