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A relict sedimentary record of 7 earthquakes between 600AD and 2000BC on the central North Anatolian Fault at Elmacik, near Osmancik, Turkey.

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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. A primary question remains unclear: does the NAF always rupture in episodic bursts? A significant historical record of earthquakes exists in Turkey, but it is not large enough to address this question. To address this question we (the scientific community) need to compile long earthquake records at as many locations as possible.

One of the largest gaps between existing paleoseismic investigations on the NAF is the central portion of the 1943 AD Tosya earthquake fault rupture. To extend the earthquake record in this area we opened 9 test-pits at prospective sites between the villages of Kargi and Tahtakopru (~45km apart) to find a trench with a long earthquake record. The most successful trench was located at a site called Elmacik, near the village of Karalaguney approximately 20km northeast of Osmacik (UTM 36T 659230 E 4552380 N). Locally the fault comprises a clear and relatively straight singular prominent trace. At the trench site the fault scarp is subtle and rounded forming a side-hill bench at an elevation of ~1140 m on the north facing side of valley wall that extends from approximately 1000 m to 1700 m elevation. Sediments derived from a small (~10 ha) steep (average slope >20°) catchment were deposited in a sediment trap formed by an up-slope facing scarp which is reflected in the geomorphology as a side-hill bench.

The trench stratigraphy comprises a simple pattern of 8 fine over coarse grained packages south of a fault shear zone which is well developed up to the base of the plough zone. North of the shear zone is older, highly deformed and poorly sorted river gravel. We infer that intense ground shaking, associated with earthquake events, provided an abundance of coarser sediments in the steep catchment that were flushed from the catchment following earthquakes. We speculate that the course sediment comes from unravelling of intensely fractured rock outcrops, tree fall (the uplift of the root zone) and slope failure. For age control, we employed a sampling strategy designed to maximise the temporal constraint on the event horizons in a Bayesian statistical model.

Why doesn't our earthquake record extend to the present? The most recent event we identified in our trench occurred around 600AD. There is clear evidence that a recent stream incision has recently migrated through the trench site area. Radiocarbon dating of an offset abandoned stream bed associated with this incision is consistent with the age of the youngest strata revealed in this trench. Therefore the earthquake record is relict as the sediments from the steep slope to the south have been re-routed into a channel.

The non-overlapping probability envelopes provide a record of 7 earthquakes, the youngest recorded events provide ages consistent with other studies on the 1943 Tosya Earthquake rupture, while the older events considerably extend the earthquake record. The recurrence interval is tentatively 190-680 years (incorporating all dating error) which is also consistent with other studies on the 1943 Tosya Earthquake rupture.