traps. The eventual analysis of samples recovered in April 1993 from a set of three bottom-moored, time-series sediment traps deployed for a 1-year period near LTER station 600.120 should test this diatom spore formation hypothesis.

We would like to thank the R/V *Nathaniel B. Palmer* cruise participants for their help with sample collection. This research was supported by National Science Foundation grant OPP 91-18439, awarded to D.M. Karl. (SOEST contribution number 3346.)

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Palmer LTER: Bacterial exoprotease activity in the Antarctic Peninsula region during austral autumn 1993

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Extensive *in vivo* measurements of exoprotease (leucine aminopeptidase, or LAPase) activity of antarctic marine bacterioplankton were made on the austral autumn 1993 long-term ecological research (LTER) cruise of the R/V *Nathaniel B. Palmer*. The LTER grid consists of 10 transect lines running approximately perpendicular to the Antarctic Peninsula at 100-kilometer (km) intervals, extending from the coast to 200 km offshore. The lines are numbered 000 to 900 from south to north, and the stations are given numbers from 000 to 200 from inshore to offshore (Waters and Smith 1992).

LAPase activity was measured using the fluorescent substrate analog L-leucyl-beta-naphthylamine (LLBN; Somville and Billen 1983). LLBN is added to a 6-milliliter water sample to a final concentration of 1 millimole per liter. This ensures saturation of all available sites so that the measured activity represents an index of the amount of enzyme present in a sample. Samples are incubated for 24 hours at 0°C and the free beta-naphthylamine liberated is measured in a Perkin-Elmer LS-5B spectrofluorometer.

Average activity for each station is based on depth-integrated (trapezoid rule) activities from individual water samples. Integration is to 80 meters (m) or to the greatest sampling depth at a few shallow-water stations. Enzyme activity is expressed in nanomoles per liter per hour (depth-integrated activity divided by integration depth).

Onshore-offshore gradients are largely absent. Several lines show regions of elevated activity that may correspond to frontal zones (figure 1), but in general, activities are as great in the offshore waters of the Antarctic Circumpolar Current as in Bransfield Strait and near the coastal islands of the Palmer Archipelago. Activities are typically fairly constant from the surface to a depth of 80–120 m, where they decline sharply.

LAPase activity in the upper 80 m is not correlated with water depth, which ranges from less than 100 m to greater than 3,000 m (figure 2). LAPase activity is relatively constant from the 900 to the 400 line and then declines toward the southern end of the grid (figure 3). Because the cruise took place in the austral autumn and the southern stations were

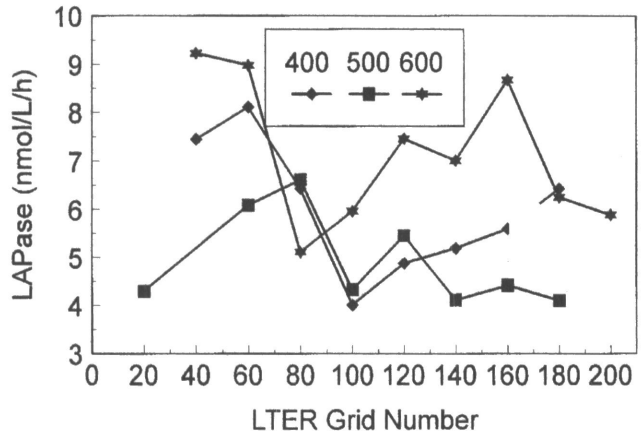

Figure 1. LAPase activity (in nanomoles per liter per hour) along the length of the LTER 400, 500 and 600 lines. Activities are mixed-layer averages based on depth profiles integrated (trapezoid rule) to 80 m or the greatest sampling depth.

