Palmer LTER program: Spatial variability in phytoplankton distribution and surface photosynthetic potential within the peninsula grid, November 1991

BARBARA B. PREZELIN, NICHOLAS P. BOUCHER, MARK MOLINE, ELISE STEPHENS, KEITH SEYDEL, AND KAI SCHEPPE

Marine Science Institute
University of California at Santa Barbara
Santa Barbara, California 93106

As part of the long-term ecological research program (LTER) 1991 austral spring cruise, which defined the biological, chemical, optical, and physical properties of marginal ice zone (MIZ) west of the Antarctic Peninsula (Waters and Smith 1993), we resolved the mesoscale variability in phytoplankton biomass, photosynthetic potential, and community composition. Preliminary results of three transects completed across the MIZ on the R/V *Polar Duke* are presented here. Figure 1*A* and 1*B* respectively, indicate station (Sta) locations and discrete depths sampled with a bio-optical profiling system (BOPS II) (Smith et al. 1992).

Due to strong westerly winds, the pack ice was compressed during this cruise and the edge of the MIZ was especially sharp (figure 1C). Phytoplankton communities beneath the ice pack west of Palmer Station (Sta 600.020 and 600.040) were sampled 7-9 November; the 700 line was transected out of the ice on 14-15 November; the 500 line was transected into the ice on 16-17 November; the outermost station of the 600 line was sampled on 16 November; and the remainder of the 600 line was transected into the ice on 18 November.

Rates of light-saturated photosynthesis (P_{max}) were determined from photosynthesis-irradiance relationships measured on bluegreen light photosynthetrons, using procedures detailed elsewhere (Prezelin and Glover 1991). Reverse-phase high-pressure liquid chromatography (HPLC) procedures were followed to determine phytoplankton pigmentation in replicate one liter samples filtered on 0.4 micrometer nylon 47 millimeter Nuclepore filters and extracted in 3 milliliter 90 percent acetone for 24

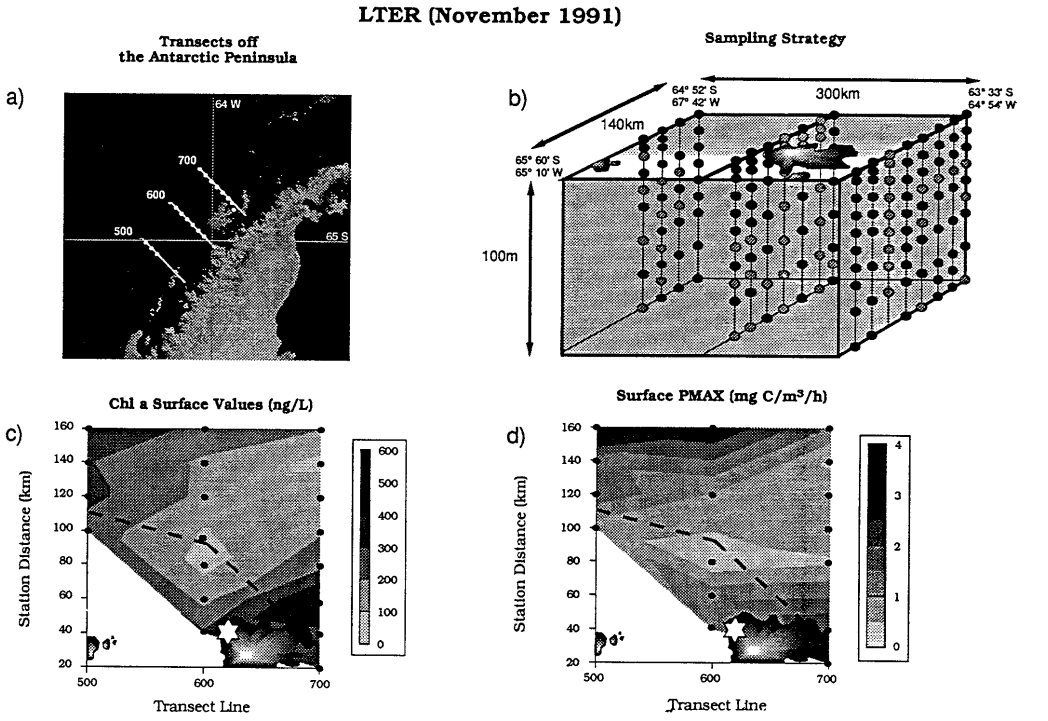

Figure 1. LTER grid, November 1991 (*A*) location of three transects west of the Palmer Peninsula; (*B*) vertical distribution of chemical (all *circles*; includes pigmentation and inorganic nutrients) and productivity (*black circles* only) discrete samples collected with the BOPS II (Smith et al. 1992); (*C* and *D*) surface contour plot of distribution of volumetric chlorophyll *a* and P_{max}, respectively, with station locations (shown as *black circles*), the edge of the MIZ (*dashed line*) and the location of Palmer Station (*star*).

