Temporal stress changes associated with the 2008 May 29 Mw6 earthquake doublet in the western South Iceland Seismic Zone

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On 2008 May 29, two magnitude MW ∼ 6 earthquakes occurred on two adjacent N-S faults in the western South Iceland Seismic Zone. The first main shock was followed approximately 3 s later by the rupture on a parallel fault, about 5 km to the west. An intense aftershock sequence was mostly confined to the western fault and an E-W aligned zone, extending west of the main shock region into the Reykjanes oblique rift. In this study, a total of 325 well-constrained focal mechanisms were obtained using data from the permanent Icelandic SIL seismic network and a temporary network promptly installed in the source region following the main shocks, which allowed a high-resolution stress inversion in short time intervals during the aftershock period. More than 800 additional focal mechanisms for the time period 2001–2009, obtained from the permanent SIL network, were analysed to study stress changes associated with the main shocks. Results reveal a coseismic counter-clockwise rotation of the maximum horizontal stress of 11 ± 10° (95 per cent confidence level) in the main rupture region. From previous fault models obtained by inversion of geodetic data, we estimate a stress drop of about half of the background shear stress on the western fault. With a stress drop of 8–10 MPa, the pre-event shear stress is estimated to 16–20 MPa. The apparent weakness of the western fault may be caused by fault properties, pore fluid pressure and the vicinity of the fault to the western rift zone, but may also be due to the dynamic stress increase on the western fault by the rupture on the eastern fault. Further, a coseismic change of the stress regime—from normal faulting to strike-slip faulting—was observed at the northern end of the western fault. This change could be caused by stress heterogeneities, but may also be due to a southward shift in the location of the aftershocks as compared to prior events.