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Using 36Cl fault scarp dating to model Holocene paleoseismic activity in the Büyük Menderes graben, western Turkey

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The roughly 140 km long and 2.5-14 km wide arc-shaped Büyük Menderes graben is one of the main tectonic structures within the seismically active western Turkey, which is formed as a result of approximately N-S extensional regime since the early Miocene. The graben structure is influenced by a fault zone composed of six main segments with their individual morphological and geological characteristics. The 37 km long normal Priene-Sazlı fault is located in its westernmost part and raises the horst system, made of carbonaceous rocks, to the topographical position up to 200 m higher than the Neogene sediments of the Söke-Milet basin.

Two major earthquakes of magnitude 7 and 6.8 were historically and instrumentally recorded along the Priene-Sazlı fault in 68 AD and 1955, respectively. However, seismic activity beyond this time span remains unexplored. In this study, we investigated the lowest part of the Priene-Sazlı fault scarp close to the ancient city of Priene and epicentre of 1955 earthquake. Based on the entire surface rupture length of the Priene-Sazlı fault, we concluded that this fault is a seismogenic fault, which is capable of producing earthquakes of maximum 6.9 magnitude. We reconstructed at least five ruptures along the fault using cosmogenic 36Cl fault scarp dating. Two of the youngest modelled ruptures correlate well with the 1955 and 68 AD earthquakes with vertical displacements of about 1 m. The older ruptures occurred at ca. 4, 6 and 8 kyr ago with vertical slips of around 3 m. Our modelled rupture history indicates a recurrence interval of about 2000 years for the Priene-Sazlı fault with a slip rate of roughly 1.5 mm/yr through the reconstructed activity periods.