Imaging of aseismic fault slip by seismic and geodetic measurements on a creeping thrust fault

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The Chihshang fault in Taiwan serves as one of the best examples of faults with a primarily thrust component that rapidly creep at the surface (2-3 cm/yr), while it is also known to have produced magnitude 6 earthquakes. The deeper portion of this thrust fault is typically offshore, where land-based geodetic measurements are insensitive to fault slip at greater depth. The understanding of inter-seismic slip rate at depth therefore remains elusive. Taking advantages of slip rates inferred from repeating earthquake sequences (RES) at greater depth, we present a method that embeds RES derived slip rate into the neighboring fault patch for geodetic data inversion. Using the geodetic and seismological data from 2007 to 2011, we reach the higher resolution of interseismic slip rate distribution below the depth of 15 km. The inferred low coupling ratio establishes the extensive creeping area that coincides with the location of abundant repeating earthquakes and swarm events. The inferred high coupling ratio on the other hand, delineates the locked area corresponding to the co- seismic slip zone of the 2003 Mw6 Chengkung earthquake. The postseismic area however, is found to mainly overlapped with the low coupling ratio area at shallow depth (freely creeping) but not where the microseismcity, repeating and swarm events are located (partially creeping). We propose that the strongly locked area is concentrated in the middle of the fault extending from near surface to the depth of 25 km, surrounded by the creeping areas where microseismicity, repeating and swarm events are taking place. We estimate that a slip rate deficit equivalent to Mw 6.26 has accumulated annually, which may be able to generate greater than Mw 7 event over an interval of 20 years. It is thus importance, to follow up by time-dependent kinematic model in the future for better estimate of large earthquake potential in this creeping fault.

Keywords: slip inversion, repeating earthquake

