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3D geometry of outcrop-scale normal faults from Taranaki, New Zealand

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Fault surfaces and fault zones have been shown to have complex geometries comprising a range of morphologies including, segmentation, tip-line splays and slip-surface corrugations (e.g., Childs et al., 2009*). The three-dimensional (3D) geometries of faults (and fault zones) is difficult to determine from outcrop data which are typically 2D and limited in size. In this poster we examine the small-scale geometries of faults from normal faults cropping out in well bedded parts of the Mount Messenger and Mahakatino formations in Taranaki, New Zealand. We present two main datasets; i) measurements and maps of 2D vertical and horizontal sections for in excess of 200 faults and, ii) 3D fault model of a small-fault (vertical displacement ~1 cm) produced by serial fault-perpendicular sections of a block 10x10x13 cm. The sectioned block contains a single fault that offsets sand and silt layers, and comprises two main dilational bends; in the 3D model we map displacement, bedding and fault geometry for the sectioned fault zone. Faults in the 2D dataset comprise a range of geometries including, vertical segmentation, bends, splays and fault-surface corrugations. Although we have little information on the local magnitudes and orientations of stresses during faulting, geometric analysis of the fault zones provides information on the relationships between bed characteristics (e.g., thickness, induration and composition) and fault-surface orientations. The available data supports the view that the strike and dip of fault surfaces vary by up to 25° producing undulations or corrugations on fault surfaces over a range of scales from millimetres to metres and in both horizontal and vertical directions. Preliminary analysis of the available data suggests that these corrugations appear to reflect fault refractions due to changing bed lithologies (unexpectedly the steepest sections of faults are in mudstone beds), breaching of relays and development of conjugate fault sets. The relative importance of these factors and their importance for fault geometry will be explored further in the poster.

*Childs, C., Walsh, J.J., Manzocchi, T., Bonson, C., Nicol A., Schöpfer, M.P.J. 2009. A geometric model of fault zone and fault rock thickness variations. Journal of Structural Geology 31, 117-127.