

New sedimentary-core records and a recent co-seismic turbidite help to unravel the paleoseismicity of the Hikurangi Subduction Zone, New Zealand

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The Hikurangi margin straddles the convergent boundary between the Pacific and Australia tectonic plates and is New Zealand's potentially largest earthquake and tsunami hazard. The 3000 m-deep Hikurangi Trough, off eastern Marlborough, Wairarapa, Hawkes Bay, and East Cape, marks the location where the Pacific plate is subducting beneath the eastern continental margin of the North Island and northeastern South Island. To date the Hikurangi margin has a short historical record relative to the recurrence of great earthquakes and tsunami, and consequently the associated hazard remains poorly constrained. In October 2016 a new, international, 5-year project commenced to evaluate the pre-historic earthquake history of the margin.

In November 2016 a RV Tangaroa voyage acquired 50 sediment cores up to ~5.5 m long from sites on the continental margin between the Kaikoura coast and Poverty Bay. Core sites were selected using available 30 kHz multibeam bathymetry and backscatter data, sub-bottom acoustic profiles, archived sediment samples, and results from numerical modelling of turbidity currents. Sites fell into three general categories: turbidite distributary systems; small isolated slope-basins; and Hikurangi Channel, levees, and trough. Typical of the margin, the terrigenous-dominated sequence included layers of gravel, sand, mud, and volcanic ash. Many of these layers are turbidites, some of which may have been triggered by strong shaking associated with earthquakes (subduction megathrust and other coastal faults). Some cores contain up to 25 individual turbidites. This library of turbidites may provide the basis of new paleoseismic records that span several hundred kilometres of strike along the plate boundary.

During the voyage the 14th November 2016 (NZDT) Mw 7.8 Kaikoura Earthquake occurred, causing strong ground shaking beneath the Kaikoura Canyon region. Sampling with a multicorer within five days of the earthquake, we recovered what appeared to be a very recently emplaced, still-fluidised, co-seismic turbidite about 10-20 cm thick over a very large region offshore of Marlborough and Wairarapa. This event appears to extend at least 300 km from Kaikoura and offers a rare opportunity to calibrate our paleoseismic data and to test hypotheses of turbidite triggering and emplacement. Up to five cores detected this highly fluidised layer overlying the pre-earthquake seabed, clearly visible as an oxidised layer. Our sampling spanned channel, channel-levee, and basin floor environments. On-board observations indicated that the turbidite was still settling on the seabed and the boundary with the overlying water column was diffuse. Further laboratory characterisation of the stratigraphy, physical properties, and benthic assemblages along with radionuclide analyses will test this hypothesis further.