

Substrate attributes as a driver for benthic communities: image analysis techniques on the Norskebanken cold seep site (Arctic Ocean)

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Cold seeps are biodiversity hotspots and can profoundly impact the local sediment geochemistry in marine environments. Methane seepage can change sediment properties and nutrient cycling, supporting unique benthic fauna living in or near the substrate. In this study, a shallow water area offshore northern Svalbard (~150m of water depth), where evidence of gas seepage has been observed, is investigated using high-resolution seafloor imagery and Object-Based Image Analysis techniques. Visual data consists of two photomosaics assembled from extracted frames of videos acquired using a work-class ROV and processed by applying the underwater Structure-from-Motion photogrammetry technique. The study aims to detect and classify every single visible specimen representing epibenthic faunal communities at the seafloor and describe changes in seafloor substrates across all the photo-referenced datasets. ArcMap software and direct ROV-based video analysis were used

to annotate all visible epibenthic fauna, identified to the lowest possible taxonomic level based on discernible external morphological characteristics. All these outcomes are reported in a catalogue, which can be used as a bionomic guide for future studies. In a further step, OBIA techniques were applied to seafloor geomorphological characteristics to provide a quantitative and repeatable classification of the substrate into four distinct classes. Finally, annotated benthic epifauna and seafloor substrate classes' data were combined to quantify patterns of community abundance and structure in relation to seafloor morphometric parameters. Network plot analysis revealed substrate class similarities and colonisation preferences exhibited by the fauna, mainly where methane-derived authigenic carbonates occur at the seafloor. This work comprises data collected during the CAGE20-7 cruise and within the framework of the INTPART-AKMA (287869).

Keywords: Cold seep, Photogrammetry, Image analysis, Habitat characterisation, Seafloor substrate, Geomorphological mapping