Spatial Distribution of Seafloor Biogeological and Geochemical Processes as Proxy to Evaluate Fluid-Flux Regime and Time Evolution of a Complex Carbonate/Hydrates Mound, Northern Gulf of Mexico

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ABSTRACT

A one km diameter carbonate/hydrate mound in Mississippi Canyon Block 118 is the site of the Gulf of Mexico Hydrates Research Consortium (GOMHRC) multi-sensor, multi-discipline seafloor observatory (SFO). In preparation for installing the observatory and understanding mound physiography and dynamics, geophysical, biological, geological and geochemical surveys have been carried out. By integrating high resolution swath bathymetry, acoustic imagery, seafloor video, and shallow geological samples in a morpho-biogeological model we have described a complex mound structure consisting of three main crater clusters: northwest, southwest, and southeast, each associated with a distinct, deep-seated fault. The crater complexes exhibit differences in morphology, bathymetric relief, outcropping hydrates, venting fluids, seafloor sediments, and biological community patterns. Spatial distribution of these attributes suggests that the craters represent three different stages of fluid flux regime; the southeast crater seems to be an extinct or quiescent vent, the southwest a mature, fully open vent and the northwest a recently established vent. Geochemical evidence from pore-water gradients corroborates this model suggesting that upward fluid flux waxes and wanes over time and that microbial activity is sensitive to such change. Sulfate and methane concentrations show that microbial activity is patchy in distribution and is typically higher within the northwest and southwest complexes, and diminished significantly over the southeast complex. Three distinct fluid-flux regimes coexisting within a single mound complex confirm the necessity of continuous monitoring over the five-to-ten years that the observatory is expected to be operational.

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