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Biogeochemical signatures of cold seeps in benthic and pelagic environments along the Gulf of Mexico continental margin

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Cold seeps are common features along continental margins that are fueled by persistent fluid and gas discharge over periods of decades to centuries. Such seepage leads to distinct biogeochemical signatures in both benthic and pelagic habitats. Along the Gulf of Mexico continental margin, two distinct types of seepage occur: hydrocarbon (oil and gas) seepage which leads to the presence of abundant gas hydrate on the seafloor and brine (brine, gas and sometimes oil) seepage which leads to the abundance of mud volcanoes and brine pools on the sea floor. Both types of seepage imprint a strong biogeochemical signature on the benthic and pelagic environments. In sediments, we used an integrated biogeochemical, molecular ecological and organic geochemical approach to elucidate interactions between the anaerobic oxidation of methane, methanogenesis, and sulfate reduction. The results indicate decoupling of sulfate reduction from anaerobic oxidation of methane and the contemporaneous occurrence of methane production and consumption in both gas-hydrate- and brine-influenced sediments. Biogeochemical signatures of sediments and patterns of microbial activity were different in hydrocarbon versus brine influenced benthic environments. Injection of methane into the water column around cold seeps resulted in high rates of aerobic methane oxidation in bottom waters and also appeared to influence water column nitrogen cycling. Incorporation of seep-derived carbon into pelagic food webs may contribute significantly to deep-water carbon cycles along continental

margins.