Imaging the Hikurangi subduction megathrust using ambient noise and passive-source body-waves, Raukumara, New Zealand

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Along the northern Hikurangi subduction margin (New Zealand) the subduction megathrust between the subducting Pacific plate crust and the Australian plate, is just 12-15 kms deep beneath the coastline, as inferred from deep marine-seismic reflection work and from earthquake hypocenters. Short-term transient (~2-3 week duration) slow slip episodes occur on this megathrust every ca.12-18 months, and are usually detected by the New Zealand GeoNet cGPS network. The shallow depth of the SSEs along the northern Hikurangi subduction margin means that, in contrast to many other subduction margins, onshore seismometers and cGPS sites lie in the 'near-field' of the transient slow-slip. The proximity of the megathrust and the associated slow slip means that we can resolve body-wave seismic properties around the megathrust at a scale useful for constraining and testing some of the theories on fundamental mechanisms governing the slow slip, such as the relationship between slow slip and high fluid content.

We focus on using passive-source seismic tomography analysis to constrain the body-wave seismic properties close to the megathrust, utilizing the relatively high level of seismic activity in the subducting Pacific plate crust. During 2011-2014 we deployed a broadband seismometer network west of the coastline, (on the down-dip edge of the SSE activity) to supplement the national seismometer network, in order to record seismic tremor and local earthquakes, which had local magnitudes ranging up to 5.1 in that time period.

We have now derived 3-D Vp, 3-D Qp and Vp/Vs from c.8 to 70 km depth along the northern Hikurangi subduction margin, using data from more than 2000 spatially distributed earthquakes recorded by the GeoNet network and by the temporary 2011-2014 seismometer array, supplementing these data with earlier campaign data recorded in 1993-1994, 2001 and 2011-2012. The results show extensive regions of subducted sediment, but with major variations along strike. Above the shallow plate interface and north of Gisborne there is a 70-km long zone of high Vp/Vs and low Vp, which we interpret as subducted sediment with high fluid-pressure. We are now exploring the relationship between the zone of high Vp/Vs and clusters of seismic activity observed along the down-dip edge of the SSEs, as well as further improving the density of coverage in the tomography inversions, folding in dispersion information from ambient noise, and exploring different inversion parameterisation.