



Fault creep and persistent asperities on the western section of the North Anatolian Fault, Turkey

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We interpret new geodetic and seismic observations along the western section of the North Anatolian Fault (NAF) in Turkey as evidence for persistent asperities on the fault surface. Analysis of geodetic and seismic observations for seven segments of the fault at different stages of the earthquake cycle suggest that areas of the fault surface that are accumulating strain (i.e. asperities) are deficient in interseismic seismicity and earthquake aftershocks compared to areas between asperities that are failing at least in part by fault creep. Although observational constraints are limited, evidence suggests that the zone of largest coseismic fault slip may relock rapidly after the earthquake with postseismic creep confined to the shallow and deeper parts of the fault. From west to east, the seven fault segments we consider include the 2014 M6.9 Gokceada earthquake and 1912 M7.4 Ganos earthquake segments, the Sea of Marmara and Princes' Islands seismic "gap" segments, the 1999, M7.6/7.2 Izmit/Duzce earthquake segments, and the 1944 M7.4 Ismetpasa segment that remains actively creeping at the surface. Aspects of each segment contribute to our interpretation of overall fault behavior. The most well-defined distribution of coseismic slip in relation to pre- and post-earthquake seismicity is for the 2014 Gokceada event, with observations indicating an anti-correlation between interseismic and aftershock seismicity, and areas of the fault with the largest coseismic slip. Rapid relocking of the asperities following the earthquake is evidenced by continuous GPS observations. The most complete set of geodetic observations (pre-, co-, and short- and long-term post-seismic) come from the 1999 Izmit-Duzce events. Simple three-layer elastic models with varying fault coupling, and rapid relocking of the area of the fault with maximum coseismic slip can account for deformation through the full earthquake cycle (see, Vernant et al., TS2.1/SM2.06). While both shallow and deep postseismic fault creep is ongoing on the Izmit-Duzce segment, the consistent pattern of strain accumulation along the long eastern segments that ruptured in major earthquakes in 1939, 1942 and 1943, suggests that deep fault healing is complete over time scales shorter than the earthquake repeat time (~250-300 yrs). We are continuing to investigate if and how these insights into the relationship between fault coupling and seismicity can help identify present asperities on segments of the NAF in the Marmara Seismic gap.