ENHANCED PRESERVATION WITHIN MICROBIAL TERRACE STRUCTURES AT SILICA-DEPOSITING HOT SPRINGS: IMPLICATIONS FOR ASTROBIOLOGY SEARCH STRATEGIES ON MARS. S.L. Kendall[1] and S.L. Cady[2], [1] Department of Geology, Portland State University, 1721 SW Broadway, Portland, OR 97201, [2] William R. Wiley Environmental Molecular Sciences Laboratory, Pacific Northwest National Laboratory, Richland, WA 99352

Introduction: Silica-depositing hydrothermal environments host the living relatives of some of the earliest inhabitants on Earth. Hot spring deposits serve as astrobiological analogs because of their high biosignature preservation potential [1,2]. The recent discovery of silica-rich mounds on the flanks of the Nili Patera caldera at Syrtis Major, a volcanic complex on Mars, have been interpreted as evidence of extinct hot spring deposits [3]. Given that siliceous hot spring deposits preserve microbial lithofacies [4], which can be used to reconstruct the paleobiology of extinct hot springs [5], such sites are important astrobiology targets on the red planet [6]. At Queen's Laundry, a silica-depositing hot spring located in Yellowstone National Park, the biofacies of the distal (T = 25-35°C) section of the outflow channels is dominated by populations of the cyanobacteria known as *Calothrix,* a microbial community common to most alkaline silica-depositing hot springs.

Research Focus: This project focused on the preservation potential of Calothrix-dominated terraces that develop at the distal end (temperature ≤40°C) of the drainage apron. These stepped terraces develop as laterally continuous ridges (Fig. 1) that, in cross-section, consist of multiple laminae. The laminae are primarily dense shrub-like or domical (convex) in nature. The typical upward growth sequence of layers transitions from shrub-like to domical laminae (Fig. 2): sometimes the vertical relief and topography of the shrub-like structures "damp" out in younger, successive laminae and the transition is gradational. In other cases, the transition from shrub-like to domical laminae is abrupt. Toward the top of both types of laminae, silicification is dense and visible as a distinct white band. These "white bands" record successive growth surfaces of the deposit, preserve detailed morphological characteristics of the shrubs and domical laminae, and entomb the dominant microbial community populations. The enhanced preservation of biofabrics and microfossils within these terraces of the lithofacies and the distinctive lateral distribution of these structures would likely be preserved in any siliceous deposits on Mars if, in fact, thermophiles, including cyanobacteria, ever thrived in martian hydrothermal systems.

References:

[1], Walter, M.R. and Des Marais, D. J. (1993) *Icarus*, 101, 129-143. [2] Walter, M.R., Farmer, J.D., and Des Marais, D.J. (1999) *JGR,* 104, 26,977-26,995. [3] Skok, J.R., et al. (2010) *Nature Geosci.*, 3, 838-841. [4] Cady & Farmer, 1996, Ciba Volume 202. [5] Walter, M.R. et al. *Palaios*, 11, 497-518. [6] Grotzinger, J. et al. (2011) *Astrobiology*, 11, 77-87.

Fig. 1.Curvi-linear terraces in Yellowstone hot springs.

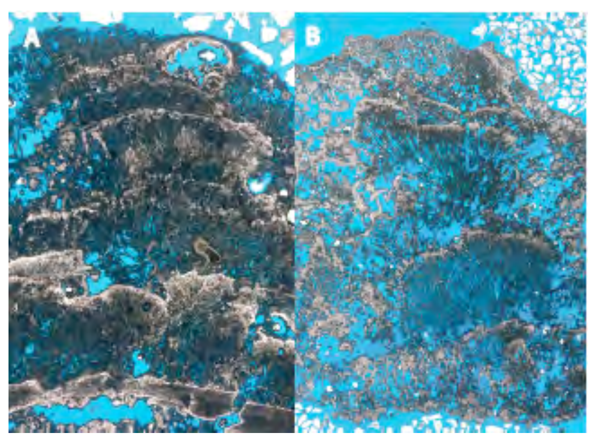

Fig. 2. Thin sections of Calothrix (A) biofacies and (B) lithofacies silica sinters. The architecture of the microbial biofilms controls the microstructure of the shrub-like and domical laminae in these sinters.