Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.35588

Microbial Abundances in Deep Subseafloor Atlantic Ocean Sediment

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Sediment in the deep marine subsurface represents one of the largest habitable ecosystems on Earth, yet it remains critically understudied due to limitations of accessibility as well as the limits of technology capable of investigating low-biomass ecosystems. But even within deeply buried sediment, life persists. The deep subsurface is inhabited by a wide diversity of microbes, including the majority of microbial biomass on Earth which live on limited rations of organic carbon and sources of reducing and oxidizing power. Due to the difficult task of accessing this environment and given the limitations of sampling, the distribution of these redox elements in this deep subsurface environment is underrepresented in current data, particularly when taking into account the sheer size of the marine subsurface. The extent, abundance, and identity of microbial cells in the deep subsurface sediment are even less well understood, particularly at depths greater than 10 mbsf (meters below sea floor) and across North Atlantic Ocean sediment. As a part of International Ocean Discovery Program (IODP) Expedition 395C and Expedition 395, we sampled a transect of sites on the eastern flank of the Reykjanes Ridge (the Mid-Atlantic Ridge), as well as a site on the Eirik Drift off the eastern coast of Greenland. These sites have different chemical input due to their disparate locations, and also span a variety of subsurface conditions, including regions of high sulfate availability, sulfate consumption, and methane production. Using a fluorometric DNA stain, we quantified microbial communities using flow cytometry at extreme sediment depths (over 1,000 mbsf) to improve our understanding of the biomass structure of the subsurface with respect to redox chemistry. Overall, the intact cell biomass recovered from ultra-deep sediment indicates some of the lowest cell concentrations ever measured with ocean drilling samples. Our findings support possible patterns of microbial subsistence, and provide new dimensions on total biomass and carbon quantities preserved in marine sediment.