

Slip History of the 1944 Rupture Segment on North Anatolia Fault Near Gerede, Turkey: Constraints on Earthquake Recurrence

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Completeness of historic earthquake catalogs must be examined by geologic records, though the geologic records are not always more complete and precise than historic records. The historic records on large earthquakes from the North Anatolian fault are tested in trenches on the segment that ruptured in 1944. Previous results indicated 3 historic and 1 geologic events in past 1000 years with characteristic ~5 m slip and quasi-periodic recurrence every 200-280 years. The one geologic event without historic information is critical to know the recurrence behavior of the fault and catalog evaluation. In 2009, we excavated seven new trenches at the Ardicli paleoseismic site, located about 15 km east of Gerede, to resolve displacement on a Byzantine-aged channel and the times of the offsets. The channel appears to have been excavated to drain the site and allow mining of clay to make bricks and tiles: a kiln is adjacent to the channel. The V-shaped channel thalweg is offset 13.5+1.5 m, and based on many cross-fault trenches, represents slip in the past three surface ruptures. Dating of pine cones, wood, and charcoal in the channel deposits and in the stratified sediments outside the channel suggest that this channel was cut in the 11th-13th century AD. The surface rupture that initially offset the channel postdates the historically-reported earthquake in 1035 AD and predates the one in 1668. The surface geomorphology records displacement from two more recent events. The 1944 surface rupture in this region produced 4-5 m of slip based on offset field boundaries and small channels. Older fluvial channels and rills in this area show about 10 m of displacement. We dated the fill from a 10 m-offset channel, and place the penultimate event as younger than about 1650 AD, which must correspond to the well-documented earthquake in 1668. From our previously reported work, we resolved 22-26 m of displacement for the past five surface ruptures on a 6th-century channel. Together, these data argue for fairly characteristic slip for the past five earthquakes. The interval between events ranges from around two centuries to three to four centuries, and there is no apparent correspondence between elapsed time and the amount of ensuing displacement.

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