Paleoseismicity of the South Ihtiman fault from a trench at Polyantsi village – seismic hazard assessment

Палеосеизмичност на Южноихтиманския разлом от канава при с. Полянци – оценка на сеизмичната опасност

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Key words: South Ihtiman fault, seismogenic faults, paleoseimology, seismic hazard assessment, Bulgaria.

The South Ihtiman normal fault associates with expressive tectonic landscape; and subsequently, is considered to be a source of large (M_W ≥5.5) shallow crustal earthquakes, although such an event in the area is not listed in historical and instrumental seismic catalogues. Geological researches are required for understanding its past seismicity – a key for improving earthquake forecast. To characterize this poorly known seismogenic fault, we performed field observation on tectonic landforms, precise topographic profiling along fault scarp, shallow electrical resistivity imaging, and excavated one trench. Our research resulted in a map of fault surface traces and a Holocene reconstruction of surface-rupturing events. Herein, we report paleoseismic data from the trench that contributes to long-term earthquake forecast in the region.

The South Ihtiman fault follows the trend of Cretaceous–Tertiary strike-slip fault segments that belong to the regional Maritsa fault system, nominated in that locality as the Iskar-Yavorniski fault (Boyadjiev, 1971). A recent field study provides evidence that so called Iskar-Yavornishki fault actually consists of two spatially separated fault zones of deferent deformation types (Gerdjikov et al., 2015, this issue). The South Ihtiman fault almost entirely inherits the NW section of Yavornishka sear zone. The younger fault is a mountain bounding normal fault those traces run along the NE Cherni Rid foothill (Fig. 1), and controls Neogene–Quaternary deposition in the Ihtiman basin (Hristov, 1976). The total length of the mapped fault is 18.35±0.95 km. Fault tips are well defined by geomorphic markers for decreased cumulative uplift of Cherni Rid close to Iskar dam in the north-west and at the upper reaches of Suludervenska River in the south-east.

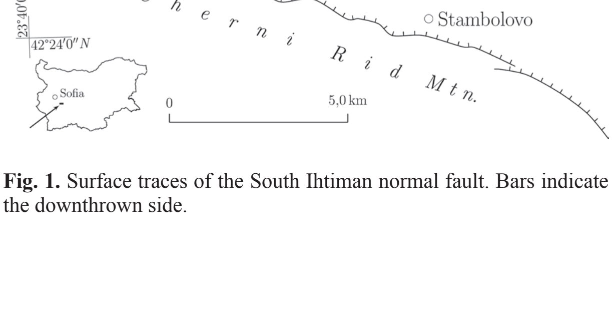

Fig. 1. Surface traces of the South Ihtiman normal fault. Bars indicate the downthrown side.

The paleoseismological trench is excavated in an interfluve southward the Polyansti village, Ihtiman municipality, centered at 42°25'0,908"N and 23°43'59,443"E (Fig. 1) in 2014. The trench is positioned perpendicularly to the local fault strike, which is 270° there. Resistivity images at the site show sharp limit between high resistivity medium (300–4000 Ωm) representative for bedrock in the footwall and low resistivity medium (16–65 Ωm) related to alluvial fan deposit in the hanging wall. The sharp resistivity transition is inclined toward the sedimentary basin down to a depth of 80 m, and is interpreted as a normal fault controlling the Pleistocene–Holocene deposition. Debris flow sediment, colluvium, burred soils, and faulted Upper Cretaceous diorite are observed in the trench (Fig. 2). The dip angle of the master fault (top surface of fault gouge) is 47°. AMS method has been applied for radiocarbon dating of eleven charcoal samples from sedimentary unit sand soils. Ages vary in a range between 42 450±266 a BP and 1233±35 a BP. Fault planes in the unconsolidated units, fault clay, scarp-derived colluvium, fissure-fill colluvial facies, offset of strata, clast rotation, and tensile cracks provide evidence for repeating surface-rupturing earth-

