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Paleo-earthquake timing on the North Anatolian Fault: Where, when, and how sure are we?

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The North Anatolian Fault (NAF) traces from the Karilova Triple Junction in the east 1400km into the Aegean Sea in the west, forming a northwardly convex arch across northern Turkey. In the 20th century the NAF ruptured in an approximate east to west migrating sequence of large, destructive and deadly earthquakes. This migrating sequence suggests a simple relationship between crustal loading and fault rupture. A primary question remains unclear: Does the NAF always rupture in episodic bursts?
To address this question we have reanalysed selected pre-existing paleoseismic investigations (PIs), from along the NAF, using Bayesian statistical modelling to determine a standardised record of the temporal probability distribution of earthquakes. A wealth of paleoseismic records have accumulated over recent years concerning the NAF although sadly much research remains un-published. A significant output of this study is tabulated results from all of the existing published paleoseismic studies on the NAF with recalibration of the radiocarbon ages using standardized methodology and standardized error reporting by determining the earthquake probability rather than using errors associated with individual bounding dates. We followed the approach outlined in Biasi & Weldon (1994) and in Biasi et al. (2002) to calculate the actual probability density distributions for the timing of paleoseismic events and for the recurrence intervals. Our implementation of these algorithms is reasonably fast and yields PDFs that are comparable to but smoother than those obtained by Markov Chain Monte Carlo type simulations (e.g., OxCal, Bronk-Ramsey, 2007). Additionally we introduce three new earthquake records from PIs we have conducted in spatial gaps in the existing data. By presenting all of this earthquake data we hope to focus further studies and help to define the distribution of earthquake risk.
Because of the long historical record of earthquakes in Turkey, we can begin to address some fundamental questions in the field of paleoseismology. For example; can we use sample ages from PIs situated 100s of kilometres apart, on a historical rupture segment, to more accurately determine the timing of paleo-earthquakes? Because the approach to earthquake age constraint is continuing to evolve, this study highlights the importance of publishing raw data from paleoseismic investigations.

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