Geophysical Research Abstracts
Vol. 14, EGU2012-3919, 2012
EGU General Assembly 2012

Frictional properties of a rapid creeping mega-thrust: a case study of the Chihshang Fault in eastern Taiwan

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The 35-km-long Chihshang Fault is a rapidly creeping thrust among the 180-km-long Longitudinal Valley Fault system - the plate suture between the converging Philippine and Eurasian plates in eastern Taiwan. We combined geological surface investigation, geodetic data, seismological information, and a rate-dependant friction model, to illustrate frictional properties and their variations at depth along the 30-km-deep patch of the Chihshang Fault. Based on the geodetic and seismological data, the Chihshang Fault is characterized by three different slip behaviours at different depths: (1) abundant micro-seismicity and semi-continuous rapid slip at the depth of 10-25 km: seismogenic zone; (2) visco-elastic aseismic slip zone beneath 20 km; (3) seasonal creep at depth of 0-2 km. Using elastic dislocation model, we combined (a) 1-D diffusion model for rainfall of water running through the fault zone, (b) Coulomb stress criterion for stick slip along the fault, and (c) rate-dependent frictional law, to simulate the surface creep curves from the creep meters data. We obtained a rate-strengthening zone with positive frictional property (a-b) in the upper 500 meters of fault segment. This uppermost segment appears to be locked during the dry season due to positive a-b and low fluid pressure. We tend to interpret it as a result of 300-500 m thick of unconsolidated gravels layers in the footwall of the Chihshang Fault.