

The Mw7.6, Manyi (Tibet) Earthquake: Surface Rupture,
Surface Displacement Field, and Fault Slip Solution
From ERS SAR Data

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ERS2 radar data acquired before and after the Mw7.6, Manyi (Tibet) earthquake of November 8, 1997, provide geodetic information about the surface displacement produced by the earthquake in two ways. (1) The sub-pixel geometric adjustment of the before and after images provides a two dimensional offset field with a resolution of ~1m in range (radar line of sight) and ~20 cm in azimuth (satellite track direction). The offset map reveals a smooth, N78E, ~170 km long surface rupture following the trace of a quaternary fault visible on satellite images. The inferred sense of slip is left-lateral, consistent with slip on the EW plane of the Harvard CMT solution. (2) Interferometric processing of the data provides a range (radar line of sight) displacement map with a precision of a few millimeters. The fault slip distribution derived from the interferometric map is bimodal: a main event ruptured the 130 km-long eastern section of the fault with a maximum slip of 7 m, a sub-event ruptured the western 40 km-long section of the fault with up to 2.6 m of slip. The observed asymmetry of the surface displacement field between the two sides of the fault suggests that elastic properties of the crust are dependent of its volume strain. Such a nonlinear elastic behavior can be attributed to the presence of cracks in the crust. Assuming a uniform elastic half-space, fault slip solutions obtained by inversion of interferometric map using the simulated annealing and the single value decomposition approaches indicate that the rupture extended to a depth of ~15 km with a maximum slip of 7 to 8 m occurring between the depths of 4 and 8 km. The RMS difference between observed and modeled surface displacement is ~2 cm for the range component (interferometric phase) and ~20 cm for the azimuth component (offset). The occurrence of a large strike-slip event in this part of Tibet is a manifestation of the left-lateral shear occurring in the area west of the Kunlun fault, toward the western corner of the plateau.