Analysis of Izmit aftershocks 25 days before the November 12th 1999 Düzce earthquake, Turkey

Ethem Görgün (1), Arno Zang (2), Marco Bohnhoff (2), Claus Milkereit (2), and Georg Dresen (2)

(1) Bogazici University, Kandilli Observatory and Earthquake Research Institute, National Earthquake Monitoring Center, Istanbul, Turkey, (2) German Research Centre for Geosciences, GFZ Potsdam, Germany

We investigate spatial clustering of 2414 aftershocks along the Izmit Mw = 7.4 August 17, 1999 earthquake rupture zone. 25 days prior to the Düzce earthquake Mw = 7.2 (November 12, 1999), we analyze two spatial clusters, namely Sakarya (SC) and Karadere-Düzce (KDC). We determine the earthquake frequency-magnitude distribution (b-value) for both clusters. We find two high b-value zones in SC and one high b-value zone in KDC which are in agreement with large coseismic surface displacements along the Izmit rupture. The b-values are significantly lower at the eastern end of the Izmit rupture where the Düzce mainshock occurred. These low b-values at depth are correlated with low postseismic slip rate and positive Coloumb stress change along KDC. Since low b-values are hypothesized with high stress levels, we propose that at the depth of the Düzce hypocenter (12.5 km), earthquakes are triggered at higher stresses compared to shallower crustal earthquake. The decrease in b-value from the Karadere segment towards the Düzce Basin supports this low b-value high stress hypothesis at the eastern end of the Izmit rupture. Consequently, we detect three asperity regions which are correlated with high b-value zones along the Izmit rupture. According to aftershock distribution the half of the Düzce fault segment was active before the 12 November 1999 Düzce mainshock. This part is correlated with low b-values which mean high stress concentration in the Düzce Basin. This high density aftershock activity presumably helped to trigger the Düzce event (Mw = 7.2) after the Izmit Mw 7.4 mainshock.