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Sulfate Reduction and Methane Migration in the Good Weather Ridge Sediments, Southwestern Taiwan

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Sulfate reduction is an important process in the organic carbon oxidation in marine environment. Methane production and migration to the sulfate reduction zone in marine sediments may enhance sulfate reduction and accompanied iron sulfide mineral formation. In particular, high concentrations of methane above the gas hydrate in marine sediments may further facilitate the sulfate reduction in marine sediments. The purpose of this study is to investigate the degree of variations of sulfate reduction under the influence of methane migration in the Good Weather Ridge slope sediments near southwestern Taiwan. Sediments were sampled using gravity, box and piston core and analyzed for pore water dissolved sulfate, sulfide, methane, iron, chloride and sediment organic carbon, carbonate carbon, acid volatile sulfide, pyrite, reactive iron and total iron. A total of 80 gravity and 34 piston core samples were collected using r/v OR-I and II.

The results demonstrate that sulfate reduction and methane are closely linked in the study region. Sulfate reduction and iron sulfide mineral formation showed large spatial variations in the study region. Unusually high concentrations of methane, up to 35,000uL/L, were found in areas with high degree of sulfate reduction. Spatial variations of sulfate reduction, ranging from complete depletion of sulfate to almost no sulfate reduction, were observed. In region with high methane concentrations, total sulfate depletion was observed as shallow as one meter beneath the sediment/water interface. In addition to sulfate depletion, high concentrations of dissolved sulfide and

pyrite were also found in sediments with high methane contents. The depletion of sulfate showed strong spatial variations among the studied relatively parallel ridges (A, B, C, D, from east to west) as well as within each ridge. Relatively fast sulfate reductions were observed in the ridge D, the westward side, while relatively slower sulfate reductions were observed in the ridge A, the eastward side.

Sulfate reduction was controlled by the supply of organic carbon. The degree of sulfate depletion exponentially correlated negatively with the water depth with the exception of those with high methane concentrations in sediment. The negative correlation probably was a result of decreasing organic carbon deposition with increasing water depth. In addition, the degree of sulfate depletion also exponentially correlated positively with the methane contents in sediments, a result of an extra supply of upward migration of methane. Upward diffusion/migration of methane is an important source of organic carbon for sulfate reduction and control the degree of sulfate depletion in the study region.