



Using MCS Reflection Data to Delineate Gas Hydrate Concentrated Zone in the Yung-An Ridge Area Offshore Southwestern Taiwan

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Yung-An Ridge is a structural high located in the accretionary complex of the Luzon subduction-collision system offshore southwestern Taiwan. Morphological and structural characters of this region are ridges formed by west-vergent thrusts and folds, and their associated slope basins. Bottom simulating reflectors (BSRs) are widespread in the region, and combined geophysical and geochemical investigations have revealed that large amount of gas hydrates and free gases are accumulated beneath the anticline and adjacent slope basins on both sides of the Yung-An Ridge, where high priority drilling sites for gas hydrate investigation have been proposed. It is thus important to have a good understanding of the crustal structures and distribution of gas hydrate reservoirs in this area. In this study, we use two large-offset seismic reflection profile data collected by the R/V Marcus G. Langseth during the 2009 TAIGER survey to derive seismic depth sections with accurate velocity models. Based on the rock physics models, we further estimated the relationships between seismic velocity values and gas hydrate saturations. Faults and growth strata are clearly imaged in the depth sections after pre-stack depth migration (PSDM) procedure. By assuming that high velocity values are caused by high gas hydrate saturations, our results show that gas hydrate may be concentrated the most beneath the ridge where velocity values are the highest, while the adjacent slope basins on either side of the ridge present relatively low gas hydrate saturation in the basin strata. The outcropped thrust fault lies beneath the western flank of the Yung-An Ridge may provide a good path for gas migrating into a reservoir beneath the ridge. In addition, the dipping strata imaged in the slope basin east of the Yung-An Ridge may have porous layers where free gas could migrate upward, and the interface between the dipping strata and the folded strata of the Yung-An Ridge could also be a good conduit for gas migrating either to the seafloor, and/or accumulated beneath the ridge. The estimated gas hydrate saturation values are the highest, up to 50 % of pore space beneath the ridge. High amplitude reflections have been observed above BSR in the western part of the slope basin east of the Yung-An Ridge, suggesting that gas hydrate and free gas might coexist in the gas hydrate stability zone (GHSZ) which reduced velocity somewhat. In the eastern edge of this slope basin, a east-dipping fault provides a good path for gas migrating to the seafloor, thus the gas hydrate saturation in the sediment strata here are not as high as that beneath the Yung-An Ridge, with values around 10 to 25 % of pore space above BSR. In the slope basin located west of the Yung-An Ridge, the vestige of paleo-channels of the Penghu Canyon systems and cut and fill structures can be clearly observed on the seismic sections. Paleo-channel fills may provide sand bodies for good gas hydrate reservoirs, especially in the eastern part of this slope basin. The estimated gas hydrate saturation values match our expectations well, as the gas hydrate saturation ranges between 20 and 35 % of pore space above BSR. Integrating all the results from seismic images, saturation profiles and AVO cross-plotting, we conclude that the detail distribution and possible formation and migration of gas hydrates are closely linked to the complex fault systems and distribution of porous sand layers in the Yung-An Ridge area.