

Authigenic gypsum occurred in methane hydrates geo-system at Site of GMGS2-08 in the northern South China Sea

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Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) precipitates widely as evaporitic mineral in evaporitic environment. However, non-evaporitic occurrences of gypsum have been reported recently in the marine methane hydrate-related sediments. Whether this gypsum is an *in-situ* authigenic precipitation and how it forms remains controversial. The GMGS2 expedition in northern South China Sea provided an excellent opportunity for investigating the formation of authigenic minerals and the relationship between gypsum and methane hydrate. Based on the occurrence, relative concentration, morphology and sulfur isotope of gypsum and pyrite at the drilled site GMGS2-08, we propose that gypsum precipitated as *in-situ* authigenic mineral precipitated mainly in the sulfate-methane transition zone (SMTZ). The sulfurs in gypsum are mixed by the sulfate derived both from seawater and from partial oxidation of authigenic pyrite. The Ca^{2+} ions for gypsum formation might be generated by the partial dissolution of authigenic carbonate due to the SMTZ fluctuation and/or by the formation of methane hydrate below the SMTZ. This proposal thus links the formation mechanism of authigenic gypsum with the evolution of SMTZ and underlying methane hydrates for the first time, and could implicate for the recognition of paleo-SMTZs and methane hydrate stabilities in ancient marine sedimentary sequences.