Development of paleoseismic trench logging and dating techniques: a case study on the Central North Anatolian Fault.

J. Fraser (1), J. Pigati (2), A. Hubert-Ferrari (1), K. Vanneste(1), X. Boës (1), U. Avsar (1), S. Altinok (3)
(1) Seismology section, Royal Observatory of Belgium, (2) US Geological Survey, Arizona. (3) Osmangazi Üniversitesi, Turkey. (jfraser@oma.be)

The North Anatolian Fault (NAF) is a dextral strike slip fault zone extending ~1400km in an arc across northern Turkey. This study seeks to further constrain the timing of ground rupturing earthquakes of the NAF while developing the techniques used in paleoseismology. A paleoseismic trench was opened ~2.7km NW of Destek on a segment which ruptured (for ~280km) in the 1943 Tosya Earthquake (M_w:7.7). The trench site comprises a pop-up structure formed by a small releasing step-over at a restraining bend which has caused progressive growth of an upslope facing scarp. The trench is situated across the main fault trace and a trapped sedimentary sequence that includes several paleosoils. The stratigraphy is expected to be Late Holocene and historic in age due to the high level of activity on the NAF, although this has yet to be confirmed by radiometric dating. Preliminary interpretation of the trench stratigraphy indicates a record of up to 6 paleoearthquake events, the presence of an angular unconformity suggests the record may be incomplete beyond the 3 most recent events on this strand.

Subtle contrasts in stratigraphy made conventional face logging difficult and was therefore augmented by mapping the magnetic susceptibility (MS) of the west wall. Approximately 6000 measurements were made using a Bartington MS2 Magnetic Susceptibility Meter with a MS2E (point) Sensor with a 5cm vertical spacing and a 20cm horizontal spacing predominantly on one side of the trench. A pilot test led to development of a strategy of moving the sensor to the nearest exposure of coarse sand or finer grained material where possible to minimize the noise generated by individual clasts. To negate the sensitivity of the MS logging method to variations in temperature the survey was conducted at night. Plotted data clearly shows the contact between rock units, the rock-soil interface (reflecting fault juxtaposition), anthropogenic influence and some soil stratigraphy.

Other paleoseismic investigations on this section of the NAF (Hartleb R. et al 2003 and Yoshioka T. et al 2000) have encountered out-of-stratigraphic-order ranges in ^{14}C ages. They attributed this to reworking, in addition to which the effects of long term human occupation are likely to be similar. The trench yielded a large amount of datable material including 158 charcoal and 140 minute gastropod samples, and some ceramic, bone and slag samples. Unlike charcoal and bone fragments, fragile minute gastropods are unlikely to have been transported, reworked or used by humans, ultimately providing improved accuracy of temporal constraints on paleoearthquakes. Using both charcoal and gastropod samples, the trench chronology can be established and the use of minute gastropods for dating paleoearthquakes can be critiqued.