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Offshore Gas Hydrates Genetically Related to On-land Mud Volcanoes in SW Taiwan: Evidences of Fluid Geochemistry

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Taiwan is located at the plate boundary between Eurasian plate and West Philippine plate (Fig. 1). Mud volcanoes, which are believed to be the products of accretionary prism due to collision, are commonly found in on-land of SW Taiwan. According to available seismic data, many active mud volcanoes were also observed in offshore SW Taiwan. Meanwhile, many bottom simulating reflectors (BSR) can also be recognized, which indicates potential submarine gas hydrate deposits may exist in this area. Since the diapiric structures can be continuously extended from offshore towards on-land in SW Taiwan, local geologists suggested that on-land mud volcanoes may be genetically related to offshore mud volcanoes and gas hydrate deposits.

For better understanding their relationship, fluid samples of representative mud volcanoes in SW Taiwan were collected for geochemical analyses. According to the data of chlorine concentrations and oxygen isotopes, some of on-land mud volcanoes exhibit compositions which fall in the mixing trend between published compositions of gas-hydrate waters and seawater. This indicates that on-land mud volcanoes are genetically related to offshore gas hydrate deposits. Furthermore, some of them exhibit higher $\delta^{18}O$ value than the mixing line. It implies that these fluids may be derived from the deeper sources which have been experienced serious water-rock interaction during diagenesis processes.

We suggested that the relationship between gas hydrates with mud volcanoes on-land and offshore SW Taiwan can be considered as an accretionary prism conveyor belt. Therefore, a four-stage genetic model is proposed to explain the evolution of mud volcanoes from offshore toward on-land in southwest Taiwan (Fig. 1). In the passive margin, where is away from the accretionary prism, the gas hydrates was produced and well-preserved (stage I). While the accretionary prism accreted and collided, the gas hydrates would be partially dissociated due to the

intruded thermal fluids via the fractures/faults and then may mix with sedimentary pore water. Consequently, this pressured fluid can migrate to the surface, and then produce mud volcanoes in submarine (stage II). In stage III, offshore mud volcanoes became on-land mud volcanoes following the continuous accretion. Finally, some dehydrated clay fluids were involved in the genesis of mud volcanoes through the deep faults (stage IV).

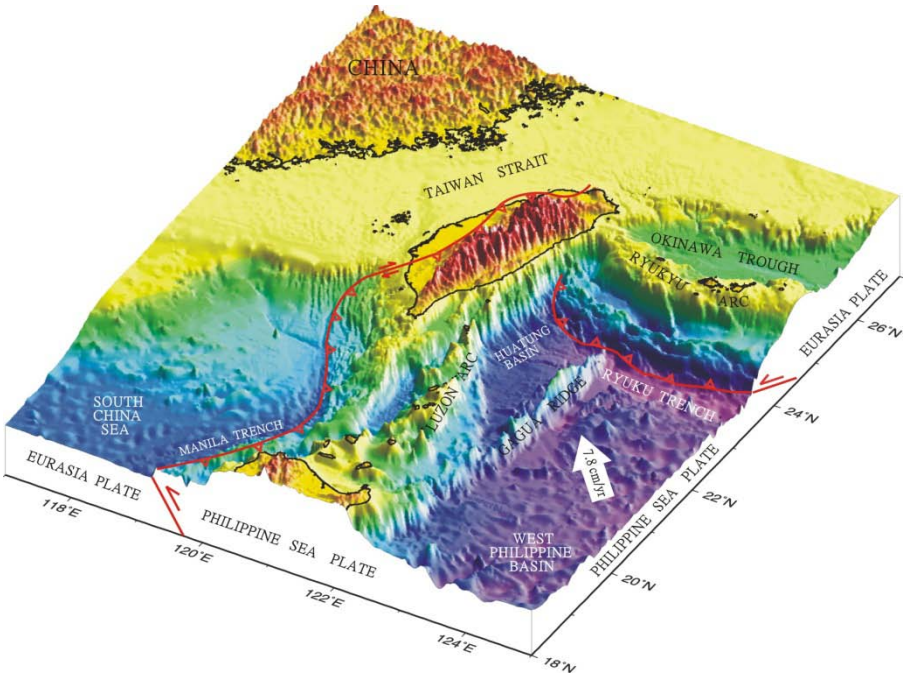

Figure 1: Tectonic environment around Taiwan (Liu et al., 2006).

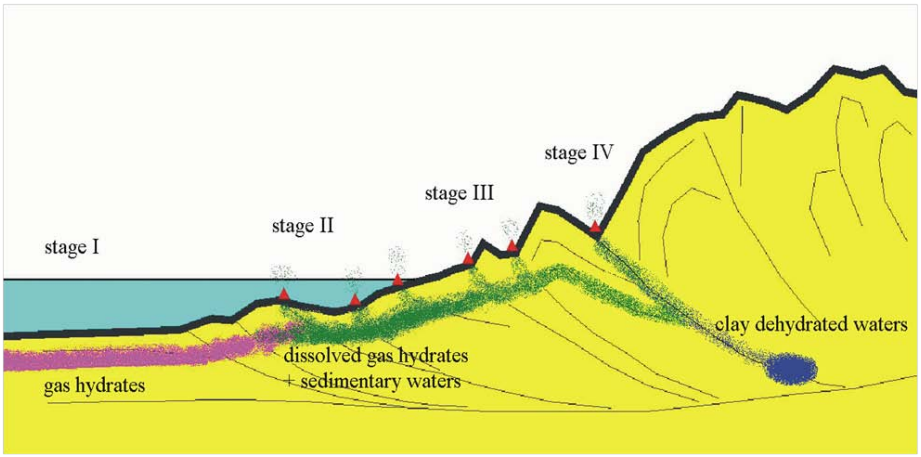

Figure 2: Schematic model for the evolution of mud volcanoes from offshore toward on-land in southwest Taiwan.