Onset and Mechanism of Surface Creep On Strike Slip Faults: Clues From The North Anatolian Fault, Turkey

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Abstract

Aseismic surface slip was first reported over forty years ago along some major strike slip faults such as the San Andreas fault in California and the North Anatolian fault (NAF) in Turkey. Yet its origin and timing on active strike slip faults and underlying physical processes still remain subjects of debate today. Recent studies based on space geodesy and geological observations howerver are now providing new insights in to the mechanism, characteristics, and initiation of fault surface creep. Using the persistent scatterer InSAR (PS-InSAR) and GPS techniques we investigate both the creeping section of the NAF at Ismetpaşa that had ruptured during the 1944 earthquake, and the postseismic deformation of the 1999 İzmit Earthquake. The results reveal that the central segment of the 1999 Izmit Earthquake rupture has been creeping for over for the past 16 years since the earthquake, becoming the longest lasting afterslip ever recorded. The slip pattern of ongoing surface creep on the İzmit rupture supports the idea that stable fault creep may commence as postseismic afterslip, a mechanism proposed previously but could not be confirmed due to the lack of pre- and post-earthquake observations on creeping faults such as the Ismetpaşa segment of the NAF and the central section of the SAF. Geological maps along the Ismetpaşa and Izmit creeping segments show that both fault zones run through ophiolitic and calcareous rocks that are known to facilitate aseismic creep due to their weak mineral contents. Observations of creeping faults suggest that following a large earthquake, a stable surface creep can be triggered on a section of a mature fault if it has evolved in to simple geometry and is located within weak rocks.

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