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Average regional crustal stress regimes revealed by mass inversion of earthquake mechanisms with various magnitudes: the South Iceland Seismic Zone

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Using Angelier's method (Geophys. Journ. Int. 150, 2002, 588-60), we carried out mass inversion of focal mechanisms of earthquakes from 1991 to 2005 along the South Iceland Seismic Zone, within a quadrangle about 37 km wide and 65 km long, with 33,878 earthquakes illuminating a crust volume of about 40,000 cubic kilometres. To identify in the first approximation the seismotectonic stress regimes that best account for the whole set of data, we neglected local variations and stress perturbations in space and time.

Regardless of magnitude selection, the inversion reveals extremely consistent orientations, for both a primary regime with NE-SW compression and NW-SE extension (about three-fourths of the data), and a secondary regime with NW-SE compression and NE-SW extension. The earthquakes of the two subsets are intricate in space and time, suggesting that the secondary regime, which shows larger dispersion and slightly lower magnitudes as compared with the primary regime, mainly results from the effects of elastic rebound, stress drop and fluid migration. These determinations are compatible with the overall distribution of seismotectonic stress in and around Iceland (Earth Planet. Sci. Lett. 219, 2004, 271-284).

Knowing that the data acquisition and our inversion technique are independent, our analysis demonstrates that small magnitude (near zero) earthquakes recorded by the Icelandic seismic network are significant and reliable in terms of focal mechanisms.

Our analysis also reveals high levels of consistency between the seismotectonic stress

pattern and the transform kinematics of the South Iceland Seismic Zone. Simple shear probably prevails within a 20 km wide corridor in the underlying viscous layer, whereas block faulting dominates at the surface, consistent with a simple structural evolution model.