

Vertical Profiling of Major Spectral Algal Classes in Ice-Covered Lakes located in the McMurdo Dry Valleys, Antarctica

The McMurdo Dry Valleys (MDV) is the largest ice-free area in Antarctica (~4000 km²) and represents the coldest and driest desert on Earth. Numerous permanently ice-covered lakes exist within these valleys and are the site of an NSF-funded Long Term Ecological Research Project (LTER; <http://www.mcmlder.org/>). These lakes along with those found in other ice-free areas in Antarctica, represent the only year-round liquid water reservoirs on the continent and differ significantly in their physical, chemical and biological characteristics. Each lake is isolated from the outside environment by a permanent 3 to 7 m thick ice cover that prevents wind-driven turbulence and yields highly stable water columns that are often chemically stratified. Ice cover prevents seasonal mixing and significant nutrient inputs: chemistry is vertically stratified in the water column, and lakes typically possess oxygen-rich/ultra-oligotrophic surface waters which are separated from anoxic layers by permanent chemoclines. Gas exchange with the atmosphere is virtually absent, with the exception of the formation of a small moat that develops during the austral summer [1]. Low annual levels of photosynthetically active radiation (PAR), and low nutrient levels [2]; they support simple, truncated food webs that are virtually devoid of metazoan life. These nutrient-poor watersheds are particularly vulnerable to climate-related episodic events and it is recognized that responses of sensitive high alpine and polar ecosystems to climate change will not be gradual or linear. Thus, the response of these low diversity ecosystems to climate change can provide important insight into more diverse and productive lower latitude aquatic systems [3].

In most aquatic ecosystems, microbial plankton, invertebrates and vertebrates interact to form complex food webs. In contrast, the MDV aquatic food web is extremely simplified and entirely dominated by bacteria, algae and protozoa. Flagellated microalgae are the dominant primary producers in the lakes. We profiled the vertical distribution of major spectral algal classes across the three main MDV lakes using the BBE FluoroProbe (BBE FluoroProbe, BBE MOLDAENKE GmbH, Germany). Here, we report the depth profiles from Lake Bonney and Lake Fryxell, which have very different water chemistry and biological signatures. In Lake Bonney, three distinct chlorophyll a peaks were observed at depths of 5-, 15- and 20-m, and were associated with unique algal consortia. Shallow populations were dominated by green algae, while a mixed population of green algae and diatoms were detected in at mid to deeper waters (Fig. 1A). In contrast, chlorophyll a maxima in Lake Fryxell was detected at 6- and 9-m. Algal populations were comprised of cryptophytes, diatoms and to a lesser extent, green algae (Fig. 1B). These depth profiles matched very closely with previous reports on the location of chlorophyll maxima in the MDV lakes using pigment extraction. Recently, molecular analyses in Lake Bonney using 18S rRNA phylogeny has identified that a cryptophyte related to *Gemingera cryophila* occupies the shallow populations, a mixed population of a haptophyte (*Isochrysis* sp.) and a stramenopile (*Nannochloropsis* sp.) occupy the mid-depths, while a diverse chlorophyte community resides in the deepest layers [4].

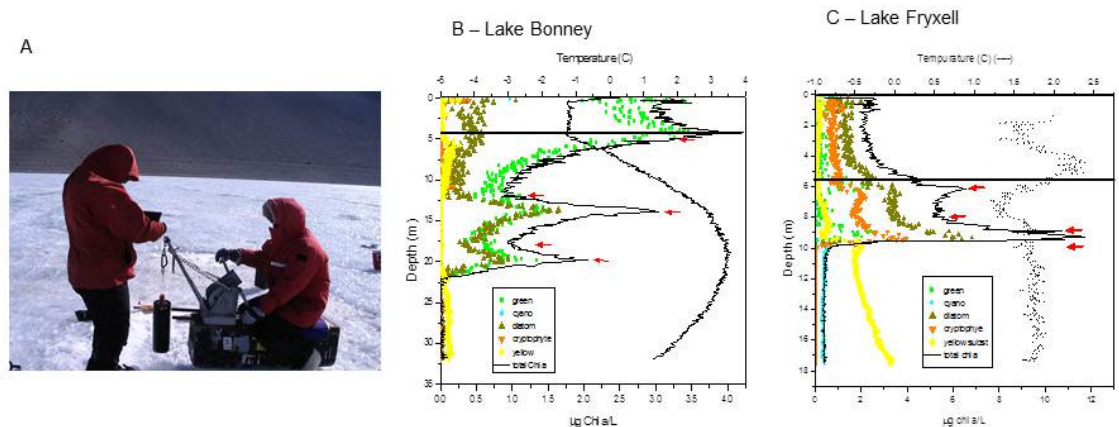


Figure 1A. Researchers preparing to profile an Antarctic lake with the BBE FluoroProbe. B, C. Depth profiles of spectral algal classes in two ice-covered lakes in the McMurdo Dry Valleys, Antarctica. Arrows denote depths where lake water samples were taken for molecular analyses and cultivation experiments. Black solid lines show depth of ice-cover.

In a recent project, we have utilized the Workstation 25 attached to the BBE FluoroProbe to monitor the composition of algal enrichment cultures from various MDV lakes (Figure 2A). Figure 2 shows the composition of 26 cultures that were enriched on several kinds of growth media. We are currently using the FluoroProbe to quickly assess community succession over multiple generations.

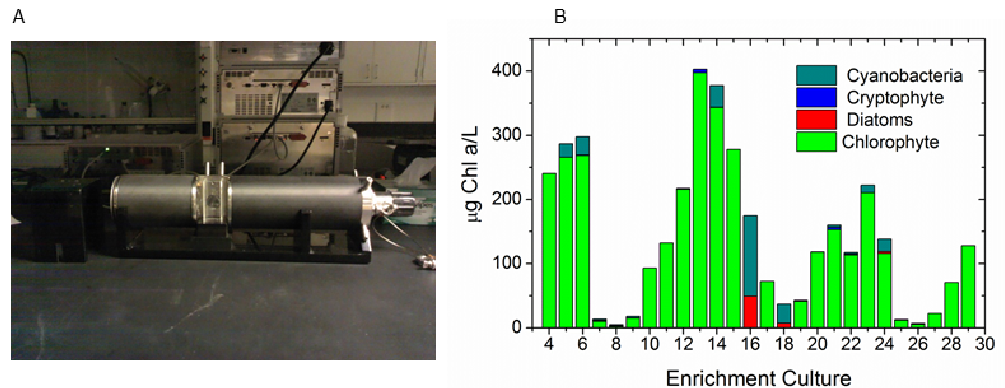


Figure 2A. BBE FluoroProbe with Workstation 25. B. Distribution of algal classes in enrichments cultures developed from lake water collected from McMurdo Dry Valley lakes.

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References:

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