How low can they grow? Characterization of active microbial metabolism in ice

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Icy environments and the microorganisms that inhabit them can serve as valuable terrestrial analogs for cold icy environments elsewhere in the solar system and have particular relevance to extraterrestrial sites that may be accessible within the next few decades such as the cold surface of Mars and the cold-icy surfaces of Europa and comets. Recently, I have demonstrated metabolic activity in the form of respiration in laboratory ices at 6°C by glacial isolates Chryseobacterium sp. V3519-10 and Sporosarcina sp. B5. Notably, quantified respiration rates did not correspond to growth, but to maintenance levels of metabolism. What maintenance metabolism is and why these microorganisms have entered maintenance metabolism, rather than continuing to grow, remains unclear. In this study, I will thoroughly characterize the maintenance metabolism of Chryseobacterium sp. V3519-10 and Sporosarcina sp. B5 in ice at 5°C by examining a variety of cellular processes and characteristics simultaneously and determining the identity of newly-synthesized proteins. Examining maintenance metabolism in detail will allow the development of hypotheses about what constrains growth and what cellular processes continue during maintenance metabolism within ice. By comparing cellular processes and characteristics of metabolism at -5°C in ice versus brine, the challenges imposed by the physical ice matrix can be separated from those imposed by the low-temperature high-salt conditions. Defining the low-temperature adaptations and limits of terrestrial life will reveal significant information about the resilience and evolution of microbial life and has a major impact on discerning where in our predominantly cold solar system Earth-like life may exist.

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