Hypolithic photosynthesis in hydrothermal areas and implications for cryptic oxygen oases on Archean continental surfaces

Jeff R. Havig^{1,*} and Trinity L. Hamilton^{2,3}

¹Dept. of Earth Sciences, University of Minnesota, Minneapolis, MN, USA 55455

²Dept. of Plant and Microbial Biology, University of Minnesota, St. Paul, MN, USA 55108

³Biotechnology Institute, University of Minnesota, St. Paul, MN, USA 55108

*Corresponding author:

Email:	jhavig@umn.edu, jeffhavig@gmail.com	
Phone:	+1(509)637-6375	
Address:	116 Church Street SE	
	150 Tate Hall	
	Minneapolis, MN 55455-0231	
	USA	

SUPPLEMENTARY ONLINE MATERIAL

Molecular data NCBI Accession numbers and four supplementary figures with captions, referenced in the text of the published manuscript.

Molecular data has been uploaded to NCBI, with the following accession numbers:

NCBI Accession numbers:

Accession	Sample Name	BioProject
SAMN07414134	ssint3	PRJNA395731
SAMN07414135	saer3	PRJNA395731
SAMN07414136	saq2	PRJNA395731
SAMN07414137	saq1	PRJNA395731
SAMN07414138	saer2	PRJNA395731
SAMN07414139	saq3	PRJNA395731
SAMN07414140	ssint1	PRJNA395731
SAMN07414141	ssint2	PRJNA395731
SAMN07414142	saer1	PRJNA395731



Supplementary Figure 1. Scanning electron microscopy imaging and electron dispersive X-ray spectrometry analysis results of petrographic thin sections of silica sand collected from the Norris Geyser Basin near the incubations sites in this study. Image (top) correlates to analyses of aluminum (lower left) and silicon (lower right), with increasing brightness related to increasing concentration/electron density. Note grains coated in amorphous silica precipitate.



Supplementary Figure 2. Map of Yellowstone National Park, WY, USA showing hydrothermal areas sampled. NGB = Norris Geyser Basin, SSA = Sylvan Spring Area of the Gibbon Geyser Basin, LGB = Sentinel Meadows Area of the Lower Geyser Basin.



Supplementary Figure 3. Google Earth images, contextual images, and close-up images of sampling areas. All sampling was conducted under Yellowstone Research Permit YELL-2016-SCI-7020.



Supplementary Figure 4. Spectra of daylight and daylight absorption through silica sinter. Daylight spectra collected at 15:22 on July 25, 2017 on a sunny day at the University of Cincinnati, Cincinnati, OH and a reference of visible light spectra from as seen through hot spring water droplets during an eruption of Old Faithful, Upper Geyser Basin, YNP (top). Solar spectra as measured through different thicknesses (2, 6, and 10 mm) of loose silica sinter from Sentinel Meadows, Lower Geyser Basin, YNP (middle left) and total lux measurements plotted against alkaline hydrothermal area loose sinter thicknesses (middle, right). Note inset image of representative sinter sample analyzed. Solar spectra as measured through different thicknesses (1, 2, and 4 mm) of loose silica sinter from the Sylvan Spring Area, Gibbon Geyser Basin, YNP (bottom left) and total lux measurements plotted against acidic hydrothermal area loose sinter thickness (bottom, right). Note inset image of representative sinter sample analyzed.