Evaluating the Carbon-Sulfur coupling and Temporal Frequencies of Natural Hydrocarbon Seeps in the Gulf of Mexico using Carbonate Geochemistry

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ABSTRACT

Offshore hydrocarbon accumulations in the Gulf of Mexico (GoM) are often accompanied by natural seepage of oil and gas from subsurface reservoirs to the seafloor and water column. These seepage sites have a significant impact on geology and biology of the seabed facilitated through complex, microbially mediated biogeochemical processes. However, the details, magnitude, and variability of these biogeochemical processes involving anaerobic oxidation of methane and non-methane hydrocarbon resulting in rapid sulfate reduction (SR) rates and carbonate authigenesis are poorly understood. Carbonate authigenesis at seepage sites is a significant carbon sequestration process and serves as a reliable geologic recorder of these dynamic biogeochemical interactions. This project will study the authigenic carbonates recovered from hydrocarbon seep sites of Southern GoM to understand their formation and the associated biogeochemical processes recorded in their carbonate chemistry. Previous studies on carbon and oxygen isotopes from authigenic carbonates have indicated a mixed contribution of methane and non-methane hydrocarbon to the dissolved inorganic carbon (DIC) pool for carbonate precipitation. Here I propose to explore the coupling of carbon and sulfur (C-S) at seeps using sulfur isotopes of pyrite and the Carbonate-Associated Sulfate (CAS) in the carbonate samples to unravel the details of SR coupled with methane/non-methane hydrocarbon oxidation, which produces the DIC pool. I will further identify the age of carbonate precipitates using U-Th geochronology to constrain the temporal variability and drivers of the seepage. This study will address several basic questions with regard to the biogeochemical evolution of hydrocarbon seep sites and the geologic record of global carbon cycling.

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