PRODUCTION AND PRESERVATION OF LIPID BIOMARKERS BY IRON-OXIDIZING CHEMOLITHOTROPHS IN CIRCUMNEUTRAL IRON DEPOSITS. E. T. Kelly[1], M. N. Parenteau[2], M. B. Wilhelm[2], A. F. Davila[2],R. C. Quinn[2], L. L. Jahnke[2], F. Rull[3], J.A. Sanz-Arranz[3], A. Sansano[3], [1]SETI Institute, Mountain View, CA 94043 (Erin.T.Kelly@nasa.gov); [2]Space Science and Astrobiology Division, NASA Ames Research Center, Moffett Field, CA 94035; [3]Unidad Asociada UVA-CSIC CAB, Paseo de Belén 5, Universidad de Valladolid, 47011 VALLADOLID (Spain).

Introduction: Data collected by the Mars Science Laboratory (MSL) and Mars Exploration Rover (MER) missions from the surface of Mars have provided (and continue to provide) mineralogical insights regarding the redox cycling of iron. Recent observations made by the MSL *Curiosity* rover have revealed ancient martian sedimentary deposits that experienced a small degree of Fe(II) oxidation (and thus, less acidity generated), allowing more benign – low salinity and circumneutral pH conditions to persist [1, 2, 3, 4].

We are studying circumneutral iron springs in Yellowstone National Park as an analog for circumneutral iron settings on Mars. We are examining the production and preservation of lipid biomarkers by chemolithoautotrophs, which oxidize Fe(II) to power their metabolism. Microbial communities such as these could have been operating on early Mars.

Results: We analyzed the lipid composition of two samples of flocculent biofilm containing chemolithoautotrophs such as *Leptothrix* and *Gallionella* collected from iron seeps at Chocolate Pots Hot Springs in Yellowstone. We extracted the lipids using solvents, separated them using thin layer chromatography, and analyzed them on a gas chromatograph-mass spectrometer (GC-MS). The dried biofilms were also analyzed using Raman spectroscopy. The samples were analyzed with a European Space Agency ExoMars flight prototype (the RLS Simulator) at UVa-CSIC-CAB Associated Unit. The aim was to compare the types of information revealed by GC-MS and the Raman ExoMars instrument**.**

Fatty acids. The chemolithoautotrophs grew in temperature ranges of 10 to 37^{o}C. The major fatty acids found in the higher temperature sample indicated the sample was dominated by chemotrophic iron-oxidizers such as *Leptothrix* [5]. Diagnostic biomarkers of these sheathed bacteria included hexadecanoic acid, cis-9-hexadecanoic acid, and oxadecanoic acid, all of which were dominant in the sample [5]. While present in lower abundance, unsaturated heptadecanoic acids and iso-heptadecanoic acid were also present in the higher temperature sample, indicating the presence of sulfate reducing bacteria. Wax esters, a diagnostic lipid biomarkers for green nonsulfur filamentous anoxygenic phototrophs (FAPs) (*Chloroflexus* and *Roseiflexus* spp.), were absent from both samples. However, the diversity of unsaturated heptadecanoic acid and high relative abundance of cis-9-octadecanoic acid and 9,12 octadecanoic acid implicate the presence of cyanobacteria in both samples, with a stronger relative presence in the cooler sample. Poly-unsaturated eicosanoic acid and docosanoic indicate possible contamination of the sample with detrital plant material.

Alkanes. Both samples were dominated by straight chain hydrocarbons, with midchain branched alkanes present. Monomethyl alkanes and heptadecanes were present in both samples, though in higher relative abundance in the cooler sample. These compounds are considered biomarkers for cyanobacteria [6,7].

Surprisingly, the lipid biomarkers resisted the earliest stages of microbial degradation and diagenesis to survive in the Fe oxides beneath the mats, though hydrocarbon signatures did show signs of degradation. Understanding the potential of particular sedimentary environments to capture and preserve fossil biosignatures is of vital importance in the selection of the best landing sites for future astrobiological missions to Mars. This study explores the nature of organic degradation processes in Fe(II)-rich groundwater springs— environmental conditions that have been identified as highly relevant for Mars exploration.

References: [1] Grotzinger et al. (2014) *Science*, 343, 1242777. [2] Vaniman et al. (2014) *Science*, 343, 1243480. [3] Bristow et al. (2015) *GSW*, 100, 824–836. [4] Treiman et al. (2015) *AM*, 99, 2234–2250. [5] Spring et al. (1996) *SAP*, 19, 634-643. [6] Shiea et al. (1990) *Geochem*, 15, 223–231. [7] Parenteau et al. (2014) *Astrobiology*, 14, 502-521.

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