Lipid biomarkers and their specific carbon isotopic compositions of South China Sea seep carbonates

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At seep sites, the anaerobic oxidation of methane (AOM), which is mediated by methane oxidizing archaea in a syntrophic consortium with sulphate reducing bacteria (SRB), is responsible for an increase in alkalinity that favors the precipitation of authigenic carbonates. Previous studies have shown that three anaerobic methanotroph clusters exist (ANME-1, -2, -3), which are distantly related to methanogens of the orders *Methanomicrobiales* and *Methanosarcinales*.

Cold seep carbonates were discovered from two locations (Dongsha and Chiasian) in the northern South China Sea and on Taiwan island. Distinct AOM communities were indicated by isotopically highly depleted archaeal biomarkers (with $\delta^{13}C$ values as low as -140.8‰) and bacterial biomarkers (with $\delta^{13}C$ values as low as -128.6‰), which confirmed that biogenic methane was the dominant carbon source.

Lipid biomarker distributions indicated that ANME-2 archaea were prevalent in the sample from Dongsha and the sample from Chiasian. Differences of the AOM communities between the carbonates appeared to be caused by the respective biogeochemical environments. ANME-1 archaea tended to be abundant in high-Mg calcite carbonates, and their formation might be linked to low methane fluxes. In contrast, ANME-2 consortia were prevalent in aragonite carbonates and appeared to have prospered at sites with high methane supply. Our data imply that the mineralogy of seep carbonates precipitated in the northern South China Sea appears to be influenced by the distinct ANME consortia, which are induced by methane flux.

This research is funded by the National Science Foundation of China (Grant No. 41203021) and the Fundamental Research Funds for the Central Universities of China (Grant No. 2014B17514).