



Paleoearthquakes of the Düzce segment of the North Anatolian Fault Zone (Turkey)

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The November 12, 1999, Mw 7.1 earthquake, on the Düzce segment of the North Anatolian Fault Zone (NAFZ), produced surface ruptures ca. 40 km long with up to 5 m right-lateral offset (3 m average) and up to 2.5 m vertical throws. The Düzce fault has an average E-W trend and a clear geomorphic expression. It is the northern of the two main NAFZ strands W of the Bolu basin and, GPS measurements suggest that it accommodates ca. 10 mmy/yr of the total NAFZ slip rate (20-30 mm/yr). Although Turkey has one of the richest records of historical seismicity in the Mediterranean, there is no clear evidence for associating historical earthquakes with the Düzce fault segment. The only historical earthquakes that are known to be close enough to the Düzce fault to be potentially associated to its rupture are those of AD1719, commonly attributed to the Karadere fault, and AD1878, which possibly occurred along the Hendek fault. In the frame of the E.C. RELIEF project, to learn about recurrence of large earthquakes on the Düzce fault, we undertook paleoseismological trench investigations. We excavated a total of 10 trenches at 5 different locations along the fault. On the basis of sedimentary and structural relations observed in the trench walls, we found evidence for repeated surface faulting paleoearthquakes pre-dating the 1999 event. Dating was based both on radiocarbon and ^{210}Pb analyses. Although the obtained age ranges of paleoearthquakes are quite broad, by merging the information obtained from all the trenches it is possible to reconstruct the seismic history of the Düzce fault for the past 800 yr. We correlate events between different trenches on the basis of their stratigraphic position and their age under the assumption that, similarly

to the 1999 event, paleoearthquakes ruptured the whole Düzce fault. Besides the 1999 earthquake (DUZ1), prior surface faulting earthquakes are dated as follows: penultimate event DUZ2, AD1685-1900 (possibly end of 19th century); event DUZ3, AD 1685-1900 (possibly close to AD 1700); event DUZ4, AD 1185-1640; event DUZ5, AD 685-1220. According to the above results, both the AD1719 and AD1878 earthquakes, which are considered to have occurred on different faults, may have ruptured the Düzce fault instead or, alternatively, a cascade of events occurred on the Düzce and nearby faults at that time (as in the case of the Izmit and Düzce 1999 earthquakes). As a first conclusion, on the basis of the recognition of five events since AD 685-1220, we can infer an average recurrence time for large surface faulting events on the Düzce fault, in the range of 200-325 yr. However, the three most recent earthquakes, including 1999, occurred within 300 yr and may be suggestive of clustering. Moreover, assuming that the ca. 3 m average slip produced by the 1999 earthquake is characteristic for this fault, the above recurrence times yield slip rates of the order of 9-15 mm/yr. This is in agreement with the estimates of slip rates obtained from cumulative offsets and dating of Late Pleistocene-Holocene geomorphic features (12-16 mm/yr - see abstract by Pucci et al. this session) as well as with GPS estimates.