in *P. decipiens* at 20 percent DFA, however, were significantly lower ($P>0.05$) than plants exposed to a 10 percent DFA concentration. Phycobiliprotein content also dropped significantly among *P. decipiens* and *P. endiviifolia* plants exposed to 10 and 20 percent DFA concentrations. In *P. decipiens* phycocyanin and phycoerythrin content was lowest at 20 percent DFA (phycocyanin content was undetectable at 20 percent DFA, figure 2). No data are available for *P. endiviifolia* at 20 percent DFA, but at 10 percent DFA, phycocyanin content dropped significantly from that of control plants (figure 3).

Previous studies of this nature also revealed that changes in photosynthesis and pigment content are variable, depending on the type of oil, its concentration, the length of exposure, method of preparation of the oil-seawater mixture, the irradiance, and the algal species (Johnson 1977). The significant drop in phycocyanin content in *Porphyra endiviifolia* at 10 percent DFA is noteworthy, since the presence of phycocyanin enables this genus to maintain high rates of photosynthesis throughout the green and into the orange region of the action spectrum (Lüning and Dring 1985) compared to phycoerythrin-rich species (e.g., *Palmaria decipiens*) which occurs lower intertidally than *P. endiviifolia*. The lack of a significant change in photosynthetic rate in these two species is not understood but may be related to the high variability in oxygen measurements that resulted from incubations performed under a wide range of natural irradiance conditions.

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Chlorophyll distribution and primary productivity in the Ross Sea, austral summer 1990

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During January and February 1990, a cruise was conducted in the Ross Sea to measure:

- the silica and carbon production of phytoplankton in the euphotic zone off the Ross Sea of the coast of Victoria Land,
- the vertical flux of particulate material through the water column,
- the regeneration of carbon and silica within the water column, and
- the accumulation of carbon and silica in the sediments.

As part of this experiment, we measured phytoplankton distribution and primary productivity along transects perpendicular to the ice edge. Based on previous results, we expected that a large phytoplankton bloom would develop in the region adjacent to the receding ice edge (Smith and Nelson 1985). Furthermore, we expected that this bloom would be restricted to the region of significant vertical stability imparted by meltwater addition. Other studies of sediment accumulation rates suggested that a large portion of the material produced at the surface within this bloom must reach the sediments (Ledford-Hoffman, DeMaster, and Nittrouer 1986). These results also suggested that a north-south gradient in sediment accumulation rates occurred along the coast of Victoria Land, although a similar gradient in surface productivity has not been observed and, furthermore, would not be expected based on a conceptual model of ice-edge phytoplankton blooms (Smith and Nelson 1986). Our study directly tested whether a latitudinal gradient in surface biomass and productivity exists.

We collected samples from the R/V *Polar Duke* from 12 January to 10 February 1990 (figure 1). Stations were occupied principally along two transects perpendicular to the ice edge (and coastline). One transect was at 76°30′S (the site of the study conducted in 1983 and reported by Smith and Nelson 1985) and one at 72°30′S. Continuous profiles of temperature, conductivity, optical transmission, and fluorescence were made at each station, and samples were collected using Niskin bottles equipped with teflon-coated stainless steel springs and mounted on a rosette frame. Sample depths were based on irradiance penetration. Chlorophyll *a* was analyzed fluorometrically and primary productivity measured by simulated *in situ* techniques (Wilson, Smith, and Nelson 1986).

Chlorophyll concentrations were elevated throughout much of the entire region, particularly along the southern transect. Surface chlorophyll levels ranged from 1.49 to 8.19 micrograms per liter along the southern transect and 0.22 to 2.42 micrograms

