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TITLE: Heterogeneity of methane seep biomes in the Northeast Pacific

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ABSTRACT:

Methane seeps provide biogeochemical and microbial heterogeneity in deep-sea habitats. In the Northeast (NE) Pacific Ocean recent studies have found an abundance of seeps at varying spatial separations and within distinct biogeochemical environments ranging in oxygen, depth, and temperature. Here, we examine eight newly discovered seeps and two known seeps covering 800 km and varying across 2000 m water depth to identify: (1) novel megafaunal communities in this geographical region; (2) variations in the microbiome of seep habitats across the margin; (3) spatial and biogeochemical drivers of microbial diversity at seeps. In addition to authigenic carbonates, clam beds, microbial mats, and exposed hydrates - we also observed Siboglinidae tube worm bushes and an anomalous deep-sea barnacle adding to the overall habitats known from the NE Pacific. The microbial communities showed high variability in their spatial distribution and community structure. The seep communities formed distinct groups that included multiple groups of anaerobic methane oxidizing Archaea (ANME; 1, 2ab, 2c, and 3), often co-occurring within one site ? however, there were also other sites with clearly dominant members (e.g. ANME-1s at Nehalem Bank). Sulfide oxidizers were dominated by the non-mat forming Campylobacterales and even though vertical gradients in redox potential typify seep sediments, in two cases there was not a significant change in community structure across the top five cm of sediment. We posit that these patterns were driven by ?bubble-turbation,? and bioirrigation by megafauna. A surprising latitudinal trend was observed in species diversity and richness with increasing richness significantly correlated to increasing latitude. Overall, our results demonstrate that heterogeneity is ubiquitous in the seep biome, spanning all faunal classes, and that the understanding of seeps and the drivers of the community structure can be improved by studying seeps at a range of spatial scales.

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