Biogeography of pelagic, particle-associated and benthic bacterial communities and extracellular enzymatic activities in the central Arctic Ocean

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The composition and heterotrophic activities of Arctic bacterial communities remain largely unexplored, but are crucial to our understanding of high latitude marine carbon cycling, particularly in light of changes in primary productivity that could profoundly impact microbial heterotrophic activities and subsequent carbon export to the deep ocean. I investigated the depth and regional variations in Central Arctic bacterial community composition (BCC) and extracellular enzymatic activities (EEA)—the initial step in organic matter breakdown—from 79°N to 88°N and from surface waters to the seafloor (~3.5 to 4.5 km). Pelagic BCC strongly varies with hydrography and particle-association; benthic BCC show little regional variation. In contrast, EEA reveal significant depth and regional differences in hydrolysis rates as well as in the spectrum of substrates hydrolyzed. Particle-associated EEA reveal an equal or greater range of enzymatic capabilities than in bulk-seawater measurements, supporting previous findings that particles are hotspots of microbial heterotrophic activity. These patterns suggest a complex relationship between BCC, EEA, and the environment: while water mass characteristics consistently differentiate bacterial communities, additional local factors shape their capabilities to hydrolyze organic matter. These findings provide a baseline for future comparisons and initial insight into the functionality and biogeography of Arctic bacterial communities.