

A Seismological Investigation of Slow Slip in the Hikurangi Subduction Zone, New Zealand

This is the first study to systematically examine continuous broadband seismic data during slow slip events in New Zealand. A total of 20 weeks of continuous broadband seismic data was reviewed during the times of three slow slip events: two in the shallow region of the Hikurangi subduction zone near Gisborne (in 2004 and 2006) and one deeper, ~18 month-long event beneath the Manawatu region (early 2004 to mid-2005).

Using the same methods that have been used in northern Cascadia by the Geological Survey of Canada (GSC), seismic tremor similar to that seen elsewhere was not detected during any of these slow slip events. This observation does not appear to be the result of network limitations: as five additional seismographs were deployed in the latter stages of the 2006 Gisborne event to augment the permanent network, and still seismic tremor was not detected. However, local earthquakes that had not been detected during routine analysis were detected and located during this study.

The analysis revealed a pronounced increase in microseismicity during the 2004 Gisborne event that is *spatially* restricted to a region of the subducting plate downdip from the slow slip patch inferred from GPS observations and *temporally* restricted to the period of slow slip. This increased rate of local seismicity is only seen in the small magnitude earthquakes. The increased rate of seismicity is not evident in the routine analysis records and was only detected by a methodical review of continuous seismic data. The 2004 slow slip event triggered microseismicity with magnitudes of $M_L \sim 1-2$, similar to the “co-shocks” reported by Segal et al. (2006) in an intraplate setting.

A similar increase in microseismicity was not observed during the 2006 Gisborne event or the 2004-2005 Manawatu events. The analysis of the 2004-2005 Manawatu data is preliminary but these results indicate that seismic tremor or increased microseismicity did not occur during this slow slip event.

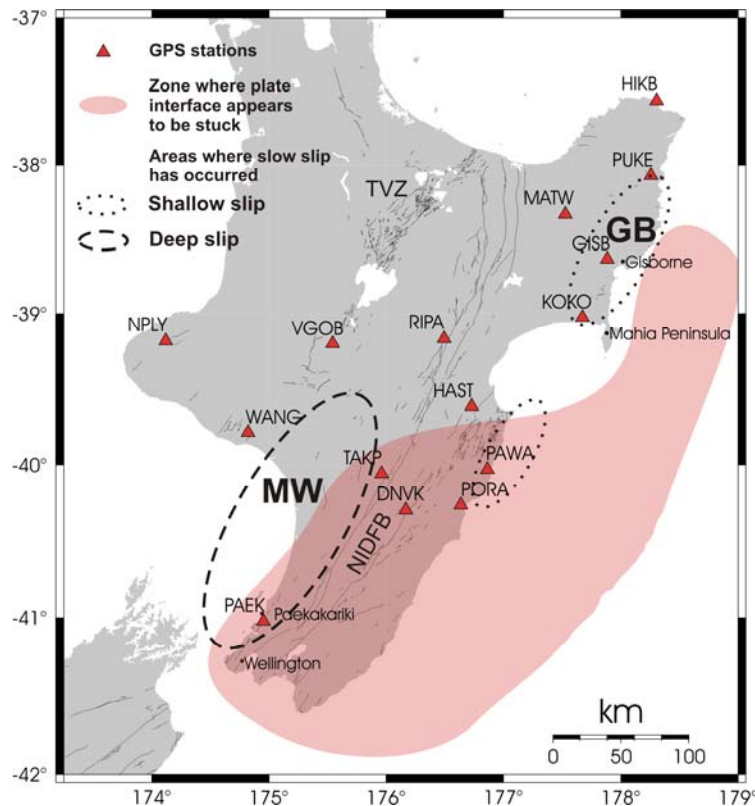


Figure 1. Distribution of slow slip events in North Island, New Zealand. Areas of observed slow slip events are indicated by the ellipses. GPS stations where slow slip has been observed. GB - Gisborne, MW - Manawatu and Paekakariki, TVZ - Taupo Volcanic Zone, NIDFB - North Island Dextral Fault Belt.