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Microbial Activity and Response to Temporal and Chemical Gradients in the Gulf of Mexico.

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Seasonal hypoxia in the Gulf of Mexico can create dead zones that have significant economic and ecological impacts. Hypoxia is exacerbated by anthropogenic activities in the Mississippi River watershed which lead to elevated nutrient concentrations in Mississippi River discharge. Previous research has established that hypoxic conditions alter microbial activity and microbial community structure. Here, we study microbial abundance and enzyme activity under different conditions to achieve a holistic view on the metabolic response of heterotrophic microorganisms to varying geochemical parameters. Two cruises were completed during March 2021 and August 2022 on the R/V Pelican in the northern Gulf of Mexico and Mississippi River. We captured gradients in salinity, temperature, nutrient concentrations, dissolved oxygen, chlorophyll, and color dissolved organic matter (CDOM). On each of these cruises, ~100 samples were collected for cell counts and enzyme activity assays. The spring dataset showed that enzyme activity rate varied by substrate and site, with esterase having the highest activity. These values were comparable with previous studies. Enzyme activity rates exhibited a generally positive correlation with dissolved oxygen concentration in both riverine and marine sites, though esterase showed no overall trend with this parameter. CDOM rates also directly correlate to enzyme activity at each site sampled. Salinity negatively correlated with enzyme activity rates at all sites except Site 2. The driver of these relationships is unclear due to the complex biogeochemical processes taking place simultaneously. Analysis of the late summer dataset will show if these trends persist under heavily stratified, hypoxic conditions. A final planned cruise in October 2023 will provide samples from after hypoxic conditions have dissipated.