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Earthquake potential of the Meishan Fault in Taiwan inferred from the GPS and leveling data, 2002-2013

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Fault length has been thought as an important key to evaluate the seismic hazard. In this study, 155 campaign-surveyed and 59 continuous-recorded GPS data from 2002 to 2013 were used to examine the inconsistency between the magnitude of 1906 M 7.1 Meishan earthquake and the length of Meishan fault (13.5 km, corresponding to Mw 6.2-6.4 earthquake) in Taiwan. This high dip angle dextral Meishan fault is the surface rupture of the 1906 Meishan earthquake, which focal depth is about 10 km. The coordinates of all GPS stations were incorporated and processed with the Bernese software v5.0 under the ITRF2008 coordinate system. GPS horizontal velocities were estimated relative to the Penghu Baisha station (S01R) based on analysis of coordinate time series using least squares method. Direction of horizontal velocities is substantially toward west (278°) or northwest (297°). Velocities decrease from east with 32.0 mm/yr to the west of Meishen fault with 1.7 mm/yr. According to the velocity profile analysis across to the Meishen fault from east to west, ∼9.8 mm/yr dextral motion is observed across the surface rupture of this fault and ∼8.1 mm/yr dextral motion is also detected across the westward 15-km extension of this surface rupture. The strain rates calculated from the horizontal velocities show that the Meishan fault is mainly a dextral fault with contraction component on its original surface rupture but with minor extension component on its westward extension segment. Therefore the length of the Meishan fault may extend westward to ∼29 km along the pre-existing normal fault and has potential to generate an Mw 6.5-6.8 earthquake. Using the velocity profile data and under the assumption of 29-km-long fault length, a series of 2D dislocation models were established and their results reveal a dip range of 45°-80° and the locking depth ranging 7-11 km. The long-term fault slip decreases from east of 13.5 mm/yr to west of 8.2 mm/yr. In terms of 2D fault modeling results, a 3D fault model will be constructed in the future to provide a better understanding of the earthquake potential of the Meishan Fault.