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The dilemma of seismic hazard assessment in mud tectonics region of SW Taiwan

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Based on geodetic data analysis, the interseismic velocity field is estimated and subsequently used to evaluate the earthquake potential and seismic hazard assuming elastic deformation caused by fault coupling. However, this velocity field may also be influenced by anelastic deformation caused by mud tectonics. While the existence of mud tectonics has been suggested in SW Taiwan, ongoing activity and its role in dominating surface deformation patterns, especially in interaction with active faults, remain subjects of debate. Additionally, confirmation of the presence of mud diapirs or mud-cored anticlines in this region is still pending. In this study, we proposed that the mud tectonics encompass various features such as mud-cored anticline, mud diapir, mud diatreme and mud volcano. The mud-cored anticlines are the primary structures in SW Taiwan through the regional geomorphological analysis, seismic reflection profiles and surface vertical velocity field. Positive gravity anomalies caused by the dewatered mudstone identify the mud diapirs on the mud-cored anticlines, which are several kilometers in scale. Then the mud diatremes, which are a few to tens of meters in scale, distributed around the mud-cored anticlines near the ground surface could be identified by the damages to artificial constructions and buildings, electrical resistivity survey, or local geomorphological investigations. Mud volcanoes are likely to form if an abundant fluid supply is within the mud tectonics, and a fault passes through this structure. The reverse faults may develop accompanying with these mud tectonics. However, when the active faults pass through the mud tectonics, active crustal faults in SW Taiwan exhibit creeping or partial creeping behavior due to the fluid and gas supplied by mud tectonics. The fault creeping rates could be up to 15 mm/yr in SW Taiwan. Although the coupling is also inferred at the part of shallow segments of faults, which is usually shallower than 2 km, the energy could be released by slow-slip events or earthquake-triggered events. Therefore, although the surface deformation rate in SW Taiwan is high, but the earthquake potential may not be as high as previously anticipated.

Keywords: mud tectonics; seismic hazard assessment; geodesy