**QUANTIFYING EXTANT LIFE AND MICROBIAL COMMUNITY PRESERVATION WITHIN ICY BRINE AND EVAPORITIC ENVIRONMENTS.** S. M. Perl[1,2], C. A. Lindensmith[1], J. Nadeau[3], C.S. Cockell[4], M. Bedrossian[5], E. Serabyn[1], J. K. Wallace[1], S. K. G. Zareh[1], S. Rider[5]

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**Introduction & Motivation:** Active microbial communities utilize their own motility functions for seeking out nutrients and energy. In environments where energy for reductive, catabolic, chemical and/or biological consumption is low, microbes will seek out nutrients using motile actions. Frozen saline environments partially generated from plume material ejected from the ice-covered crust on Europa could contain evidence of metabolic activity from organisms living under the frozen material. From a terrestrial standpoint between 5-70% of bacteria in the ocean are motile [1], which highlights how energetic ocean systems can be. Moreover, competition for nutrients [2] among microbial communities also leads to using motility as an overall strategy [3] in fluidic environments [4,5].

The purpose of this paper is two-fold. First we will discuss the astrobiological significance of motility as a biosignature for preserved extant life, using planetary analogue field sites having varying ages and geochemical compositions. Specific geobiological datasets from the sites will be compared with 4D bacterial imaging, showing how the activity of terrestrial microorganisms can be quantified simultaneously using the mineralogy, geochemistry, and motility.

**Methodology & Observation Techniques:** Microbial motility from individual bacteria in low biomass ($10^2$ cells per mL or lower) and higher biomass ($\geq 10^6$ cells/mL) samples can be quantified with regard to velocity, time and movement in three-dimensional space [6-9]. Meaningful motility is readily distinguishable from Brownian motion. In low biomass brine environments individual bacteria are sparse (Fig. 1) and just as motile as in denser samples. These can be easier to characterize and track than in high biomass settings. Using Digital Holographic Microscopy (DHM) we can resolve bacterial concentrations in varying geochemical brine environments with microbial concentrations between $10^1$ and $10^8$ with a high probability of detection for concentrations $\geq 10^4$ [7].

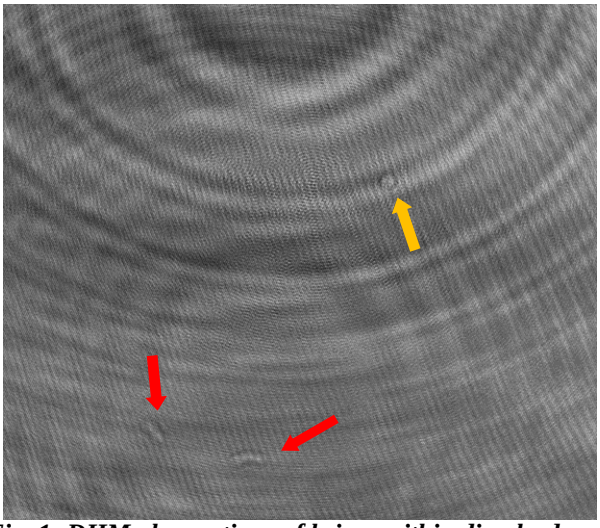

***Fig. 1: DHM observations of brines within dissolved Permian salts. Note the dimensional differences between the taxonomic units.***

**References:** [1] Azam & Malfatti (2007) *Nat Rev Microbiol. (*10):782-91. [2] Smriga et al. (2016) *PNAS* 113 (6) 1576-1581; [3] Ford (1991) The Leeuwenhoek Legacy, *Biopress, Bristol, and Farrand Press*. ISBN 0-948737-10-7. [4] Nadeau et al. (2016) *Astrobiology* v16, No. 10 [5] Son et al. (2015) *Nature Reviews Microbiology* v13,761–775. [6] Lindensmith et al. (2016) *PLoS ONE* 11(1): e0147700. [7] Bedrossian et al. (2017) *Astrobiology*, v17 No. 9. [8] Serabyn et al. (2018) *Proc. SPIE* 10677, Unconventional Optical Imaging. [9] Wallace et al. (2015) Optics Express v23, No. 13.