

Carbon, nitrogen, and sulfur isotopes of seafloor sediments associated with natural hydrocarbon seeps from the Gulf of Mexico

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Deep seafloor sediments (~1000 to ~1900m depth) from Mississippi Canyon, salt domes, and a mud volcano in the Gulf of Mexico were analyzed in an effort to understand the impact of hydrocarbon seeps and oil spills associated with oil production on sea sediments.

Elemental concentrations and stable isotopes of carbon, nitrogen, and sulfur of seafloor surface sediments (0 to 1 cm depth) and subsurface sediments (1 to 3 cm and 3 to 5 cm depth) were analyzed. Sediment organic matter (SOM) related to hydrocarbon seeps was characterized by maximum C/N atomic ratio (~16.5 to 10.0) and minimum $\delta^{13}\text{C}$ values (-32.6‰ to -20.8‰), suggesting high biological activity nearest seeps on the sea floor and a gradual mixing with marine and terrestrial organic matter.

Additionally maximum sulfur concentrations of sediments were observed in the vicinity of seeps (~10 to 1% weight) with associated $\delta^{34}\text{S}$ values ranging from 48.3 to -7.2‰. No correlation between sediment $\delta^{34}\text{S}$ and interstitial water $\delta^{34}\text{S}$ was observed. Maximum $\delta^{34}\text{S}$ and sulfur concentrations of subsurface sediments are consistent with the presence of sulfur derived from brines. $\delta^{13}\text{C}$ values of carbonate crusts ranged from -35.5 to -20.5‰. Carbonate precipitation, $\delta^{13}\text{C}$ of carbonate, and sulfur data indicate microbial anaerobic oxidation of hydrocarbons coupled to sulfate reduction had occurred.