

# Phytoplankton phosphorus deficiency and alkaline phosphatase activity in the McMurdo Dry Valley lakes, Antarctica

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ABSTRACT: We assessed the nutrient (N, P) deficiency of phytoplankton from the perennially ice-covered lakes in Taylor Valley, Antarctica, with $^{14}C$-based bioassays. Phytoplankton in the near-surface waters from three of the four lakes displayed elevated photosynthetic carbon assimilation in the presence of added P relative to controls. Carbon assimilation in samples from deep chlorophyll layers was also enhanced by P addition in two of the lakes. No effect of N addition without simultaneous P addition was noted in any lake. Lake Bonney near-surface phytoplankton consistently showed a strong response to P and N + P additions, suggesting P deficiency. The near-surface phytoplankton of Lake Hoare responded to N + P but not N or P addition alone, suggesting a more general nutrient deficiency. Further investigation of phytoplankton phosphorus deficiency was carried out in the east lobe of Lake Bonney and in Lake Hoare. Water column dissolved and sestonic elemental ratios and planktonic alkaline phosphatase activity measurements corroborated the results of the bioassays. Despite the proximity of the lakes and their similarity in ice cover and watershed, a high degree of phytoplankton phosphorus deficiency was evident in Lake Bonney but not in Lake Hoare. We hypothesize that the difference in the degree of phytoplankton P deficiency between these lakes may not be due to differences in external P fluxes, but rather to differences in the internal cycling of phosphorus stemming from large differences in water column chemistry.

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