Seafloor and subseafloor experiments at the Hikurangi subduction margin to investigate the causes and consequences of slow slip events

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Slow slip events (SSEs) involve transient aseismic slip on a fault (lasting weeks to months) at a rate intermediate between plate boundary displacement rates and that required to generate seismic waves. Only since the advent of dense, plate boundary–scale geodetic networks in the last decade has the importance of these events as a significant mode of fault slip been recognized. The northern Hikurangi subduction margin, New Zealand is the site of the shallowest well-documented slow slip events (SSEs) on Earth. Due to the close proximity of the SSE source area to the seafloor at the offshore Hikurangi margin (<2-15 km), it has become an important international target for a variety of geophysical studies to understand the offshore physical mechanisms that lead to slow slip. A recent seafloor geodetic study using Absolute Pressure Gauges measured 1.5-5.5 cm of vertical deformation of the seafloor during large slow slip. These data demonstrate for the first time that slow slip continues to within at least 2-3 km of the seafloor, and it is possible that it occurs all the way to the trench (Wallace et al., 2016). We also show that using realistic elastic properties in the geodetic inversions greatly increases the amount of shallow slip needed to fit the data.

The centerpiece of efforts to understand slow slip at the Hikurangi margin is a series of IODP proposals (781A-Full and 781B-Full) to undertake riserless (Joides Resolution) and riser (Chikyu) drilling, and CORK observatory installation on a transect spanning the shallow Hikurangi SSEs. Joides Resolution drilling is scheduled at the Hikurangi margin for November-December 2017 and March-May 2018 on Expeditions 372 and 375. These two expeditions aim to investigate the processes and in situ conditions that underlie subduction zone SSEs at northern Hikurangi through coring and logging of the frontal thrust, upper plate, and incoming sedimentary succession, and by installation of borehole observatories in the frontal thrust and upper plate above the slow slip source area. The LWD data will be acquired on Expedition 372, while coring and installation of the CORK observatories will take place on Expedition 375. We will also discuss the plans and scientific objectives for the upcoming JOIDES Resolution drilling.

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