Geophysical Research Abstracts, Vol. 9, 07940, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07940

Paleoseismologic investigation of two well-documented historical large earthquakes in the Upper Thracian Depression, southern Bulgaria

K. Verbeeck (1), A. Radulov (2), K. Vanneste (1), M. Yaneva (2), T. Petermans (1), T. Camelbeeck (1) and S. Shanov (2)

(1) Royal Observatory of Belgium (2) Geological Institute, Bulgarian Academy of Sciences (koen.verbeeck@oma.be / Fax: +32 2 3730339 / Phone: +32 2 8909854)

The Upper Thracian Depression in southern Bulgaria was struck by two large earthquakes in 1928, one on each border fault of this E-W striking graben system. On 14 April the northern Chirpan fault ruptured in a M = 6.8 (I_0 = IX MSK) earthquake with epicenter and maximal destruction near Chirpan. Only four days later, on 18 April 1928, the southern Popovitsa fault ruptured causing a larger (M = 7.1 and I_0 = IX to X MSK) earthquake with epicenter near the village of Popovitsa, 20 km WSW of the first epicenter. Repeated levellings by the National Cartographic Institute of Bulgaria before 1927 and after 1929 precisely quantified the permanent coseismic displacements caused by these earthquakes. We combined a review of the contemporary literature with geomorphology, geophysical prospecting (electrical tomography) and hand augering to re-identify and map the rupture traces. The northern Chirpan fault can be subdivided in three main normal fault segments that may all have ruptured during the earthquake. On the 12.5-km-long central segment between Orizovo and Chirpan we analyzed two paleoseismic trenches and one excavation along a highway construction. We found evidence for 4 surface-rupturing earthquakes since 8900 cal years B.P. with offsets between 0.45 and 0.7 m in one trench, and we correlated the most recent events between the 3 observation points. Dating of the events was mostly based on archeological dating of pottery fragments, and on correlation of palynological profiles from the trenches with a pollen profile in an alluvial-paleosoil sequence in a nearby quarry that was well calibrated by radiocarbon dating. For this fault segment we obtained a Holocene slip rate of 0.22 ± 0.12 mm/yr and an average recurrence interval of 2350 $\pm$ 643 years for earthquakes comparable to or larger than the 14 April 1928 event.

The April 18, 1928, M_S 7.1, Popovitsa earthquake generated, according to the literature, a 53-km-long system of discontinuous breaks, trending 120-160° E, with throws up to 1.5 m, and in one place even up to 3.5 m, down to the north. Although the offset was larger for this event than for the one on the Chirpan fault, the fault scarp was more difficult to find because of severe human landscape modification. We suspect that not all of the 53-km-long rupture system described in the contemporary literature are real earthquake ruptures because some river bank collapses have been mapped as fault ruptures. Until now we mapped about 18 km of the rupture in detail. We investigated a trench just west of Popovitsa to study the faulting history of this fault. A clear set of faults was exposed and we identified 3 faulting events on the trench walls and two more based on hand-auger holes. We dated 4 radiocarbon samples that provide age information on the 3 most recent events and are still waiting for the results of OSL dating that can help to date the three oldest events in the trench. The most recent event is correlated with the April 18, M_S 7.1, 1928 event as the contemporary descriptions match this displacement, and a picture of the same site taken 11 years after the earthquake shows the rupture trace with a comparable amount of displacement. The return interval for the 3 most recent events is larger than 2404 yr and the slip rate is smaller than 0.61 mm/yr. The OSL datings will allow us to constrain the age of events 3, 4 and 5 and can considerably improve the estimates of recurrence interval and average slip rate. The large-distance offsets of the different events are relatively comparable, which could indicate that all events had more or less the same magnitude (M_S 7.1) as the April 18, 1928 event. This should be confirmed in future trenches.

The timing of the different paleo-eearthquakes on the Chirpan and Popovitsa faults does not seem to correspond, which may indicate that their rupturing is not always clustered.