

Active tectonics in the Western foothills of Southern Taiwan in relation to mud volcanoes

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Date : 2022/11/11

Abstract

Mud volcanoes are a typical geological phenomenon that can be seen all over the world in tectonically compressed areas. In southern Taiwan, mud volcanoes are common near the axis of faults and anticlines in the Coastal Plain and Western Foothills, where the geology is dominated by the 3-5 km-thick Gutingkeng mudstone formation, which is late Miocene to Pleistocene in age. Existing geodetic data suggests the existence of a southwest striking right-lateral strike-slip fault in the Holocene Coastal Plain. The inferred fault trace is associated with a topographic scarp and with the presence of the Gunshuiping mud volcano (Yanchao, Kaohsiung), which displays dome-shaped topography. At first, we observed the dome-shaped topography in the Gunshuiping mud volcano area was being deformed by fault activity that made the asymmetric dome-shaped topography, and the mud volcanoes in this region are located on the hanging wall and along the fault trace. This leads us to investigate the kinematics of the active fault and its relation with the formation of the mud volcano. We consider two possible scenarios for the formation of mud volcanoes: mud migrating upwards through faults or fractures or through ductile “piercement”. Then, we investigated the deformation of buried Holocene strata using shallow boreholes and ^{14}C dating data for stratigraphic correlation across and along the inferred fault. The fault-parallel cross-sections shows the 4.7 ka B.P buried layers lying sub-horizontally is in contrast to the dome-shaped topography, indicating the maximum age of the topography is 4.7 ka years ago. The formation of the topography was explained as the result of mud intrusion and mud flows phenomenon observed in the cores, which was the indicator for mud moving upward through fractures and faults. We estimated the average horizontal offset by matching the morphology on two sides of the inferred fault. Combining with the age of the topography, the horizontal fault slip rate in this location is 11.5 mm/yr. Using the vertical offset of distinct layers along the fault-perpendicular correlation profile, leads to a vertical fault slip rate of roughly 4.3 mm/yr since 10 ka.

Keywords: Active tectonics, fault slip rates, mud volcanoes, Gutingkeng formation.