

Ocean-bottom seismic and geodetic observations of transient slow slip events in the Japan Trench

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The seismic coupling coefficient in the whole seismogenic zone of the plate boundary is approximately 25% in the Japan Trench on the western Pacific rim, where is characterized by an active erosive plate margin; fast (8 cm/yr) convergence of the Pacific plate subducting beneath the landward plate makes the seismicity along this plate boundary the highest in the world. The relatively low seismic coupling coefficient suggests that small or moderate-sized asperities surrounded with aseismic slip region exist, and much of the interplate motion in the seismogenic zone is accommodated by aseismic slip or slow earthquakes that compensate for lacking the seismic coupling over 75%. We report on a transient slow slip event in the shallow subduction zone updip of the seismogenic section in the Japan Trench off northeastern Japan. To observe various types of slow earthquakes, we deployed two temporary observation sites on the landward slope of the Japan Trench because there are no offshore seismological and geodetic observations near the trench capable of detecting slow earthquakes. Each site had a short-period seismometer, an intermediate-period seismometer, and a pressure gauge to record the frequency components of various types of slow earthquake. Ocean-bottom sites were deployed in May 2008 (YK08-06) during a cruise of R/V Yokosuka (Japan Agency for Marine-Earth Science and Technology: JAMSTEC). The seismometers were recovered by a pop-up system and replaced once in October 2008 (KT08-28) during a cruise of R/V Tansei-Maru (JAMSTEC). All sensors were recovered by a pop-up system at the end of the observation period in May 2009 (KT09-06) during a cruise of R/V Tansei-Maru. Relative vertical motion of 0.02 m over 5 days measured by two ocean-bottom pressure gauges is interpreted as a slow slip event on the plate boundary with slip of 0.08 m. The event preceded an M 6.1 interplate earthquake further downdip, suggesting that the precursory transient slow slip event may induce a shear stress increase that triggers an earthquake in the downdip portion of the subduction interface.

Keywords: slow earthquake, Japan Trench, ocean bottom seismometer, ocean bottom pressure gauge