A 3000 year chronology of North Anatolian Fault ruptures, utilizing magnetic susceptibility trench logging, near Lake Ladik, Turkey.

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The North Anatolian Fault (NAF) is a dextral strike-slip plate-boundary fault zone extending ~1400 km in an arc across northern Turkey. A trench was opened ~2.7 km NW of Destek village on a segment which ruptured (for ~280 km) in the 1943 Tosya Earthquake (M_w:7.7). Sediments exposed in the trench yielded information on the timing of at least 5 paleoearthquake events during the last 3000 years in addition to the 1943 event.

The trench was excavated across an uphill-facing fault scarp caused by an oblique splay of the NAF near a localized compressive bend. The uphill-facing scarp trapped sediment derived from a small (~2 ha), non-channelised catchment with erosion in the steeper upper half and deposition in the lower half. Conventional descriptive trench logging identified a sequence of colluviums and poorly defined paleosols on the down-thrown, northern side of the fault. On the up-thrown side of the fault, localized residual soil graded with depth to weathered rock of various lithologies. Conventional trench logs alone do not negate the possibility that the observed stratigraphy is formed due to climate cycles or anthropogenic processes, rather than earthquakes.

Magnetic susceptibility (MS) measurements provide a link between the sequence stratigraphy and fault rupture. Two-dimensional logging of magnetic susceptibility, using a MS2E Bartington point sensor, was undertaken on the west wall of the trench. The residual soil on the up-thrown side of the fault displayed low MS values overlying rock with relatively high MS values which we interpret as the result of leaching by supergene processes. Wedges of low MS values were identified on the down-thrown side of the fault in a soil of otherwise intermediate MS values representing colluvium sourced from the catchment. The wedges are interpreted to be colluvium derived from the residual soil on the up-thrown block. The presence of the MS wedges helps to define a sequence genesis model whereby paleosols are buried following earthquakes.

The event chronology was established by radiocarbon dating of charcoal samples. The reliability of the samples was determined by comparing the age of the intact original organic material with the age of the combined degraded original organic material and contaminants. Sample ages were used to (tentatively) constrain the timing of 5 probable earthquake events at 1430–1800 AD, 1010–1310 AD, 390 BC–50 AD, 770–370 BC, 930–610 BC and 2 possible event windows at 590–680 AD and 10 BC–640 AD (one or two events).

Many minute terrestrial gastropods were encountered in the soil exposed in this trench. Their short life span and fragility makes them an ideal potential chronometer and, therefore, we attempted to use them for radiocarbon dating. However, gastropod shell ages consistently and significantly overestimated the age of the sediments relative to ages obtained on charcoal. It may be possible, with further dating of gastropod specimens, to establish a correction for this type of sample.