



## Primary Surface Rupture and Slip Distribution Associated with the Mw 7.6 06 February 2023 Elbistan Earthquake, Turkey

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The February 06, 2023, Kahramanmaraş earthquake sequence started with an earthquake with magnitude Mw 7.0 on the Narlı Fault and continued on the tectonic boundary between the Anatolian and Arabian plates. The main event, the Mw 7.8 Pazarcik earthquake, ruptured the East Anatolian Fault (EAF) bilaterally for over 300 km. This main event was followed nine hours later by the Mw 7.6 Elbistan earthquake, with the epicenter near the town of Ekinözü, about 100 kilometers away from the epicenter of the Pazarcik earthquake. The Elbistan earthquake also ruptured bilaterally, resulting in approximately 140 km of co-seismic surface rupture along a set of faults that form a major splay of the East Anatolian Fault Zone. Field investigations supplemented with interpretations of high-resolution photographs from small unmanned aircraft systems and helicopters show that the surface rupture associated with the Elbistan earthquake occurred on two different left-lateral strike faults: The first, known as the Çardak fault, extends from the town of Göksun in the west to Bıçakçı village in the east. The second is the newly identified Yeşilyurt Fault, an NE-SW-striking left-lateral fault with a subtle topographic expression that strikes parallel to the EAF.

The surface trace of the Çardak Fault can be divided into two geometric sections: The arc-shaped western section extends nearly 80 km between Göksun and Nurhak where the rupture was continuous and focused within a narrow zone. Horizontal slip along the eastern half of this section was typically over 6 meters, reaching over 8 meters at the maximum slip location just east of the epicenter. The average lateral slip drops to approximately 4 meters west of Ericek before decreasing uniformly to the west from Fındık until the surface rupture ends in Göksun. The second fault section extends nearly E-W between Nurhak and Bıçakçı for almost 20 km, including the structurally complex region associated with the Nurhak restraining bend, where only a handful of field slip measurements were made in this broadly deformed section. The average minimum

horizontal slip measurements in this section of the Çardak fault is around 2.5 m. Our field investigations indicate that the rupture established a new trend parallel to the East Anatolian Fault instead of using the E-W-oriented Sürgü Fault to connect with it. The average slip along this new 40 km-long fault zone, here named Yeşilyurt Fault, is about 1m, with maximum left-lateral slip reaching ~2.5m. Unlike the nearly continuous rupture along the Çardak fault, the rupture zone of the Yeşilyurt Fault generally consists of a series of right-stepping en-echelon arrays of discontinuous sinistral fault traces of various lengths and stepovers that range between tens of meters to several hundred meters.