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HCG35-10 Room:105 Time:May 27 11:45-12:00

Palaeoseismic signals in coastal dune ridge systems

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Palaeoseismic research in regions adjacent to active fault zones has traditionally been concerned with identifying geological or geomorphological features associated with the immediate effects of past earthquakes, such as tsunamis, uplift or subsidence, with the aim of estimating earthquake magnitude and/or frequency. In a palaeoseismic context, coastal dune ridge systems are invariably used to infer relative sea level change, be it by uplift or subsidence. However, on a catchment-wide basis, research has linked a sequence of environmental changes such as forest disturbance, landslides, river aggradation and rapid coastal dune building as geomorphological after-effects of large earthquakes (Figure 1). In this model large pulses of sediment created by co-seismic landsliding in the upper catchment are moved rapidly to the coast where they leave a clear signature in the landscape. Coarser sediments form an aggradation surfaces and finer sediments form a new coastal dune or beach ridge. Coastal dune ridge systems are not exclusively associated with seismically active areas, but where they do occur in such places their potential use as palaeoseismic indicators is often ignored. Data are presented from sites in both New Zealand and Japan to illustrate the concept.

First, a well dated suite of coastal dune ridge sequences in SW New Zealand are shown to be linked by a series of geomorphological processes to large ruptures of the regionally significant Alpine fault (Wells and Goff, 2006; 2007). These fine resolution chronological sequences were achieved using the ages of trees from the ancient forest still growing there. A time lag of 10-50 years between earthquake and dune ridge formation attests to the short sediment transport distance from the mountains to the coast (~50 km) coupled with high annual rainfall. Second, these data are contrasted with evidence from SE New Zealand where a longer sediment transport distance from the mountains to the coast (~150 km) coupled with lower annual rainfall causes a time lag of 150-200 years between earthquake and dune ridge formation (McFadgen and Goff, 2005). Differences in coastal configuration and a lack of native forest chronology complicate event chronologies but additional geomorphological indicators and human responses enhance interpretations. Third, we investigate beach ridges of northern Honshu with a focus on the Sendai Plain where a study carried out following the 2011 Tohoku-oki earthquake and tsunami reveal a regional picture of the seismic driving of beach ridge formation. More work needs to be done but the initial results are both exciting and have significant implications for understand the palaeoseismic and palaeotsunami record for the region.

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Figure 1: The seismic cascade of physical and human environmental responses to giant earthquakes (after Goff and McFadgen, 2002; Goff and Sugawara, 2014).

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