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The effect of pulse venting on anaerobic oxidation of methane and pyrite formation in the cold seep environment, offshore SW Taiwan

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AOM (Anaerobic oxidation of methane) is a key process in seep environment. Sulfate was consumed during oxidation of methane or organic matter with pyrite as a major end product in the anoxic marine environment. Typical changes observed in the pore water include an increase of methane with depth beneath the SMTZ (sulfate methane transition zone), as a result of diffusion and/or advection, and appearances of a dissolved sulfide maximum underneath a dissolved iron peak with depth. A number of other related biogeochemical processes and end products may register their respective changes in sediments as a result of AOM and related reactions. However, flux, time and duration of gas migration may have changed by either long term processes, e.g., tectonic activities and/or climatic induced sea level changes, or short term, e.g., tidal variations. There is relatively little study addressing termination of gas migrations and subsequent changes in the seep environments. In this study, we will present our study on a seep environment where pulses of gas migration may have occurred with a number of chemical anomalies in sediments. We have collected pore water and sediments for their chemical compositions of sulfate, dissolved sulfide, chloride, organic carbon, carbonate carbon and pyrite as well as echo sounding for flares, and towcam for sea surface topography and benthic community.

Our results show that methane gas may have migrated in sediments in carrying out AOM reaction and pyrite formation, however, gas migration may have been relatively short and in pulses. Pulses of gas migration resulted in little or even no sulfate reduction in pore water, but with appearance of dissolved sulfide as well as very high concentrations of pyrite in sediments. Flares were observed but not constantly at the site where chemical anomalies were observed. Pulses of gas migration may come from solid gas hydrate formation and dissociation as evidence from pore water chloride enrichment and dilution. The result demonstrated that short term pulses of gas migration may induce additional pyrite formation but with an appearance of no sulfate reduction in seep sediments.