

ANALYSIS OF WEBBED PINNACLE MICROBIAL MAT VARIATION ALONG A DECREASING SEDIMENT GRADIENT IN LAKE JOYCE, ANTARCTICA. B. Allen¹, T. J. Mackey¹, J. Lawrence, S. Leidman¹, I. Hawes², M. Kursor¹, L. Mowchan³, A. D. Jungblut⁴, D. Y. Sumner¹.

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Introduction: Lake Joyce is a perennially ice covered lake in Antarctica's McMurdo Dry Valleys. Benthic microbial mats growing at specific sites in the lake, referred to as "webbed pinnacles," are morphologically analogous to microbial textures preserved in 2.5 billion year old carbonate rocks [1]. By evaluating webbed pinnacle distribution in the lake, it may be possible to ascertain how environmental conditions affect mat morphology. Here we provide an analysis of image data collected by a downward-facing drop camera to determine the co-variance of webbed pinnacle structure, distribution, and orientation along a decreasing sediment gradient produced by a glacial melt-water delta in the lake.

Methods:

Data collection. To determine how mat morphology varies with respect to sediment influx, images were collected at 6 GPS referenced sites set at increasing distances from the source of sediment influx on the northern shore of the lake (Figure 1). To ensure that variations were due primarily to sedimentation, all data were collected at depths of 10-13m, where water chemistry and light intensity were relatively constant [2], [3]. 25 boreholes spread across the 6 sites were made using a Jiffy drill. A downward facing GoPro deployed into the lake through each borehole collected images every second as it descended toward the lakebed. Using a pressure transducer and a 5cm downward facing laser scale extending into the camera's field of view, the area of the lakebed captured in an image could be determined at any height (Figure 2).

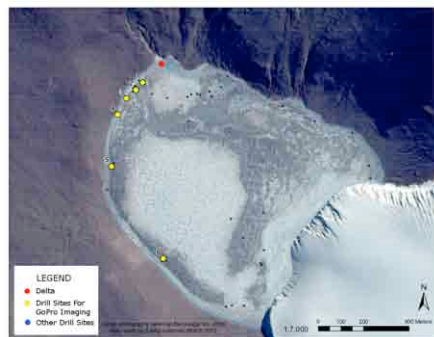


Figure 1. Satellite view of GoPro image collection Sites 1-6 (yellow) and the delta (red) in Lake Joyce. Site number 1 is closest to the delta. The scale at bottom right is 400km.

Data processing. Images collected with the GoPro had fisheye lens distortion, and were corrected using the image-editing software GIMP 2.8. Using ImageJ, an image-processing program, we measured select high resolution downward facing images at all drill sites to determine the 1m² spacial distribution and structural patterns of webbed pinnacles. These data were used to determine how webbed pinnacle distribution varies at a single drill site, and at various distances from the delta.

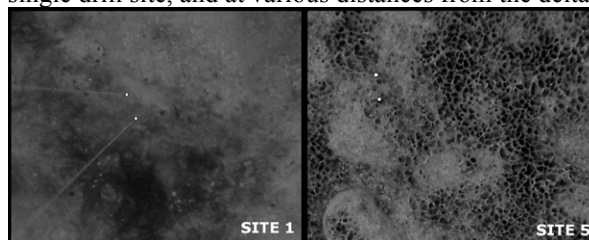


Figure 2. Webbed pinnacles do not form ~0.12km away from the delta at Site 1. Abundant webbed pinnacles produce a characteristic "honeycomb" pattern ~0.5km from the delta at Site 5. White points are the 5cm laser scale. Area $\approx 0.4\text{m}^2$

Results and Implications: Qualitative observations indicate webbed pinnacle distribution can be heterogeneous over decimeter to meter distances, but overall increase in abundance at distances farther from the delta (Figure 2). We interpret these results as having lower sediment influx.

Additional quantitative analysis of trends in mat morphology will include determining the average size, arrangement, and abundance of pinnacles over 1m² sections of lakebed at each drill site. Our analysis will supplement ongoing research using physical samples from the microbial mats to test the hypothesis that distinct webbed pinnacle morphologies present in Lake Joyce co-vary with sedimentation rates. Our results will provide insights into how microbial communities respond to sedimentation, and thus variations in stromatolite morphology for ancient earth.

References:

- [1] Sumner D. Y. (1997) *Palaos*, 12, 302- 318.
- [2] Green W. J. et al. (1988) *Geochimica et Cosmochimica Acta*. 52, 1265-1274
- [3] Hawes I. et al. (2011) *Geobiology*. 9, 394-410.