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Fluid Migration Patterns in Gas Hydrate System of Four-Way-Closure Ridge Offshore Southwestern Taiwan

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Four-Way-Closure (4WC) Ridge shows great potential as a hydrate prospect from collected multitude of marine geophysical datasets offshore southwestern Taiwan. The aim of my study is to better understand the fluid migration patterns and the possible source locations of the methane at this site. It is a cold seep site with an elongated NW-SE trending anticlinal ridge, which is formed by fault-related folds in the frontal segment of the lower slope domain of the Taiwan accretionary prism along its convergent boundary.

So I detail recognized the regional feature structures of the 4WC Ridge, including the thrust faulting and a seismic chimney beneath the seepage sites. I plan to study the temperature perturbation at the 4WC Ridge to better understand gas hydrate system there. To quantify the amount of temperature perturbation near the fault zone, we need to correct the temperature field data for other geological processes. One important correction we want to make concerns the topographic effects on the shallow crust temperature field. So we used 3D finite element method to quantify how much temperature perturbation can be attributed to the local bathymetry at the 4WC Ridge. This model will give us a temperature field based on pure thermal conduction. Then, we can compare the model temperature field with the temperature field derived from thousands of BSRs from the seismic cube, and interpret any resulting temperature discrepancy.

As our previous study, we known several geological processes can cause such a discrepancy, including advective fluid migration. If the fault zone fluid migration hypothesis is correct and gas hydrate system reacts to the deep warm fluids from below it, we expect that the BSR will become shallower near the fluid pathways, and the BSR-based temperature field might be a few degrees Celsius higher than in the 3D thermal conductive temperature field. Otherwise, the two temperature fields should be similar. This study is important for hydrate prospecting because additional deep gas sources might mean the hydrate saturation rate of the sediments is higher than normal. Furthermore, knowing how methane migrates to shallow crust could help in the study of how this greenhouse gas transfers into the lithosphere or even the hydrosphere and atmosphere.