THE LAST 2 M.Y. OF WEDGE CONSTRUCTION IN THE HIKURANGI MARGIN: INSIGHTS FROM STRUCTURAL MODELLING

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Reprocessed, depth-converted and geologically interpreted seismic lines across the central Hikurangi margin (latitudes 40°-41°.5 S) provide a clear image of the offshore accretionary prism above the subducting Pacific plate. Turbidite units deposited in the last 2 M.Y. over older clastic and pelagic sequences of the Hikurangi plateau have been rapidly accreted to the margin by imbrication along E-verging thrust faults that propagated up-section from the low-angle interplate thrust. Growth stratigraphy of piggy-back basins and thrusting of progressively younger horizons trace the eastward advancement of the outermost thrust front for a distance of c. 60 km over 2 M.Y. Moderate shortening within fault-bounded panels reflects fast creation and abandonment of thrust faults; however, early formed faults have also undergone out-of-sequence reactivation, attributable to maintenance of the critical wedge taper.

Structural reconstructions show progression of shortening involving: (1) initial development of c. 10 km wide “proto-thrust” zones, comprising conjugate sets of moderately to steeply dipping low-displacement reverse faults; (2) localisation of dominant thrust faults that exploit the early proto-thrust fabric and propagate up-section by progressive break-through of folds localized above the fault tips, with the youngest, unbreached folds deforming the present-day seabed. Progressive retro-deformation of sedimentary packages bounded by marker horizons interpreted as 0.01, 0.6, 1 and 2 M.Y. in age shows a scenario with deformation rates higher than sedimentation rates, resulting in a continuous re-adjustment of the “seabed” morphology imposed by folding and thrusting, isolation of satellite basins perched above surface-breaching faults, and strong control on thickness and bathymetric depth of syntectonic units.

This structural evolution provides the basis for forward numerical modelling of the accretionary wedge, aimed at constraining the mechanical parameters that control the wedge taper and interplate slip, progression of wedge shortening in relation to interplate convergence, and along-margin changes in the observed geometry of the accreted units.