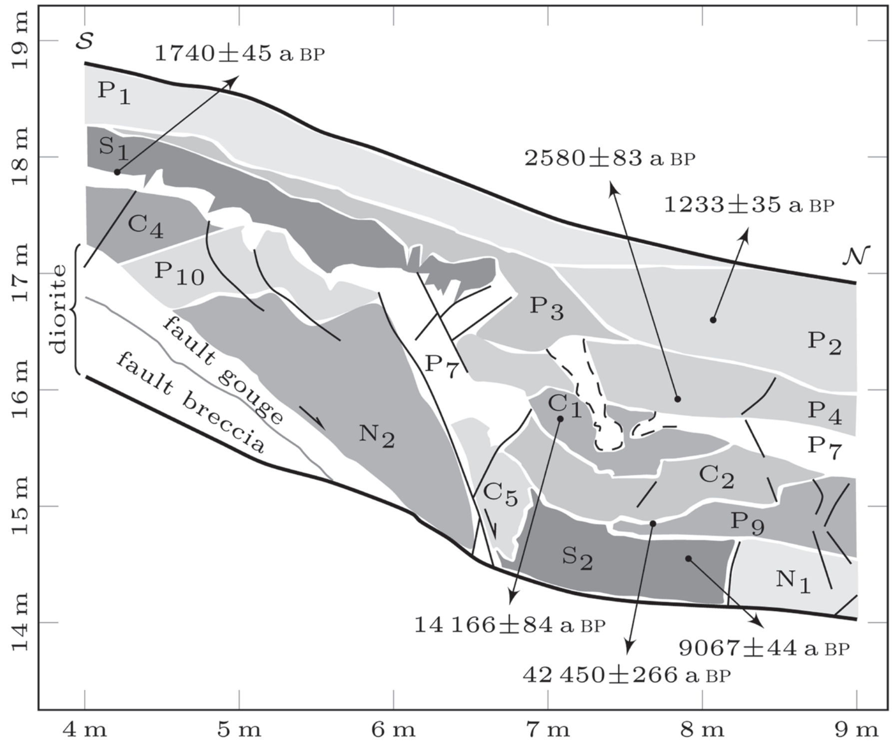

Fig. 2. Simplified log of the fault zone on the western trench wall. Derbies flow units: P_1, P_2, P_3, P_4, P_7 and P_9; burred soil units: S_1 and S_2; colluvial units: C_1, C_2, C_4, C_5; mixed sediment influenced by soil formation: N_1 and N_2. Mean ages and 1σ interval of charcoal samples are reported in calibrated years before present (a BP). Note: x-axis and y-axis are not in the same scale.

Table 1. Past seismicity of the South Ihtiman fault reconstructed in trench Polyantsi

Event	Magnitude	Date
Last	6.6 ± 0.1	1398 – 1274 BP (68.2% probability)
Penultimate	6.6 ± 0.1	3962 – 2549 BP (68.2% probability)
Antepenultimate	?	8428 – 6092 BP (67.8% probability)

quakes at least since the oldest radiocarbon date obtained in the trench. We recognized three earthquakes occurred after the formation of burred soil unit S_2 on Fig. 2. Estimates on dip slips for the last two earthquakes are 1.35±0.05 m for the penultimate event, and 1.44±0.05 m for the last event. Table 1 lists earthquake ages obtained from trench stratigraphy and their moment magnitudes calculated from fault length and displacement per event. Mean fault slip rate for the last two seismic cycles is 0.25–0.54 mm a^{-1} (68.2% probability).

Provided new data characterize the earthquake potential of the South Ihtiman fault. Seismic hazard assessment in the area significantly will be improved if considers these data. For example, knowing the seismic moment rate of the fault and the elapsed time since the last surface-rupturing event, the size of an expected earthquake for a given future time can be assessed.

Acknowledgments: This study was supported by the Natsionalna Elektricheska Kompania EAD.

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