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Informing models of life in Ocean World brines: lessons from active microbial life in briny waters of Lake Vida at -13C

Abstract

In the last 25 years, NASA's Galileo and Cassini missions have identified salty liquid oceans beneath ice on Jupiter's moon Europa and Saturn's moon Enceladus. These Ocean Worlds are an exciting discovery because analogue environments on Earth contain biodiverse and active microbial communities. Lake Vida is an isolated subglacial anoxic brine cryoecosystem in the Victoria Valley, Antarctica. Temperatures of -13.4 C are sustained and yet the microbial communities maintain low levels of protein production in situ. An exploration of cold adaptations in these Lake Vida microorganisms will inform future NASA Ocean Worlds missions. In this project, we are using multiple SSU rRNA and metagenomic datasets to extend our understanding of the organisms inhabit Lake Vida and what features of cold adaptation are present in the Lake Vida metagenome (specifically, 7 metagenome assembled genomes (MAGs)). Slight differences show the bias in differing sequencing strategies used, but overall Pseudomonodales and Flavobacteriales are most abundant throughout the Lake Vida microbial community. A custom database of cold adapted genes was recently assembled after mining the literature. Cold adapted protein families (PFAMs) are now being compared to PFAMs found in the MAGs using the MetaERG annotation pipeline. The presence of cold adapted PFAMs illustrates the potential for cold adaptation in the LVBR microorganisms. Although often linked to generic functions, these PFAMs have been shown to be upregulated in cold adapted organisms. Future work will dig into the metatranscriptome to compare levels of gene expression mapped to the rRNA gene and MAG sequences. Lake Vida offers a unique environment to investigate the boundaries of habitability, specifically in low temperature and high salt extremes. Examining the features of cold adaptation in the Lake Vida microorganisms will reveal survival strategies in isolated cryoecosystems, which may reveal clues to life in Ocean Worlds, such as Europa or Enceladus.