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Infrastructure damaged by anomalous deformation due to high mobility of mud-core anticline and weak décollement during earthquake cycle of SW Taiwan

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Abnormal deformation with an uplift rate of 8 cm/yr and a shortening of 6 cm/yr localized in the Chungliao Tunnel and Tienliao III Bridge in the mudstone terrain located in fold-and-thrust belt of SW Taiwan revealed by geodetic measurements from 2011 to 2016. The accumulated deformation rate could be attributed from three major deformation processes. The first one is the high mobility of the mud-core anticline associated with ramp duplex structures in high overpressure zone, which can have contributed an uplift rate reaching to 2-3 cm/yr observed on the Lungchuan anticline duplexed by a flat-ramp structure and a backthrusting predicted by a 2-D numerical simulation. The InSAR result based on ALOS-1 data and precise leveling also show the deformation centered at the apex of a ramp duplex anticline. The second process comes from the triggering slip of moderate earthquakes located in mid-crust revealed by 2010 Mw 6.2 Jia-Shian earthquake and Mw 6.4 Meinong earthquake. These two events triggered the significant far-field coseismic deformation by the non-seismogenic faulting and folding on a fold-and-thrust belt above a weak décollement shown by SAR interferometry and geodetic measurements. The creeping behavior on the weak décollement inferred from high Vp/Vs ratio suggest a third process for high deformation the mudstone terrain of SW Taiwan. Overall, these three processes could explain the major contribution on the high deformation rate occurred on the mudstone terrain in the fold-and-thrust belt revealed by SAR interferometry and geodetic measurements.