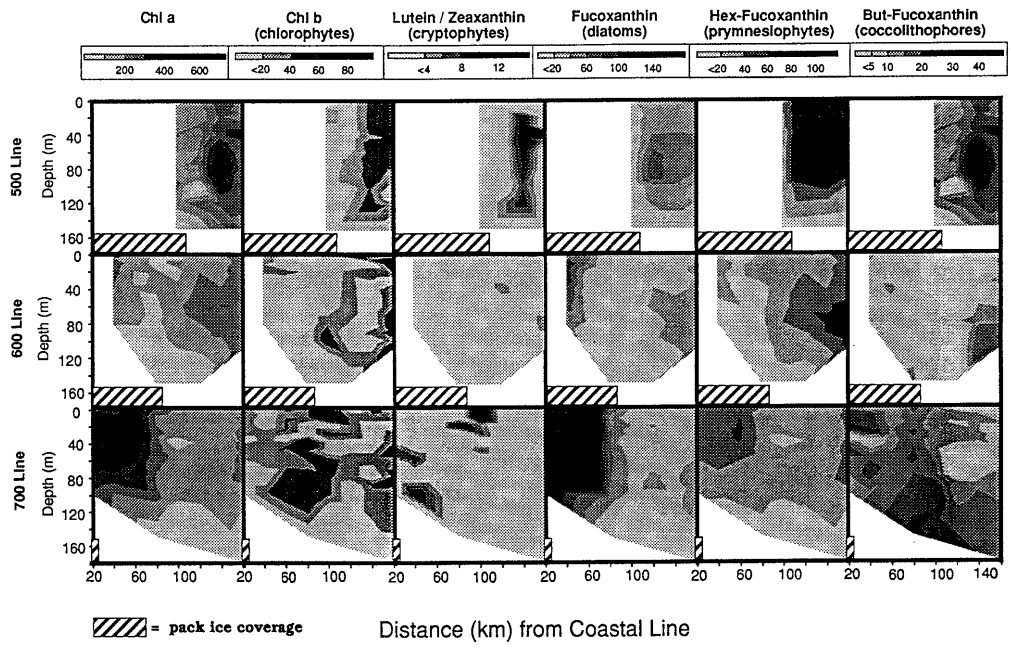

Figure 2. A comparison of contour plots for HPLC pigment distribution along the 500 line (*upper panels*), the 600 line (*middle panels*), and the 700 line (*lower panels*) during November 1991. Pigment concentrations are expressed as ng/L, and the phytoplankton group that each pigment chemotaxonomic marker represents is given in parentheses. Pack ice coverage (*slashed bar*) is indicated at the bottom of each panel.

hours in the dark (-20 °C). Following previously described procedures (Bidigare et al. 1989), pigment separation was carried out with a Hitachi L-6200A liquid chromatograph equipped with a Radial-PAK C18 column (8 × 100 millimeter column; 5 μ particles) and a Hitachi L-4250 UV/VIS Variable Wavelength Detector (436 nanometer). Individual HPLC peak areas were quantified with the aid of Hitachi D-6000 software. Peak identities of the algal extracts are determined by comparing their retention times with pure pigment standards and extracts prepared from standard plant materials of known pigment composition. Diode array spectroscopy (Beckmann DU-64) from 350 to 550 nanometer confirmed identities of the major pigments.

The spatial distribution of plant biomass and volumetric P_{max} in surface waters of the LTER grid are shown in figures 1 C and *D*, respectively. Results indicate that surface plant biomass and productivity was low but quite variable, showing a tendency to covary within the mesoscale grid. Moreover, a comparison of the three transects indicate that while elevated Chl biomass are found along the MIZ, this is not always the case. Note that the lowest levels of plant biomass and primary productivity were located at the ice edge of the 600 line (figure 1 *C* and *D*).

We have used the presence of key chlorophyll and carotenoid pigments as chemotaxonomic markers for different phytoplankton groups and the distribution of their *in situ* concentrations to define the spatial variability in phytoplankton distribution and the relative abundance in various ocean regimes (Smith et al. 1987, 1992). A comparison of contour plots for the most abundant pigment markers along the three LTER transects is presented in figure 2 that indicates diverse communities of phytoplankton existed at discrete locations within the grid. For instance, plant biomass (chl-*a*) was especially high in subsurface waters at the edge of the MIZ in the relatively shallow waters of the Dallmann Bay (inshore on the 700 line). Under the ice, a diatom (fucoxathin)-dominated community was evident and appeared shoreward of a mixed community of chlorophytes (chl-*b*) and coccolithophorids (but-fucoxanthin). While prymnesiophytes (hex-fucoxanthin) such as *Phaeocystis* spp. were present, they appeared concentrated in the open surface waters that entered the Dallmann Bay from the Gerlache Strait. Equally high chlorophyll *a* concentrations were found in subsurface waters over a topographical rise near the end of the Renaud Line (the 500 line), about 40 kilometers offshore the edge of the pack ice. In contrast to the Dallmann Bay, prymnesiophytes appeared to dominate mixed phytoplankton communities, where pigment markers for diatoms, coccolithophorids, chlorophytes, and perhaps cyanobacteria (zeaxanthin) were evident in lesser amount.

It is clear that HPLC technology and the sampling strategy employed during the first field season of the antarctic LTER pro-

gram were successful in documenting the mesoscale variability in phytoplankton communities along the MIZ. The data base is being further analyzed with respect to bottom topography, ocean circulation, and macronutrient availability within the same region to better define the physical and chemical variables that may regulate the mesoscale variability in phytoplankton distribution and the community structure in antarctic waters within a given season.

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