'Andersonian' wrench faulting in a regional stress field: the 2010 M_w7.1 Darfield (Canterbury, New Zealand) earthquake sequence

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Abstract - The M_w7.1 Darfield earthquake sequence occurred west of Christchurch in the South Island of New Zealand. It gave rise to right-lateral strike-slip of up to 5 m along the segmented rupture trace of a subvertical fault trending 085° across the Canterbury Plains for ~30 km. While this agrees with long period focal mechanisms for the mainshock, near-field data suggest a composite mainshock initiating with a reverse-slip rupture north of the strike-slip surface trace. Seismological, geodetic and geological stress determinations for the central South Island suggest that maximum compressive stress σ_1 is horizontal and oriented 115±5°. The principal dextral rupture therefore lies at ~30° to inferred regional σ_1, the classic 'Andersonian' orientation for a low-displacement wrench fault. An aftershock lineament trending c. 145° possibly represents a conjugate left-lateral strike-slip structure that may intersect the principal rupture. The inferred stress field is also consistent with predominantly reverse-slip reactivation of structures trending NNE-NE along the Southern Alps range-front. The main strike-slip fault appears to have low finite displacement and may represent either a fault that is fairly new-formed in the regional stress field, or an existing subvertical fault that is optimally oriented for frictional reactivation.