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Non-characteristic recurrence behavior on the 1942 Niksar-Erbaa earthquake rupture along the North Anatolian fault system, Turkey

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Repeatability of surface slip distribution through earthquake cycles is basis to evaluate size and timing of future large earthquakes generated by active faults. In order to examine characteristic slip hypothesis on the North Anatolian fault system (NAFS), we have systematically performed 3D trenching survey on the 1944 Bolu-Gerede and the 1942 Niksar-Erbaa earthquake ruptures, to simultaneously reconstruct timing and slip associated with paleoearthquakes. These two earthquake segments are relatively well-known on historical earthquake records indicating the timing and the rupture extent. The results suggest that 1) the NAFS is highly segmented in several tens km long, 2) past large earthquakes have been produced by the multi-segment faulting, and 3) each fault segment seems to have their own characteristics of recurrence behavior. At Demir Tepe site on the Gerede segment which recorded the maximum slip during the 1944 earthquake (M7.4), we revealed the repetition of ca. 5-m-slips and quasi-periodic repeat time of ca. 330 year. The reconstructed slip history gives us to support characteristic slip behavior on the segment, although the segment had ruptured during the historical earthquakes with greatly varied rupture length for each. On the other hands, at Ayvaz site on the Niksar segment which recorded 2.5-m-slip during the 1942 earthquake (M7.0), the preliminary results of 3D trenching exhibit 6.0-m-slip during the penultimate event, probably corresponding to the 1668 Anatolian earthquake. Since this gigantic M8 earthquake ruptured through almost half of the entire NAFS, including both the 1944 and the 1942 earthquake segments, the 1942 type earthquake is not characteristic earthquake. This non-characteristic behavior implies various sizes of large earthquakes have occurred on the NAFS. The key for understanding multi-segment ruptures may be recognition of such macroscopic barrier segment like the 1942 earthquake segment.