High abundance and diversity of anaerobic hydrocarbon metabolizing archaea in sediment of Guaymas Basin

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The sediments of the Guaymas Basin are known to harbor various hydrocarbons such as methane, ethane, propane, butane and so on that formed biologically and thermogenically. The anaerobic oxidation of these hydrocarbons by microbes is a key biogeochemical process balancing the carbon flux from marine sediments into seawater and atmosphere. Although it has been well studied that methane and only recently butane can be actively converted to CO2 through a reserved methanogenesis pathway, the functional based in situ investigation of hydrothermal sediment with a rich source of organic degradation is poorly characterized due to the highly diverse and complexity of microbial hydrocarbons metabolism. Here we performed a comprehensive metagenomic and metatranscriptomic analysis on a sediment sample from the Guaymas Basin to achieve a complete view of hydrocarbon metabolic pathway and its hosting microorganisms and constructed the microbial carbon cycle that occurs in this site. We have clearly illustrated a high diversity of anaerobic methanotrophic archaea in marine sediment at the Guaymas Basin. ANME-1, ANME-2a-like, ANME-2d-like and unexpectedly the Bathyarchaea-like and recently reported butane oxidation archaea the Syntrophoarchaeum were found coexist in the single site, with ANME-1 as the dominant group. Meanwhile, these hydrocarbon metabolizing archaea were found closely related with dissimilatory sulfate reducing bacteria as revealed by metatranscriptome. The high diversity of anaerobic methanotrophic archaea in a single site may be stimulated by locally abundant and diversified hydrocarbons that provide multiple ecological niches in the hydrothermal sediment ecosystem.