TEXTURAL BIO-SIGNATURES OF GEYSERITES IMAGED BY µXRT.

C. Munoz-Saez[1], and J.I. Gutierrez[2], M. Manga[1]. [1]EPS Department, University of California, Berkeley, 169 McCone Hall, Berkeley, CA, 94720 (carolimunoz@berkeley.edu). [2]MCB Department, University of California, Berkeley, 393 LSA, Berkeley, CA, 94720 (gutierrez@berkeley.edu).

Introduction: Silica sinter on Earth is generated when hot water that circulates underground, dissolves silica from the host rock, is discharged by hydrothermal vents, and then precipitates at the surface as the water cools. Similar opaline silica deposits have been identified in two areas on Mars, by Spirit Rover at Home Plate [1], and Nili Pater Caldera in the Syrtis Major volcanic complex [2], in both cases suggesting past hydrothermal activity [3].

Discharge of water from hot springs generates extensive sinter formations: terraces, platforms, cones and conduits. Those environments are inhabited by microorganisms. The sinter may thus preserve biological signatures, providing important information about mineral-microbe-environmental associations in hydrothermal systems [4-5]. We studied the structural fabric produced by microbial material that reveals past environmental conditions including temperature and flow.

Methodology: We collected samples of a fresh sinter terrace from El Tatio, Atacama. The samples were collected ~15 cm beneath the surface. They were still saturated of water. These rocks are formed by fine layers (10 to 5mm) and include organic material.

In the laboratory, we studied the rock texture and micro-organisms. Thin sections were made by drying the saturated rock samples. We also drilled 2.5 mm diameter cores from individual layers to image them with a non-destructive micro X-Ray tomography (µXRT), which produces a 3D high-resolution (1.3µm/voxel) scan of the rock (Figure 1). These 3D images were obtained to characterize microstructure and the distribution and volume of microbial material [6]. Last, we dissolved the rock and analysed individual micro-organisms.

Results and discussions: Preliminary results suggest that the microbes present in the rock are cyanobacteria, which form filaments >2.5 mm long and ~10 µm diameter (Figure 1 bd). These filaments are consistent with low to medium temperature environments [7].

Filaments are covered by silica but not yet fossilized. The volume of bacterial material reached up to 20% of the sample. The total porosity of the sample was estimated to be 50%, and the pores are elongated in the same direction as the filaments [6]. These observations imply that filaments provide a surface for silica precipitation [7], which leaves a signature in the pore structure of the rocks (Figure 1 ab).

There are no signs of diagenetic processes in the rock. We observed that living filaments mats are oriented in the direction of water flow. The orientation of the filaments and thus the pores in the rock - perpendicular to ~70^o angle from the horizontal layering – preserve information about the flow direction.

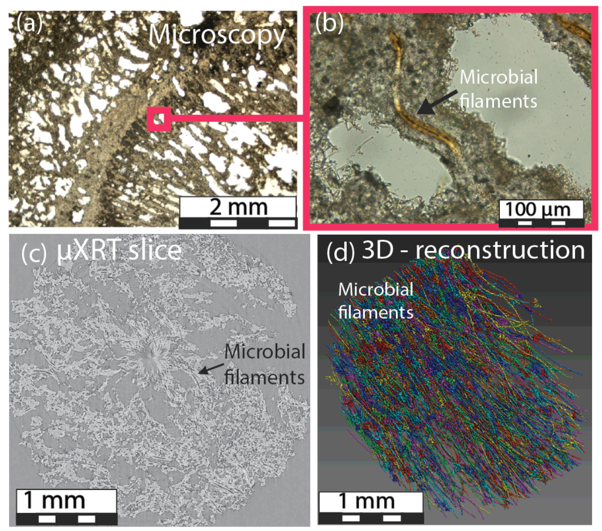

Figure 1: (a) and (b) Thin sections imaged with transmitted light. (c) XRT slice and (d) 3D reconstruction of filament microbes.

References:

[1] Squyres et al., 2008, *Science*, 320(5879) [2] Skok et al., 2010, Nat Geosci., 3 (12); [3] Ruff et al., 2011, *J. Geophys. Res.,* 116. [4] Jones, et al., 2003, Palaios 18, 87–109. [5] Lynne and Campbell, 2003, Can. J. Earth Sci. 40, 1679-1696. [6] Munoz-Saez et al., 2016. Submitted JVGR, Feb. 2016 [7] Cady and Farmer, 1996, Bock G.R., Goode,150–173.