Aftershock Activity as a Tool to Monitor Dynamic and Kinematic Features Around Ruptured Fault Segments

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Abstract

We investigate the spatial variation of stress field along the fault rupture zone of the 1999 Izmit earthquake (Mw=7.4) using the first motion polarity data at 7 distinct aftershock clusters. The first motion polarities of all the aftershocks in a cluster are simultaneously inverted to determine the stress tensor parameters and fault plane solutions of individual events using the method of Horiuchi et al. (1995). The results show that where post-seismic slip was significant (e.g. Sapanca, Sakarya-Akyazı, and Karadere segments) we obtain stress tensor with fault parallel or fault normal maximum (σ_1) and minimum (σ_3) principal compressive stress axes implying either low frictional coefficient or fault weakness. A stress tensor with similar features was derived from the Çınarcık cluster where the aftershocks lie in a low velocity zone of a geothermal area. The maximum principal stress axis tends to remain parallel to the trend of the pre-mainshock σ_1 around the Yalova segment that experienced little to no co-seismic displacements. The stress tensor around the Gölcük segment where maximum of 5.5 m surface displacements were observed is 20^o-25^o degree counter clockwise rotated but the aftershock alignment remains fault parallel that we tie up with strong crust. On the other hand, both the aftershock alignment and the stress tensor are rotated in the Izmit epicentral region despite the lower co-seismic displacements – a feature that we attribute to crustal weakness.