AUSTRALIAN ACID BRINE LAKE AS A MARS ANALOG: AN ANALYSIS OF PRESERVED LIPIDS IN SHORE AND LAKE SEDIMENTS. H.V. Graham[1], J.C. Stern[1], A.M. Baldridge[2], and B.J. Thomsen[3]; [1]NASA Goddard Space Flight Center (8800 Greenbelt Rd., Greenbelt, MD 20771; heather.v.graham@nasa.gov), [2]Saint Mary's College of California (1928 St. Mary's Rd., Moraga, CA 94575), [3]Boston University (725 Commonwealth Ave., Boston MA 02215).

Introduction: The ephemeral, saline, acidic lakes on the Yilgarn Craton of Western Australia have been suggested as geochemical analogues to Martian paleo-terrains that are characterized by the interbedding of large deposits of phyllosilicates and hydrated sulfates [1]. These areas indicate shifting environmental conditions, from the circumneutral wet to alkaline wet conditions that began in the Hesperian. The habitability of such a dynamic environment can be informed by investigating biomes of the Yilgarn Lake system. Previous work has found phospholipid fatty acids (PLFAs) evidence of microbial communities in sections of fresh sediment cores taken from Lake Gilmore [2]. These communities include both Gram-positive and –negative bacteria, Actinomycentes, and communities of up to 50% bacterial methanotrophs in certain strata. Given recurring detections of methane at the Martian surface, evidence of a methane cycling community in an analogous terrestrial environment is of particular interest [3]. This study attempts to confirm the presence of such a community and assess the preservation of microbial biosignatures in dried core sediments more similar to contemporary Mars.

Carbon Isotope Profile: In this study we quantify and analyze the carbon isotope composition ($\delta^{13}C$) of bulk organic material, as well as the extracted lipids from the Lake Gilmore sediment cores at both near-shore and mid-lake locations. These analyses reveal very low (<1% by weight) accumulations of organic carbon, concentrated primarily in a gypsum-rich near-shore core. The near-shore sediments showed a down-core decrease in the abundance of organic carbon as well as depletion in the carbon isotope composition with depth. The $\delta^{13}C$ of bulk carbon (-21‰ to -16‰) did not exhibit the highly depleted, diagnostic $\delta^{13}C$ signature (-85‰ to -30‰) often associated with methanotrophic biomass in any of the strata analyzed [4].

Analysis of Preserved Lipids: Preserved lipids were extracted from sediments by solvent sonication as well as modified Bligh-Dyer methods. Some long-chain fatty acids were identified but the majority of lipids extracted from the sediments were pristane, phytane, and *n*-alkanes - all molecules associated with terrestrial plants. The abundance of terrestrial plant material in the sediments could be responsible for the enriched carbon isotope signature of bulk organic carbon [5]. While the *n*-alkanes were not necessarily the chain length distribution associated with C4 grasses the enriched isotopic signature would indicate provenance of a C4 signal. Very little of the free lipids were particular to bacteria (hopanoids *e.g.*) and markers particular to archaea (the domain responsible for methanogenesis) such as glycerol dialkkyl glycerol tetraethers (GDGTs) and archaeol were not found [6].

While these lipid results do not show evidence of a methane producing community compound specific isotope analysis of carbon in extracted methanotroph PFLAs could still confirm the presence of a methane cycling metabolism at depth. The excess of terrestrial detritus may overprint any isotopic contribution of methanotroph-derived carbon preserved in these sediments, given the very low amounts of microbial biomass found in lake cores. These results could indicate either that methane cycling communities are not present in these sediments or that the lipid amounts are so minor as to not be detectable by these methods. This could indicate either that the communities are very small or that these lipids do not preserve well in these acid, saline sediments, even on the decadal timescales represented by this study.

Mineralogy and Preservation: X-ray diffraction analyses of strata in both core sections confirm that the best molecular preservation can be found in sediments with higher amounts of gypsum. These results can help guide further investigations by indicating preferable molecular preservation conditions. Further, the assemblage of minerals in the cores suggest oxic conditionsrather than anaerobic conditions which would not favor methanogens. This would does not rule out a methane cycling community but might indicate that mineral precipitation did not coincide with growth.

References: [1] Baldridge A.M. et al. (2009) *GRL, 36,* L19201. [2] Nguyen A. et al. (2014) *AGU 2014,* Abstract #P33C-4039 [3] Webster C.R. (2015) *Science,* 415-417. [4] Summons R.J. et al. (1994) *GCA, 58,* 2853-2863. [5] Farquhar G.D. et al. (1989) *Ann Rev Plant Phys & Plant Mol Bio, 40,* 503-537. [6] Grice et al. (1998) *Org Geochem, 28,* 349-359.