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# Slip rate of the Düzce segment of the North Anatolian Fault Zone from offsets of geomorphic markers

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The prominent geomorphic signature of strike slip faulting along the active transform margin of Northern Anatolia, is one of the main direct consequences of the relevant and long-lasting (Late Miocene-Early Pliocene to present) ongoing strain (20-30 mm/yr by means of GPS data). Despite its large extent and continuity, the North Anatolian Fault offers only a few study areas where the cumulative offset and the geological slip-rate have been documented and calculated.

Several repeated surface-rupturing earthquakes along the North Anatolian Fault are known to contribute to the build up of its long-term geomorphic signature. One of these earthquakes, that occurred on November 12, 1999 along the Düzce fault segment, produced surface ruptures along a 40 km-long mountain front, characterized by clear evidence of its long-term tectonic history. This makes the Düzce fault a natural laboratory where we studied also long-term landforms (Late Holocene to Late Pleistocene) that are the result of cumulative fault-related deformation.

Particular attention was devoted to the study of the continental Holocene and Pleistocene deposits, with the aim to reconstruct the Quaternary deformational history of the Düzce fault. For this purpose, we investigated the setting of depositional and tectonic landforms along with the long-term structures that have resulted from cumulative fault-related deformations. We carried out a detailed tracing and measurement of the 1999 coseismic ruptures, coupled with geological and geomorphological mapping at a 1:25,000 scale. Geomorphological observations were made on 1:18,000 and 1:35,000 scale aerial photographs, 20-m-resolution Digital Elevation Model and standard morphometric derivatives (hill-shaded and slope angle maps), as well as during the field

survey. A clear relation between the repeated activity ($i.e.$, earthquakes) along the fault and the evolution of the landscape was found.

Following the reconnaissance of offset geomorphological markers, we reconstructed right-hand stream deflections of about 100 m and offset of remanents of a be-headed alluvial fan of 300 and 900 m. In order to calculate the long term slip rate of the Düzce fault, we sampled depositional and erosional terraces for $^{14}$C and OSL (Optically Stimulated Luminescence) dating. The preliminary results suggest a constant slip-rate of 14.0$\pm$1.8 mm/yr for the last 60,000 years, in agreement with the estimates carried out by paleoseismological investigation of the Düzce fault (see abstract Pantosti et al., same session).