Terrestrial Cryenvironments as Mars, Europa, and Enceladus Analogues. L. G. Whyte[1], J. Goordial[1,2], I. Raymond-Bouchard[1], G. Lamarche-Gagnon[1], A. Davila[3], and C. McKay[3]. [1]McGill University, Macdonald campus, Ste. Anne de Bellevue, Quebec, Lyle.Whyte@McGill.ca; [2]Bigelow Laboratory for Ocean Sciences, East Boothbay, Maine; [3]NASA Ames, Ames, Californian, USA.

Introduction: The search for life on other solar system bodies will be a major focus of planetary exploration in the coming decades. The primary targets for astrobiology investigations of other solar system bodies are Mars, in the short term, as well as Europa and Enceladus, in the mid to longer term. Extremely cold temperatures characterize these targets, and, as such, the best terrestrial analogues may be the Earth's polar regions. Considerable evidence has been found strongly indicating that Mars was much warmer and wetter before ~ 3.5 bya and potentially capable of hosting microbial life and ecosystems based on our current knowledge of extremophile microbiology. For example, the MSL mission has reported ample evidence of past fluvial, deltaic, and lacustrine environments within the Gale Crater [1]; thus the search for ancient biosignatures are key feature of Mars missions and life detection on, for example, ExoMars 2018 and Mars 2020. The very recent significant report of surface brine water at several reoccurring slope linaea (RSL) locations on Mars [2] now opens up the possibility that extant microbial life, most likely cold-°adapted and halophilic, is present at these sites and will almost certainly be the targets of future missions in the mid-2020s and beyond, including potential sample return missions. Similarly, exciting discoveries over the last ~10 years point to the existence of cold, salty oceans under the ice covers of Europa and Enceladus [3, 4] which could also support extant microbial ecosystems based on our knowledge of similar salty cryoenvironments on Earth.

Microbial metabolic activities including heterotrophic, photoautotrophic, and lithoautotrophic metabolisms (as well as viral replication) at subzero temperatures detected under ambient conditions, as well as hydrogenotrophic sulphate reduction in the hypersaline (~25% salinity), subzero (-5ºC) Lost Hammer spring system, supporting the existence of active microbial ecosystems in these cryoenvironments [5, 6]. In contrast, extremely low levels of microbial biomass/metabolic activities under the ambient conditions found in University Valley permafrost soils indicates that the combination of subzero, hyper arid, and oligotrophic conditions is severely constraining microbial life, and where microbial activity is either severely limited or potentially nonexistent [7].

This presentation will focus on the cold temperature limits of life in these cryoenvironments; "Omic" analyses of cryophilic bacteria isolated from these analogue sites (*Planococcus sp.*, *Rhodococcus sp.*) and a yeast (*Rhodotorula sp.*) capable of growth at subzero temperatures are revealing global genomic adaptations (amino acid composition, genome redundancy, cold adaptive genes such as those for osmoregulation) for surviving in such extreme habitats. The presentation will interpret these results in relation to the search for life in other solar system bodies (Mars, Europa, Enceladus) and the development and testing of novel life detection instrumentation such as the Nanopore MinION sequencing platform in terrestrial analogous cryoenvironments.

References:
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