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ORIGINAL RESEARCH PAPER

Gas seepage, pockmarks and mud volcanoes in the near shore of SW Taiwan

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Abstract In order to understand gas hydrate related seafloor features in the near shore area off SW Taiwan, a deep-towed sidescan sonar and sub-bottom profiler survey was conducted in 2007. Three profiles of high-resolution sub-bottom profiler reveal the existence of five gas seeps (G96, GS1, GS2, GS3 and GS4) and one pockmark (PM) in the study area. Gas seeps and pockmark PM are shown in lines A and C, while no gas venting feature is observed along line B. This is the first time that a gas-hydrate related pockmark structure has been imaged off SW Taiwan. The relatively high backscatter intensity in our sidescan sonar images indicates the existence of authigenic carbonates or chemosynthetic communities on the seafloor. More than 2,000 seafloor photos obtained by a deep-towed camera (TowCam) system confirm the relatively high backscatter intensity of sidescan sonar images related to bacteria mats and authigenic carbonates formation at gas seep G96 and pockmark PM areas. Water column gas flares are observed in sidescan sonar images along lines A and C. Likewise, EK500 echo sounder images display the gas plumes above gas seep G96, pockmark PM and gas seep GS1; the gas plumes heights reach about 150, 100 and 20 m from seafloor, respectively. Based on multichannel seismic reflection (MCS) profiles, an anticline structure trending NNE-SSW is found beneath gas seep G96, pockmark PM and gas seep GS2. It implies that the gas venting features are related to the anticline structure. A thermal fluid may migrate from the anticline structure to the ridge crest, then rises up to the seafloor along faults or fissures. The seafloor characteristics indicate that the gas seep G96 area may be in a transitional stage from the first to second stage of a gas seep self-sealing process, while the pockmark PM area is from the second to final stage. In the pockmark PM area, gas venting is observed at eastern flank but not at the bottom while authigenic carbonates are present underneath the pockmark. It implies that the fluid migration pathways could have been clogged by carbonates at the bottom and the current pathway has shifted to the eastern flank of the pockmark during the gas seep self-sealing process.

Keywords Sidescan sonar · Sub-bottom profiler · Backscatter intensity · Pockmark · Gas seep · Gas flare · Southwest Taiwan

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Introduction

Gas seeps and mud volcanoes are generally found in permafrost and continental margins. Milkov (2000) suggested that the formation of submarine gas seeps and mud volcanoes in passive and active continental margins are due to the high sediment accumulation rate and the lateral tectonic compression. Dimitrov (2002) claimed at least one common characteristic of an overpressured source layer in the sedimentary pile. The rapid sedimentation is believed to be the main reason for overpressure in sedimentary layers (Milkov 2000; Talukder et al. 2007). Brown (1990) suggested that mud diapirs are driven by buoyancy forces due to the bulk density contrast between an overpressured muddy mass and an overburden of greater density. The additional factor of gas-charged sediments is regarded as an important factor in the diapir formation (Hovland and