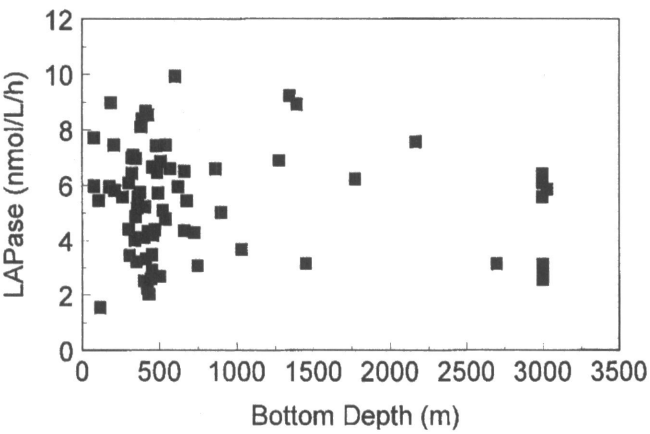

Figure 2. Relationship of depth-averaged mixed layer LAPase activity (in nanomoles per liter per hour) to water depth. Depths greater than 3,000 meters are listed as 3,000 meters.

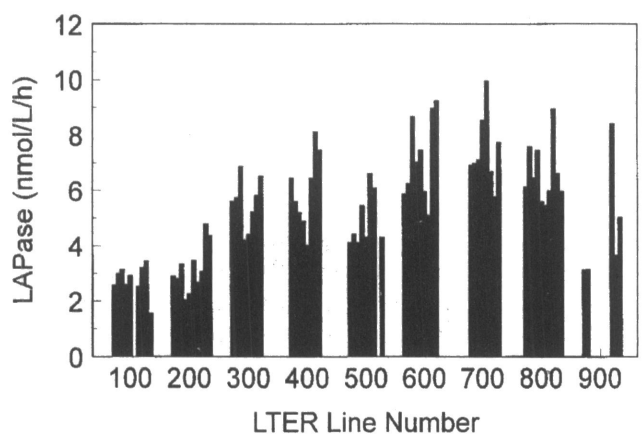

Figure 3. Depth-averaged LAPase activity (in nanomoles per liter per hour) on LTER lines 100 through 900. Bars in each histogram are individual stations, inshore to offshore from left to right.

sampled last, it is difficult to distinguish between latitudinal and seasonal variation. Repeat visits to several stations near the center and at the northern end of the grid after the southern stations were completed show activities that had declined substantially from a month earlier. However, these are still higher than the activities at the southernmost stations, and it is uncertain whether this indicates a year-round geographic difference or simply the earlier onset of winter at higher latitude.

Seasonality in antarctic waters is characterized by large changes in insolation and day length with minimal change in water temperature. The decrease in aminopeptidase activity in winter probably results from reduced availability of organic substrates derived from phytoplankton production and photolysis of dissolved organic matter.

LAPase activity in the shelf and oceanic waters of the Antarctic Circumpolar Current are surprisingly high and extend to significant depths. LAPase activity tends to decline sharply around the pycnocline. In Gerlache Strait during austral summer 1991–1992, LAPase activities declined sharply at depths of 10 to 40 meters (Christian and Karl 1992). On the seaward edge of Anvers Island on this cruise, activities comparable to those at the surface extended to depths as great as 100 m. Although summertime activities in Gerlache Strait are higher than those measured on this cruise, the depth-integrated activity may be greater in outer shelf and oceanic waters where wind mixing extends to greater depths.

The absence of a strong onshore-offshore gradient has significant implications for the remineralization of organic matter in the southern oceans. The data presented here are potential activities measured at saturating substrate concentrations. The rate of enzymatic hydrolysis *in situ* is controlled by the rate of supply of suitable substrate. If turnover rates are high, there will be little horizontal advection of phytoplankton-derived detritus. If turnover rates of dissolved peptides and proteins are low, however, as might be expected in a permanently cold environment (Pomeroy and Deibel 1986), production and consumption of dissolved organic matter may be uncoupled in time and space, and attempts to "close the loop" and balance photosynthesis and respiration must integrate over fairly large space and time scales.

We thank G. Tien, J. Dore, and T. Houlihan for their assistance in sample collection. This research was supported by National Science Foundation grant OPP 91-18439, awarded to D. Karl. (SOEST contribution number 3338.)

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