



The Transpressive Mt Fyffe and Seaward Segments of the Hope Fault, Marlborough Fault System, New Zealand

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In this onshore to offshore study we focus on the northeastern sections of the high slip-rate Hope Fault (19-28mm/year), a major element of the NZ plate boundary zone. By combining marine EM2040 multi-beam bathymetry data and seismic reflection profiles, with onshore high-resolution LiDAR and tectonic geomorphology field mapping we provide new insights into the location, structural style, segmentation, and slip-rate variations along the Mt Fyffe and Seaward sections of the Hope Fault in NE South Island.

Onshore the predominantly dextral shear, high slip-rate (23 ± 4 mm/year) Conway segment of the Hope Fault inland and SW of Mt Fyffe, abruptly transitions to a wide, complex transpressive deformation zone along the Mt Fyffe range front. Shallow-level fault slip partitions into strike-slip, thrust and normal splays. Prominent thrust “flaps”, driven by the topographic loading of the overriding Mt Fyffe block, have propagated and widened the fault zone by up to ~ 1 km into the SE footwall block, deforming alluvial fans and unstable slopes, with several of these thrusts accommodating minor slip (< 0.5 m) during the 2016 M7.8 Kaikōura Earthquake. The distributed deformation here is also associated with the partial slip-siphoning of dextral shear onto the north-trending Jordan Thrust Fault (JTF). Surface fault traces of the partially over-ridden, Hope Fault “re-appear” NE of the JTF intersection, as braided dextral-slip strands broadly arranged in a left-stepping en-echelon pattern approaching the coast, but with substantially reduced slip rates (< 5 mm/year).

Onshore, on the north Kaikōura Plain, an E-W trending subsidiary splay off the Hope Fault projects offshore to possibly link with the Kaikōura Fault, forming a right step-over/bend with the formation of an associated mid-outer shelf basin. The main Seaward section of the Hope Fault extends to the NE across the shelf as a series of splays linking to the Te Rapa section 30 km east of Kekerengu. Here the structural style of deformation is also transpressive with multiple (> 10) dextral-slip fault splays associated with folding and uplift. The length of the combined Seaward-Te Rapa sections NE of the Jordan Thrust Fault reaches 80 km, with total left step-over width of 10-15 km. On-going analysis of dextral offsets captured in the high resolution (2 metre DEM) EM2040 multi-beam data will lead to improved assessments of slip-rates.

The onshore to offshore transpressive Marlborough Fault System is one of the best examples globally of plate boundary slip-transfer and routing through a network of strike-slip and crustal-scale contractional relays above a subduction zone interface. Our combined field mapping and marine survey data, along with new insights provided by the 2016 M7.8 Kaikōura Earthquake, are providing important constraints on the transpressive structural styles of deformation and how plate convergence is accommodated by contraction and slip-transfer in the obliquely collisional southern Hikurangi Margin.