Characteristic Slip on the Gerede Segment During Four Historical Earthquakes, North Anatolian Fault System

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We excavated three dimensional trenches to simultaneously reveal timing and offsets of paleo-earthquakes at Demir Tepe site, 12 km east of Gerede on the 1944 Bolu-Gerede earthquake ruptures of the North Anatolian fault system.

At this site, right-stepping fault traces form a linear depression and fault scarplet on the fan surface. Fault-crossing trenches excavated into the depression and fan surface show evidence of four paleo-earthquakes. The most recent event identified in the soil A horizon is correlated to the 1944 event. The penultimate event occurred after AD1452 based on radiocarbon dates and it corresponds to the great 1668 earthquake. The two events prior to the 1668 event possibly occurred in 13 to 15 century and AD1035, considering historic records and results from trenching study at Ardicli site.

According to our slip measurement, the 1944 event accompanied offset of 4.0-5.0 m, estimated by an offset line of trees at the site. Two shallow gullies incising the alluvial fan surface exhibit cumulative offsets of 9.2+-1.3 m and 9.7+-1.2 m. The 1668 event horizon lies above the channel deposits of the gullies. Furthermore, distinctive older buried channels exposed in fault-parallel trenches provide cumulative offsets of 14.5+-0.8 m and 19.3+-0.3 m. Based on the offset measurement and dating of these channels, we can resolve four discrete offsets; 4.0-5.0 m (AD1944), 4.8+-1.5 m (AD1668), 5.3+-2.3 m (13-15c) and 4.7+-0.9 m (AD1035).

These data suggest that the similar amount of slips repeated during the recent four events at the site. Along the central portion of the 1944 ruptures including the Demir Tepe site, cumulative offsets exhibit the double to quadruple multiple offsets of 1944. This implies that the similar slip distribution along the North Anatolian fault system has been repeated through the four most recent earthquake cycles.