'Andersonian' wrench faulting in a regional stress field during the 2010-2011 Canterbury, New Zealand, earthquake sequence

R.H. SIBSON[1], F. C. GHISETTI[2] & R.A. CROOKBAIN[3]

[1]*Department of Geology, University of Otago*
P.O. Box 56, Dunedin 9054, New Zealand
(e-mail: rick.sibson@otago.ac.nz)

[2]*TERRAGEOLOGICA, 129 Takamatua Bay Rd.,*
RD1, Akaroa 7581, New Zealand
(e-mail: francesca.ghisetti@terrageologica.com)

[3]*OMV New Zealand Ltd., P.O. Box 2621*
Wellington 6140, New Zealand
(e-mail: robert.crookbain@omv.com)

Abstract – The initial M_w7.1 Darfield earthquake sequence was centred west of Christchurch City in the South Island of New Zealand but aftershocks, including a highly destructive M_w6.3 event, eventually extended eastward across the city to the coast. The main shock gave rise to right-lateral strike-slip of up to 5 m along the segmented rupture trace of a subvertical fault trending 085±5° across the Canterbury Plains for ~30 km, in agreement with teleseismic focal mechanisms. Near-field data suggest, however, that the mainshock was composite, initiating with reverse-slip north of the surface rupture. Stress determinations for the central South Island show maximum compressive stress σ_1 to be horizontal and oriented 115±5°. The principal dextral rupture therefore lies at ~30° to 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. This stress field is also consistent with predominantly reverse-slip reactivation of NNE-NE faults along the Southern Alps range-front. The main strike-slip fault appears to have a low cumulative displacement and may represent either a fairly new-formed fault in the regional stress field, or an existing subvertical fault that happens to be optimally oriented for frictional reactivation.
