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Evidence for very shallow locking depth along the Xidatan segment of the Kunlun fault from CGPS observations 2007-2009.

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The Kunlun fault is one of the major strike-slip faults accommodating the eastward escape of the Tibetan plateau as a result of the India/Eurasia collision. During the last hundred years, several segments have ruptured through large earthquakes with magnitude from 6.1 to 7.5 involving slip reaching 8 m and surface rupture trace over 150 km. The latest event (Kokoxili earthquake, Mw=7.8, 2001) ruptured a ∼400 km long segment. Observation in paleo-seismological trenches East of to the 2001 rupture shows a reccurence time for M>7 earthquakes of ∼500 years. These observations support the idea of a fault being locked at brittle crustal depths, accumulating large amount of elastic stress, eventually released in large earthquakes.

We present new results from a CGPS network operating since 2007 across the Xidatan segment, located at the eastern tip of segment ruptured during the Kokoxili 2001 earthquake. In a global reference frame, CGPS time series of daily positions show an annual signal with magnitude of 3 mm of the north component and spatially correlated across the network. When removed using common mode filtering time series have repeatabilities below 1 mm of horizontal components and below 3 mm on the vertical component. As a consequence, we believe that velocities are determined with an accuracy of 1 mm/yr (95% confidence level) after 2.5 years of data.

Two sites located in the far field of the fault indicated a left-lateral relative motion of 17 +-1 mm/yr. This estimate is about 50% larger than slip rate deduced from paleo-seismological studies along the Xidatan segment. Very large strain rate is observed close to the fault, with an increase of 14 mm/yr of eastward velocity over 20 km as one cross the fault from north to south. Little internal deformation is observed inside each block surrounding the fault. These observations evidence that the segment is currently is weakly locked.

We use 2D elastic modelling to further quantify the locking depth. Best agreement to the data is found for a locking depth shallower than 5 km and CGPS velocities are also compatible with possible creep along the Xidatan segment. We investigate the possibility that shallow creep has been triggered by increase of Coulomb stress induced by the adjacent Kokoxili rupture.