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Microbial Carbonate Records of Changing Antarctic Lake Chemistry

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The McMurdo Dry Valleys (MDV) of Antarctica contain multiple perennially ice-covered lakes (PICLs) that provide environments for microbial photosynthetic activity. Lake Joyce is a pro-glacial, closed-basin PICL in Pearse Valley, MDV, with water input from Taylor Glacier and five alpine glacier streams (Green et al. 1988), which form a delta on the northern side of the lake. The water column is density stratified with freshwater lenses overlying deep, brackish water generated by freeze-concentration (Mackey et al. 2018). The 18O of the water column decreases with depth, ranging from -38.2‰ at 10.5 m to -42.9‰ at 36.5 m due to differences in water sources and the extent of freeze concentration through time (Mackey et al. 2018). Benthic microbial mats cover the lake bottom and serve as the location of most carbonate precipitation within the lake. In the lake pycnocline between ~20-22 m depth, the microbial mats form stromatolites with a mm-thick marker layer of calcium carbonate at the center. These marker layers can be used as a record of lake chemistry and lake level rise through time (Mackey et al. 2018), as well as spatial chemistry variability within the lake. Work by Halen (2023) indicates the thickness of the marker layer increases with stromatolite height, ranging from 0.4 mm to 1.2 mm.

In this contribution, we explore the influence of melt water streams and pycnocline development on carbonate precipitation in Lake Joyce. We pair petrography with 18Ocalcite of stromatolites from similar depths both near and far from the delta to isolate the role of lateral changes in local water sources in carbonate precipitation. Results indicate that differences in local water sources are recorded in carbonate isotopic compositions. Further petrographic analysis of Lake Joyce stromatolites will assess the effect of stream mixing on the carbonate precipitation mechanisms within this perennially ice-covered lake.