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Paralic foraminiferal record of seven large Holocene earthquakes in eastern New Zealand

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Most previous studies using foraminifera to help identify and quantify Holocene earthquake displacements in tectonically-active coastal areas have focussed on the record in high tidal marsh environments. In this study we show that it is sometimes also possible to utilise low-tidal and shallow-subtidal faunas to identify large vertical displacement events.

Foraminiferal assemblages in eleven cores (3-7.5 m deep) of Holocene sediment from brackish Ahuriri Inlet in Hawke's Bay, eastern New Zealand, provide a record of 8.5 m of subsidence followed by 1.5 m of uplift in the last 7500 cal years. Modern Analogue Technique was used to estimate paleotidal elevation (subtidal to extreme high water spring level) of the 97 richest foraminiferal assemblages in the cores. The modern dataset comprised census counts on 272 faunas from New Zealand sheltered harbour and estuarine environments. The most precise elevational estimates are for marginal high tidal salt marsh assemblages and the least precise are from low tidal and subtidal assemblages from near the centre of the inlet. These paleoelevation estimates combined with sediment thicknesses, age determinations (from tephrostratigraphy and radiocarbon dates), the New Zealand Holocene sea level curve, and estimates of compaction, identify the Holocene land elevation changes and earthquake-displacement events in each core.

Because of the lower precision of elevational estimation in subtidal, low-tidal and terrestrial environments, no single core contains a precise record of all the large displacement events. By combining the records from all cores, however, we recognise the following major, earthquake-related displacements: ~7200cal yrs BP (>-0.6 m displacement); ~5800cal yrs BP; ~4200cal yrs BP

(~ - 1.5 m); ~3000cal yrs BP (~-1.6 m); ~1600cal yrs BP (~ -1.7 m); ~600cal yrs BP (~ -1m); 1931 AD Napier Earthquake (+1.5 m). The six, large (possibly subduction interface) subsidence events in the last 7200 years have had a return time of 1000-1400 years. In addition to recognising subsidence events, the foraminiferal record also documents 1.5 m of uplift during the devastating 1931 Napier Earthquake, which was caused by near-surface slip on a local thrust fault.