Methane Hydrate Formation and Stability along the Texas-Louisiana Shelf, in the Gulf of Mexico

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Work has been conducted on the Texas-Louisiana Shelf, Norwegian-Greenland Sea, and Cascadia Margin to compare the relative input of biogenic and thermogenic methane on hydrate formation, stability and lattice saturation. Hydrate composition and carbon isotope analysis of organic sediment, bacterial biomarkers and methane shows a wide range of sources between these coastal regions. In the Norwegian-Greenland Sea the hydrates contained 99.5% methane, while on the Texas-Louisiana Shelf the values ranged from 30% to 78%. In the Norwegian-Greenland Sea and Cascadia Margin biogenic signatures, averaging –63.5 ppt, were measured in methane from the hydrates. Data from the Texas-Louisiana Shelf suggests that there is mixture between the sources of methane. Methane stable carbon isotope ratios range from – 48.5 to –33.0 ppt, with the lower values suggesting that methane is from bacterial activity. Radio carbon isotope analysis on methane from hydrates in the Cascadia Margin and Texas-Louisiana Shelf were isotopically depleted suggesting a strong influence of thermogenic carbon or vertical migration of old biogenic carbon.

In addition to the analysis of surface hydrates on the Texas-Louisiana Shelf, work has addressed the flux of methane into the water column. Stable carbon isotope analysis suggests ocean floor methane contributes a significant portion of the total carbon that is assimilated by bacterioplankton. In a subsequent study, the analysis of methane assimilation by bacteria in terms of a carbon concentration budget does not thoroughly support methane contribution to bacterial biomass. An alternate analytical approach is an energetic calculation as a function of methane availability, related to heterotrophic bacterial production. Application of this approach was conducted over a methane hydrate rich region on the Texas-Louisiana Shelf. Methane concentrations through the water column over a series of 20 submarine dives show a high concentration of methane in the water column, toward the ocean floor. Analysis of methane turnover, in incubation experiments, during this period indicate potential for a rapid cycling of the methane pools. The energy in the dissolved methane relative to the bacterial production in vertical profiles, demonstrates occasions that methane can support a dominant fraction of the carbon cycle.