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Data for Holocene activity of Chirpan fault (South Bulgaria) from Cherna gora paleoseismological trench

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The Chirpan fault is a normal fault striking E-W and dipping to the south in northern periphery of the Thrace Depression. During the Chirpan Earthquake on April, 14, 1928 (M=6.8), a rupture appeared on the surface. Г. Бончев & П. Бакалов (1928) had reported a rupture between the villages of Cherna Gora and Trakija of total length 37 km and a length between the ends 36.6 km. С. Бончев (1931) had described a rupture between the town of Belozem and the village of Samuilovo of total length 40 km and a length between the ends 20 km. The ruptures in both papers coincide only partially. A subsidence 0.30-0.40 m south from the fault has been pointed out, which is in agreement with coseismic elevation offset estimated by the topographical leveling surveys carried out before and after the earthquake (Янков, 1945).

Specifying the paleoseismity of the Chirpan fault necessitated this study. We traced the fault scarp by geomorphological analysis on the area using aerial photographs in 1:18 000 scale, digital elevation model in 1:5 000 scale, and field observations. The fault scarp is most expressive in 12 km long section between Cherna Gora and north from Chipan that is the same as overlapped section in reported ruptures after the earthquake. Detailed topographic profiles, electrotomographical profiles, vertical electrical soundings and boreholes realized in seven sites across the fault scarp provide information for the geological settings in each site and confirm the Quaternary activity of the fault. Different genetic types of Quaternary deposits have been displaced along the fault plane. We chose to find out the fault activity records in a trench 1 km north from Cherna Gora and 2.8 km west from Omurovo River. The clear geomorphic expression of the fault scarp and the presence of fault-like structures visible in the geophysical profiles, that intersect Quaternary alluvial sediments, were the main criteria for site selection.

The trench is 54 m long, 4 m wide and 4 m deep and is perpendicular to the fault strike, which is 80º in this section. The trench walls expose alluvial sand of Ahmatovo Formation (Коюмджиева & Драгоманов, 1979) in footwall and Late Pleistocene and Holocene alluvial silt in hanging wall. Recent soil covers all alluvial sediments. The similar to present geomorphic settings in the region in Pleistocene assume that the Omurovo River deposited the sandy beds in footwall during Pleistocene. Units Y, X, V and U in the log of the trench walls are beds of Ahmatovo Formation that are less affected by later soil processes (see figure). Unit Z is a paleosol formed in a sandy bed during very arid climate and is a Bt horizon in the profile of recent soil. Back erosion has affected the top of unit Z. Hanging wall consists of silty sediments deposited by temporary floodings of Omurovo River. These sediments have been modified by soil formation after each flooding. Units next to the fault in hanging wall also contain deposits of colluvial origin derived from the scarp. The sedimentological analysis and the age of samples A03 and B03 state that unit F has been developed during the Last Glacial. Pollen content of units A, B, C1, C2, D, E1 and E2 is typical for postglacial time. Agricultural plants appear in the base of unit E1 and mark the beginning of human influence. The first human settlement in the region was established 5 Ka BC. We found the pottery of

the same age in the trench – sample K03. In accordance with archeological knowledge, information for earlier human presence does not exist.

The movement of 1928 event was along fault F1. The displacement measured on the fault is 0.30 m and the offset of the top of unit B and its analogue in footwall unit C1b is 0.45 m. Unit Ac is a preserved from human modification colluvial wedge derived from the fault scarp of 1928 event. We found evidence for a penultimate event in displacment of units C1, C2, D and E1 along the fault F2. Unit C1c is a colluvial wedge related to that event. The offset of top of unit C1 along the fault F2 is 0.25–0.30 m and measured on long distance is 0.45–0.50 m. Event 2 was before deposition of unit B and after deposition of unit C1. The colluvial wedge Dc1 and covering colluvial wedges Dc2 and Dc3 are records of event 3. The faulting affected units D, but not unit C2. Movement was along fault F1. Top of unit Z was a surface in the time of event 3 and had been eroded after the earthquake. The event horizon in hanging wall lies in upper part of unit D. The thickness of colluviall wedges Dc1 and Dc2 is 0.50–0.60 m. The estimated offset of unit D and non eroded top of unit Z is also 0.50–0.60 m. The event was before deposition of unit C2 and after first human settlement – 7 Ka BP. The colluvial wedges Ec1 and Ec2 are evedences for event 4. The thickness of unit Ec1 is 0.50-0.70 m. The colluviall wedge contains sediments from unit E1, unit F, unit W and very old calcareous concretions (sample B10). Event 4 was before 7 Ka and after the Late Glacial. We consider the thickness of the colluviall wedges as the minimum vertical displacement of events that they correspond to.

