MICROBIAL COMMUNITY CHARACTERIZATION OF LAVA TUBE ICE ON EARTH TO DETERMINE ITS HABITABILITY ON MARS. B.R.W. O'Connor[1,3], R. J. Léveillé[2,3], L. G. Whyte[1,3], [1]Department of Natural Resource Sciences, Macdonald Campus, McGill University, Montreal, QC, Canada, [2]Department of Earth and Planetary Sciences, McGill University, Montreal, QC, Canada, [3]McGill Space Institute, McGill University, Montreal, QC, Canada.

Introduction: To date most of the research characterizing the habitability of Mars has been largely confined to the surface. However recently it has become widely accepted that if extant/extinct life does exist on Mars it is much more likely to be preserved in the subsurface. Lava tubes identified on Mars provide access to the subsurface and may provide many of the conditions necessary for the persistence of life or the preservation of biosignatures. Martian lava tubes would provide constant stable temperatures, and protection from surface radiation. Specifically, the notion that water in the form of ice may be stable within Martian lava tubes greatly increases their habitability [1,2] as hypothetical Martian microbes could remain viable/active within the thin microscopic channels of liquid water formed in the ice due to local melting by solutes [3]. It has been our goal as part of the "ATiLT: Astrobiology Training in Lava Tubes" funded CSA FAST grant to characterize the microbial communities of lava tube ice to determine if this environment could support a microbial ecosystem on Mars.

Results: During the summer of 2017 and 2018 we collected ice samples from lava tubes within Lava Beds National Monument, CA, USA. Effort was made to collect a diverse set of ice samples from the various lava tubes visited. We collected samples from ice floors, ice stalagmites as well as samples which varied in terms of the concentration of particulate matter visible within the ice.

The microbial community appears to be cold adapted with 24-74% of cultured microorganisms capable of growth at 5°C (classified as psychrophiles and psychrotrophs) and abundant with heterotrophic cell counts ranging from 10^6-10^9 cells/ml.

Determination of the microbial community composition by Illumina 16S rRNA sequencing returned 21,744 unique ASV's which were grouped into 11,476 taxonomic classifications. The community was primarily composed of members of the phyla Actinobacteria (15-71%), Bacteroidetes (11-40%), and Proteobacteria (1-39%), all of which are found ubiquitously in other cave environments.

Biomineralization experiments performed to determine the metabolic activity of the lava tube ice microbial communities at near *in situ* conditions revealed the community to be metabolically active at above (5°C) but not subzero (-5°C) temperatures, possibly owing to the difficulty in respired CO_2 diffusing out of ice. Biolog assays however, were able to detect microbial activity at above and subzero temperatures on many heterotrophic carbon sources. These assays revealed the heterotrophic functional diversity of the microbial communities to be high at both incubation temperatures. Interestingly however, in almost all cases no difference in heterotrophic carbon source utilization was observed between the incubation temperatures suggesting heterotrophic lava tube ice microbial communities don't modify their metabolism in response to freezing temperatures. Taken together these results illustrate a cold adapted and metabolically active microbial ecosystem and suggest lava tubes remain a promising target to find life on present day Mars.

References: [1] Williams et al. (2010) *Icarus, 209,* 358-368. [2] Léveillé and Datta (2010) *Planet. & Space Sci., 58,* 592-598. [3] Price (2007) *FEMS Microbiology Ecology, 59,* 217-231.