The dynamics of shallow plate interface slip at the offshore Hikurangi subduction margin, New Zealand

Wallace, L.M. [1,2], Barnes, P..[3], Saffer, D. [4], Henrys, S. [1], Barker, D. [1], Bassett, D. [1], Caratori-Tontoni, F. [1], Kaneko, Y.[1], Ito, Y.[5], Mochizuki, K. [6], Webb. S. [7], Clark, K. [1], Cochran, U. [1], Litchfield, N. [1], Williams, C.[1], Fry, B.[1], Todd, E. [8], Bell, R. [9], Petronotis, K. [10], Pecher, I. [11], Leah LeVay[10] and the IODP Expedition 372 and 375 Science Parties

1 *GNS Science, Lower Hutt, NZ*

2. *University of Texas Institute for Geophysics, Austin, Texas, USA*

3. *National Institute for Water and Atmospheric Research, Wellington, NZ*

4. *The Pennsylvania State University, State College, Pennsylvania, USA*

5. *Kyoto University, Kyoto, Japan*

6. *Earthquake Research Institute, University of Tokyo, Tokyo, Japan*

7. *Lamont-Doherty Earth Observatory, Columbia University, New York, USA*

8. *Otago University, Dunedin, NZ*

9. *Imperial College, London, U.K.*

10. *International Ocean Discovery Program Texas A&M University, College Station, Texas, USA*

11. *University of Auckland, Auckland, NZ*

The offshore northern and central Hikurangi subduction zone hosts frequent (every few years), large (Mw ~6.5-7.0), and shallow (<2-15 km depth) slow slip events (SSEs) beneath the outer forearc. Recent seafloor geodetic experiments suggest the possibility that SSEs at north Hikurangi may propagate all the way to the trench, which has important implications for the physical conditions that can host SSEs. We also observe instances of large-scale dynamic triggering of shallow Hikurangi SSEs by regional earthquakes. The duration and magnitude of the dynamic stress changes induced in the SSE source area from regional earthquakes are strongly amplified by the presence of a low seismic velocity outer forearc overlying the SSE source. Although GPS measurements suggest that most of the north and central Hikurangi margin SSE source region appears to creep over decadal timescales, there is some spatial heterogeneity in coupling within the shallow SSE source region. There is also an intriguing co-location of SSEs at the central Hikurangi margin with the source areas of pre-historic megathrust earthquakes rom paleoseismological studies, suggesting that the slip behavior of the plate interface could vary in time.

The shallow nature of Hikurangi SSEs offers an opportunity to undertake high-resolution imaging of an SSE source region, to use scientific drilling to sample rocks and measure in situ conditions within or near the SSE source, and to monitor offshore deformation and other properties in the very near-field of SSEs. Seismic images and magnetic data reveal that subducting seamounts may strongly influence the distribution of shallow slow slip and tremor at north Hikurangi. International Ocean Discovery Program Expeditions 372 and 375 were undertaken to investigate the processes and in situ conditions that underlie subduction zone SSEs at the northern Hikurangi trough, and to install observatories near the SSE source to measure temporal variations in deformation, temperature, and fluid flow. We will bring together geodetic, seismological, paleoseismological, active source seismic imaging, and results from recent IODP drilling to develop an integrated perspective of the dynamics of shallow SSEs at the Hikurangi subduction margin.