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Triple Oxygen Isotope Signatures of Perennially Ice-Covered Lake Fryxell, McMurdo Dry Valleys, Antarctica

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Perennially ice-covered lakes (PICLs) are lake systems with a permanent ice cover unique to polar hyper-arid regions and have patterns of sedimentation distinct from open water lakes. Antarctica's McMurdo Dry Valleys hosts various PICLs and paleolake deposits which have responded to climate change since the Last Glacial Maximum (LGM), holding records of regional environmental change throughout the continent's geologic and glacial past. Of these lakes, Taylor Valley's Lake Fryxell is a closed-basin modern PICL fed by seasonal glacial meltwater; as a result of its ice cover, the water column is both chemically and physically stratified. Calcite and aragonite minerals precipitate both in microbial mats and the water column. Assessing the geochemistry of carbonate sediments in Lake Fryxell is essential to building a facies model for perennially ice-covered lakes and further our understanding on the drivers of carbonate precipitation in these settings.

We present high-precision triple oxygen isotope analyses ($\Delta'^{17}O$) of the Lake Fryxell water and carbonate phases to test for evidence of evaporative concentration and ice cover loss through time. Sediment was subsampled from cores housed at both the University of New Mexico and the University of Maine. The stratigraphy of Lake Fryxell consists of ~20 cm thick carbonate units, likely associated with the larger Glacial Lake Washburn encompassing much of Taylor Valley during the LGM, followed by alternating and mixed layers of microbial mats, medium-to-fine-grained sand mound deposits, and calcareous mud. Average $\Delta'^{17}O$ signatures of Lake Fryxell waters collected in 2022 at 9.1-9.8 meters depth along the oxycline range from -0.002 to -0.041‰ (VSMOW). From these data, a calcite-water equilibrium fractionation line was calculated based on previous work established by Wostbrock et al. [1]. Isotope signatures of carbonates, both modern and those associated with paleolake Washburn deposits down core, are isotopically consistent with each other and fall within the fractionation line, suggesting these carbonates precipitated in equilibrium with mid-depth waters below 10°C. Further isotope analyses of Lake Fryxell carbonates through time have the potential to elucidate changing water sources or evaporation through time.

[1] Wostbrock, Brand, Coplen, Swart, Carlson, Brearly & Sharp (2020), *Geochimica et Cosmochimica Acta* 288, 369-388.