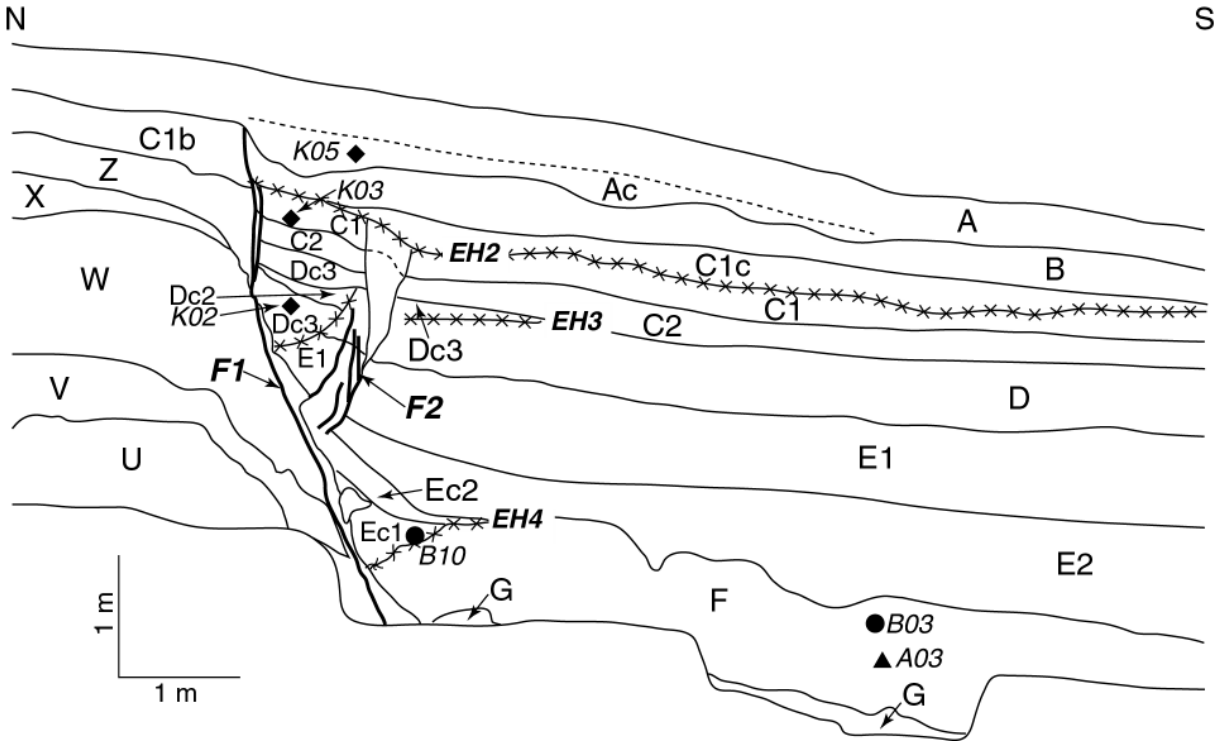

Figure. Fault zone in east wall of Cherna Gora trench. Sedimentary units: A – A horizon of recent soil, B – Bt horizon of recent soil, C1 – sandy-clayey silt, C1c – colluvial wedge, C1b – units C1 and B in footwall, C2 – calcareous clayey-sandy silt, D – clayey silt, Dc1 – unsorted debris facies colluvial wedge, Dc2 and Dc3 – sorted debris facies colluvial wedge, E1 – sandy-clayey silt with sparse calcareous concretions, E2 – sandy-clayey silt with alined calcareous concretions, Ec1 – unsorted debris facies colluvial wedge, Ec2 – sorted debris facies colluvial wedge, F – calcareous sandy-clayey silt, G – clayey chalk, Z – calcareous sandy-clayey silt, X, W, V and U – sandy and silty beds of Ahmatovo Formation. Faults: F1 and F2. Samples: A03 – radiocarbon age of bulk – 28450±170 Ka BP, B03 – U-Th age of calcareous concretion – 17.9±1.0 Ka BP, B10 – U-Th age of calcareous concretion – 27.9±0.3 Ka BP, K02 – pottery >1.5 Ka BC, K03 – pottery 4.9±0.1 Ka BC, K05 – pottery II–IV centure. Event horizons: EH2, EH3 and EH4.

We have estimated the slip rate from the beginning of human influence recorded in the base of unit E1 on meter 40 on west wall. The Holocene slip rate is 0.33 mm/yr. Using the relationship between the average coseismic displacement and the slip rate (WGNCEP, 1996) the return period for an earthquake with a mean displacement is 1.45±0.25 Ka. Additional data for age of units are necessary for better understanding the seismic history of the Chirpan fault.

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