Geophysical Research Abstracts
Vol. 20, EGU2018-6847, 2018
EGU General Assembly 2018

Understanding fault complexity in New Zealand: Relationship of the 2016 Mw7.8 Kaikoura earthquake to previous deformation within the Marlborough Fault Zone

Ed Rhodes (1), John Elliott (2), Simon Lamb (3), Max Wilkinson (4), Rob Bryant (1), Dave Mackenzie (5), and Barry Parsons (5)

(1) University of Sheffield, Geography, Sheffield, United Kingdom (ed.rhodes@sheffield.ac.uk), (2) Univeristy of Leeds, School of Earth & Environment, Leeds, United Kingdom (j.elliott@leeds.ac.uk), (3) Victoria University of Wellington, Geography, Environment and Earth Sciences, Wellington, New Zealand (simon.lamb@vuw.ac.nz), (4) Geospatial Research Limited, Durham, United Kindom (maxwell.wilkinson@durham.ac.uk), (5) Univeristy of Oxford, Earth Sciences, Oxford, United Kingdom (barry.parsons@earth.ox.ac.uk)

The Mw 7.8 Kaikoura Earthquake of 14th November 2016 was characterised by a surprising degree of spatial complexity in the surface displacement field in the Marlborough region, South Island, New Zealand. This complexity includes movement on up to 12 faults, besides a high degree of variability in apparent slip along strike of individual faults over relatively short distances. This pattern of surface rupture perhaps suggests that non-elastic processes are playing a significant role in controlling displacement.

The location and tectonic setting of the coastal Marlborough region is useful as it displays active deformation of a convergent margin on land (with consequent good access and visibility). The Marlborough Fault Zone (MFZ) is located at the transition from subduction along the Hikurangi Interface to the north, to a transpressional transform (Alpine Fault) to the south. It represents an accretionary wedge, subject to shape adjustments that balance the tendency to thicken by compressive thrusting with topographic reduction caused by gravitational loading, as a function of the frictional properties of the faults involved. The various mountain ranges of the Marlborough region have been constructed by thrusting on a series of sub-parallel thrust faults, that have subsequently evolved to accommodate strike-slip motion. While active uplift of the Papatea Block by up to 8m occurred during this event, it is perhaps surprising that this was accommodated by oblique normal slip on parts of the fault system, effectively producing a large scale translational pop-up structure. Geomorphic evidence implies similar motion has also been sustained in past earthquakes. Slip rate estimates for other MFZ locations show temporal complexity with significant variations over multiple earthquake cycles. The relationship between the contemporary Kaikoura event and the record of Late Pleistocene to Holocene MFZ earthquakes will be explored, and the tsunami hazard posed by similar structures in accretionary wedges located underwater considered.