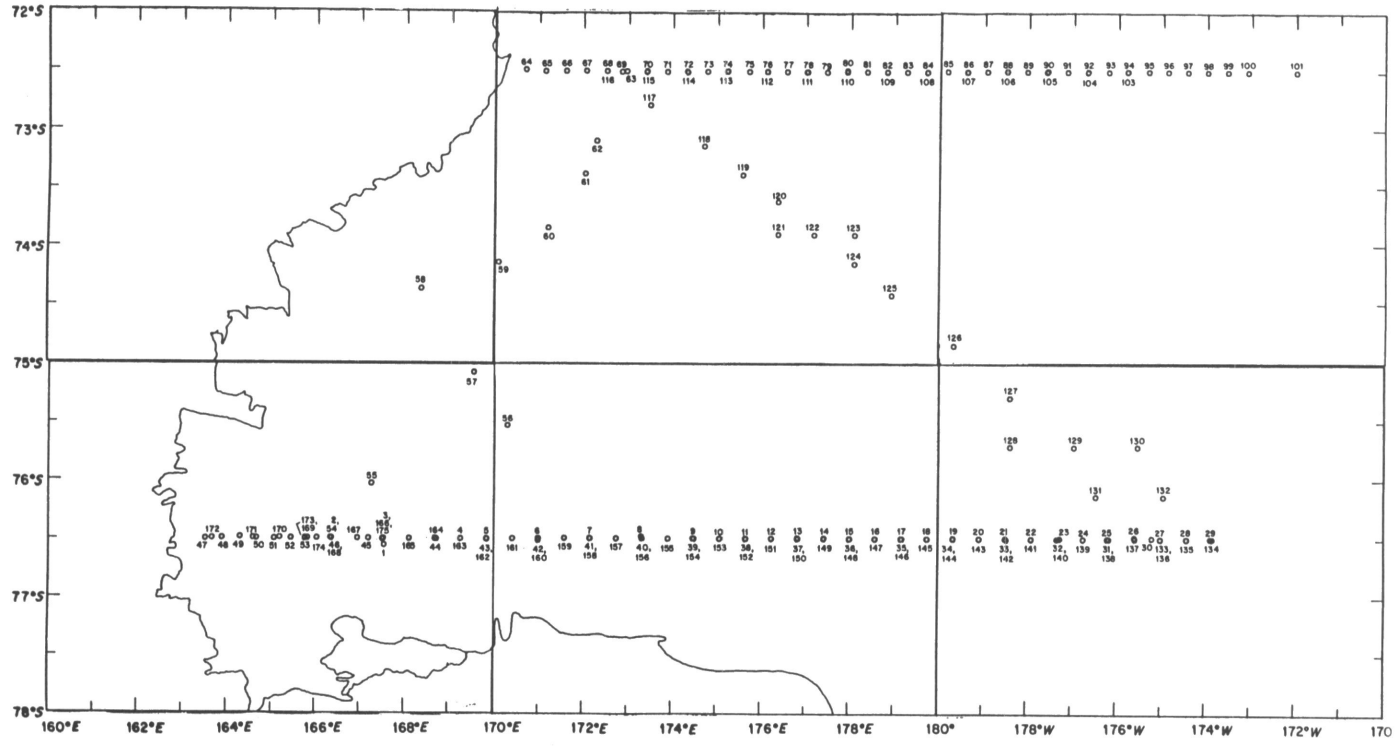

Figure 1. Map showing location of stations occupied during the cruise.

per liter along the northern transect. Sections of density and chlorophyll (figure 2) suggest that some vertical stability was present throughout the southern transect, although the depths of the mixed layer were less closer to the coast. Although not reflected in absolute surface chlorophyll levels, phytoplankton species composition changed dramatically, with a diatom-based assemblage occurring close to the ice, and one with diatoms mixed with *Phaeocystis pouchetii* farther offshore. The vertical distribution of chlorophyll was also different between these two zones, with the increased biomass extending deeper in the water column when *Phaeocystis pouchetii* was present.

In the northern transect, the absolute levels of chlorophyll were much less. Sections of density and chlorophyll (figure 3) appear similar to those from the southern transect, but based on National Oceanic and Atmospheric Administration maps of ice coverage, we know that this region was ice-covered until just prior to our occupation of the transect. We suspect that the low biomass was in large part related to the length of time which the phytoplankton had been exposed to high irradiances and been growing at elevated rates, similar to findings in the Weddell Sea (Nelson et al. 1989; Comiso et al. 1990).

Primary productivity was very high, particularly when contrasted with previous studies. Wilson et al. (1986) found the average carbon fixation rate to be 962 milligrams of carbon per square meter per day, and El-Sayed, Biggs, and Holm-Hansen (1983) found the mean productivity to be approximately 200 milligrams of carbon per square meter per day along the Ross Sea ice shelf. The mean integrated primary productivity (through the 0.1 percent isolume) for the southern transect was 1,370 milligrams of carbon per square meter per day, whereas the average for the northern transect was 999 milligrams of carbon per square meter per day. Such a large productivity, particularly in the southern region, indicates that during this season large amounts of biogenic matter were potentially available for export to subeuphotic depths and to the underlying sediments. A quantitative budget of carbon and silicon await the information on the vertical flux rates estimated from a year-long deployment of sediment traps and analysis of sediment accumulation rates.

