THE LIPIDOMICS OF THE BRINE OF LAKE VIDA (MCMURDO DRY VALLEYS, ANTARCTICA): DISCERNING BETWEEN LEGACY BIOMARKERS AND CURRENT METABOLISM OF A COLD ISOLATED MICROBIAL ECOSYSTEM. L. Chou[1], F. Kenig[1], A. E. Murray[2], P. T. Doran[1,3], C. H. Fritsen[2]
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Introduction: The McMurdo Dry Valleys of Antarctica are regarded as one of the best Earth analogs for astrobiological investigations of icy planetary worlds. In the dry valleys, Lake Vida contains a permanent ice-sealed brine that hosts a population of active microbes at -13˚ C. The biogeochemical processes used by these slow-growing microbes, at the physical boundary of life, are still unclear. Lake Vida brine (LVBr) has been isolated from the environment for approximately ~2800 years [1]. Here, we use the constraints provided by lipidomics to enhance our knowledge of the biogeochemical processes that take place in Lake Vida brine.

Methods: Preliminary investigation of organic compounds from LVBr and Lake Vida brine filtrates (>0.7 and >0.22 μm) was performed using gas chromatography-mass spectrometry (GC-MS) and solid-phase micro-extraction (SPME) GC-MS.

Results and discussion: LVBr contains a vast variety of lipids and is dominated by low molecular weight compounds. Many of these compounds (e.g. dimethylsulfide derived from the photosynthate dimethylsulfoniopropionate [2] and dihydroactinidiolide derived from a diatom pigment [3]) are markers of biological processes that took place in Lake Vida prior to evaporation and brine cryo-encapsulation. These legacy compounds, derived from a past ecosystem, do not provide us information on the current metabolic processes in LVBr. In contrast, LVBr filtrates contain compounds that can be ascribed to an active microbial system (e.g. unsaturated fatty acid methyl esters). This suggests that LVBr contains compounds providing evidence for both legacy biomarkers and active biochemistry. In order to obtain a usable library of organic compounds for LVBr, an important distinction has to be made between the biogeochemistry pre- and post-encapsulation.

LVBr contains 50 μg/L of perchlorate (ClO_4^-) which posed a problem during analysis of volatiles by SPME GC-MS [4]. In contrast, direct liquid-liquid extraction of LVBr and solvent extraction of LVBr filtrates provided extract that did not appear to be affected by oxichlorines during analysis.

Conclusions: Our ability to obtain organic compounds that were not affected by perchlorates makes Lake Vida brine an excellent analog for encapsulated water on other icy planetary bodies such as Mars, Enceladus, and Europa. Discerning between legacy biomarkers and active biochemistry would place constraints on astrobiological investigations on other extra-terrestrial icy habitats, providing clues to both its biogeochemistry and evolution.

References: [1] Murray, A.E. et al. (2012) *Proceedings of the National Academy of Sciences of the United States of America* 109, 50, 20626-20631. [2] Curson, A.R.J. (2011). *Nature Rev. Microbiology* 9, 12, 849-859. [3] Repeta, D. (1989) *Geochimica et Cosmochimica Acta* 53, 3, 699-707. [4] Kenig, F. et al. (2015) *JGR*. [in preparation]

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