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Using P- to S- wave conversions from controlled sources to determine the shear-wave velocity structure along Hikurangi Margin Forearc, New Zealand

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The Hikurangi subduction margin offshore of the east coast of New Zealand displays along-strike variations in subduction-thrust slip behavior. Geodetic observations show that the subduction-thrust of the southern segment of the margin is locked on the 30-100 year scale and the northern segment displays periodic slow-slip on the 1-2 year scale. It is hypothesised that spatial variations in pore-pressure may play a role in this contrasting phenomenon. Higher pore-pressures would result in lower effective stresses, which promote slow-slip of the subduction-thrust. In addition, the presence of a sedimentary wedge with very low shear wave-speeds in the northern Hikurangi margin has been proposed to fit the ultra-long duration of ground motions observed following the 2016 Kaikoura earthquake. Compressional (P-) wave velocities (V_p) of the subsurface provide useful information about the lithological composition. Combined with shear (S-) wave velocities (V_s), the V_p/V_s ratio which is directly related to Poisson's ratio can be obtained. This is a diagnostic property of a rock's consolidation and porosity. Typical V_p/V_s ratio of consolidated and crystalline rocks range from 1.6 to 1.9 and that of unconsolidated sediments can range from 2.0 to 4.0.

We use the controlled sources of R/V Marcus G Langseth recorded by a profile of 49 multi-component ocean bottom seismometers (OBS) along the Hikurangi margin forearc for the Seismogenesis at Hikurangi Integrated Research Experiment (SHIRE) to derive the V_s structure and estimate the V_p/V_s ratio. The orientations of the horizontal components of each OBS are found by a hodogram analysis and by an eigenvalue-decomposition of the covariance matrix. Using the orientations, the horizontal components of each OBS are rotated into radial and transverse components. P to S converted phases are identified on the radial and transverse components considering their linear moveout, polarisation angle, and ellipticity. We confirm incoming S-waves to OBSs by comparing them with their hydrophone components. We identify both PPS (up-going P-wave after reflection or refraction converts to an S-wave at an interface) and PSS (down-going P-wave from the controlled source converts to an S-wave at an interface) type conversions. The

identified conversion interfaces are the sediment-basement interface and the top of the subducting crust. The travel-time delay of a PPS type conversion relative to its P-wave arrival is indicative of V_s above the converting interface. The linear-moveout of PSS type conversions are indicative of V_s along the raypath after the conversion. Preliminary results from the southern Hikurangi margin suggest V_p/V_s ratios of ~1.70 for the basement rocks above the subducting crust and ~1.90 for the sediments overlying the basement rocks. These values indicate that the basement rocks are consolidated and less porous than the overlying sediments.

We expect to estimate the V_p/V_s ratios in the northern Hikurangi margin to assess the role played by pore-pressure in the along-strike variation in subduction-thrust slip behavior. We also expect to ascertain the presence and estimate the thickness of the low-velocity sediment wedge in the northern Hikurangi margin.