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Regional Multibeam Surveys for Seep Exploration and Geochemical Coring in Frontier Areas

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ABSTRACT

Chemosynthetic benthic communities are distributed throughout the Oceans where hydrocarbon-rich gases and fluids permeate through the seafloor. Hydrocarbon 'cold seeps' and associated sessile fauna physically modify the seafloor as fluid seepage creates topographically-distinct features such as mud volcanoes, pockmarks and depressions, methane hydrate deposits, flanks of salt domes, and characteristic patterns of seafloor faulting. Additionally, cold seeps and associated chemosynthetic communities are commonly associated with authigenic carbonate deposits which are the product of the anaerobic oxidation of methane, as well as aggregations of cold seep clam and mussel shells, which are relatively hard and/or rough compared to the seafloor around them. Oil droplets and gas bubbles are also commonly observed in the water column in association with hydrocarbon cold seeps. The seafloor morphology, character of the seafloor material, hydrocarbons in the water column , and subsurface indicators of shallow gas, can all be investigated using geophysical remote sensing techniques based on their acoustic reflectivity properties. Interpreting these geomorphologic and reflective patterns from multibeam echosounder data (bathymetry, backscatter and water column) integrated with subbottom profiler datasets is a fundamental component of seep hunting and geochemical exploration surveys in frontier regions. Integration of these data sets allow for precise targeting of piston cores at hydrocarbon seeps to collect sediment samples for geochemical analysis. Multibeam seafloor mapping allows for identification of seep-related features and, through analysis of several terrain variables, characterization of their geomorphological signature, which can be used to constrain seafloor seep distribution on a regional scale. This approach can help identify areas of potentially high benthic biodiversity that lack the classic geophysical reflective indicators. In the Arctic, a regional multibeam dataset would not only provide information on seeping hydrocarbons, but could also be used for charting, habitat characterization, baseline studies, geohazard assessments (e.g. extent of ice gouge stamukhi zone), and providing other information necessary for infrastructure development. Here we will discuss methods for the utilization of multibeam data for regional studies in general and seep studies in particular, especially as it relates to the Alaskan Arctic.