LIGHT-DEPENDENT PRIMARY PRODUCTIVITY IN A PROTEROZOIC OCEAN ANALOG. T. L. Hamilton[1], M. Weber[2,3], C. Lott[2,3], C. Clark[4], D. de Beer[3], A. Dron[3], J. L. Macalady[4], [1]Department of Biological Sciences, University of Cincinnati, Cincinnati, OH 45221, USA, trinity.hamilton@uc.edu, [2]HYDRA Institute for Marine Sciences / Elba Field Station, Via del Forno 80, I-57034 Campo nell'Elba, Italy, [4]Max-Planck Institute for Marine Microbiology, Celsiusstrasse 1, D-28359 Bremen, Germany, [4]Department of Geosciences and the Penn State Astrobiology Research Center (PSARC), The Pennsylvania State University, University Park, PA 16802, USA.

Introduction: The delay in the rise of oxygen to present day levels at the end of the Proterozoic represents an important gap in our understanding of ancient biogeochemical cycling. One hypothesis suggests contributions to primary production by anoxygenic phototrophs, including metabolically versatile cyanobacteria, effectively limited oxygen production throughout Earth's middle age [1]. Little Salt Spring, a karst sinkhole in Sarasota County, FL, USA, has low sulfate concentrations (<5 millimolar) and micromolar concentrations of both oxygen and sulfide in the photic zone, conditions that may have been widespread in surface oceans during long stretches of the Proterozoic. Phototrophic pinnacle mats comprised of cyanobacteria and green sulfur bacteria occupy the sediment-water interface in the sunlit upper basin of the sinkhole. The water chemistry of the sinkhole combined with these conspicuous microbial populations provide a model analog system for determining the role of anoxygenic photosynthesis in the delay of oxygenation of the surface oceans.

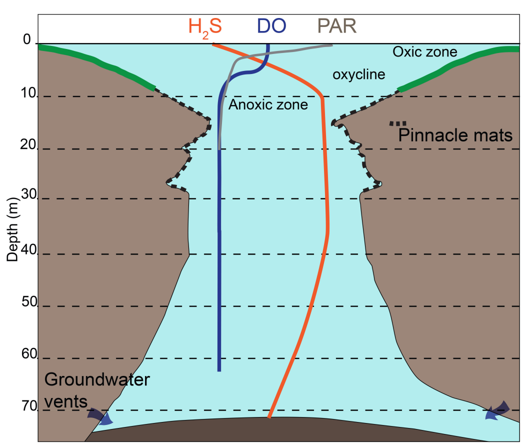

Figure 1. Geometry and water column geochemistry of Little Salt Spring, a cover collapse sinkhole in Sarasota County, FL. Approximate distribution of red pinnacle mats at the sediment water interface is shown.

Diver operated microsensors deployed at the water sediment interface recorded changes in the concentrations of sulfide and oxygen during a 24-hour period. Coupled measurements of bicarbonate update indicate higher levels of primary productivity in the light. Light quality and quantity measured *in situ* reveal the intensity and wavelength of light supporting photosynthetic primary productivity in the pinnacle mats. Inhibition of photosystem II via DCMU reveals cyanobacterial members of the pinnacle may be capable of anoxygenic photosynthesis and thus contributing to primary production in the absence of oxygen evolution.

In Little Salt Spring, anoxygenic phototrophs contribute to primary productivity in the water column where sulfide and oxygen co-exist. These data support the hypothesis that anoxygenic phototrophs, including metabolically versatile cyanobacteria, could have played a role in delaying the rise of oxygen on early Earth.

References:

[1] Johnston D. T., Wolfe-Simon F., Pearson A., and Knoll A. H. (2009) *PNAS, 106,* 16925-16929.