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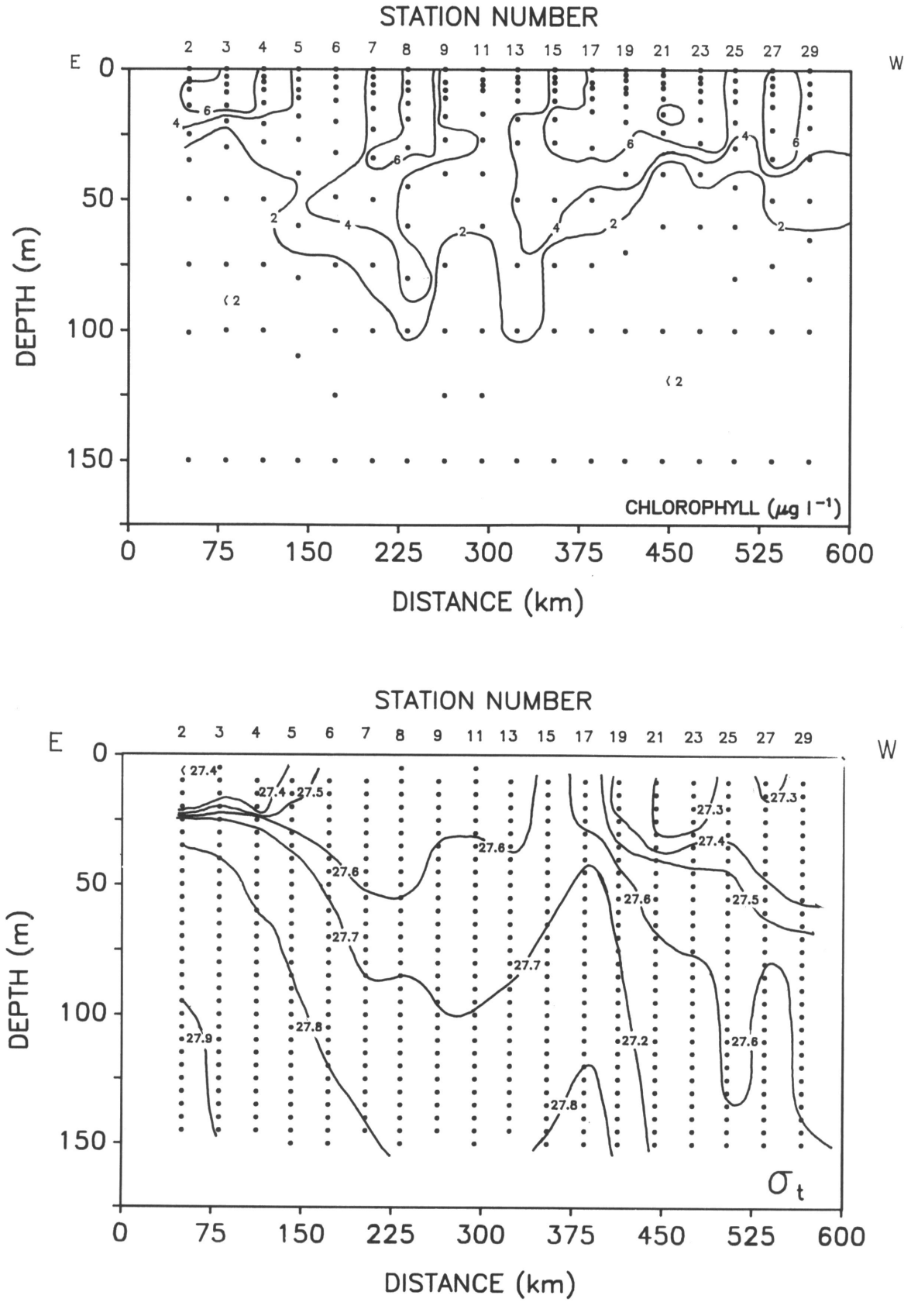

Figure 2. Vertical distribution of density (expressed as σ_t) and chlorophyll in micrograms per liter along the southern transect (76°30′S). Samples were collected from 18 to 20 January 1990. (m denotes meter. km denotes kilometer.)

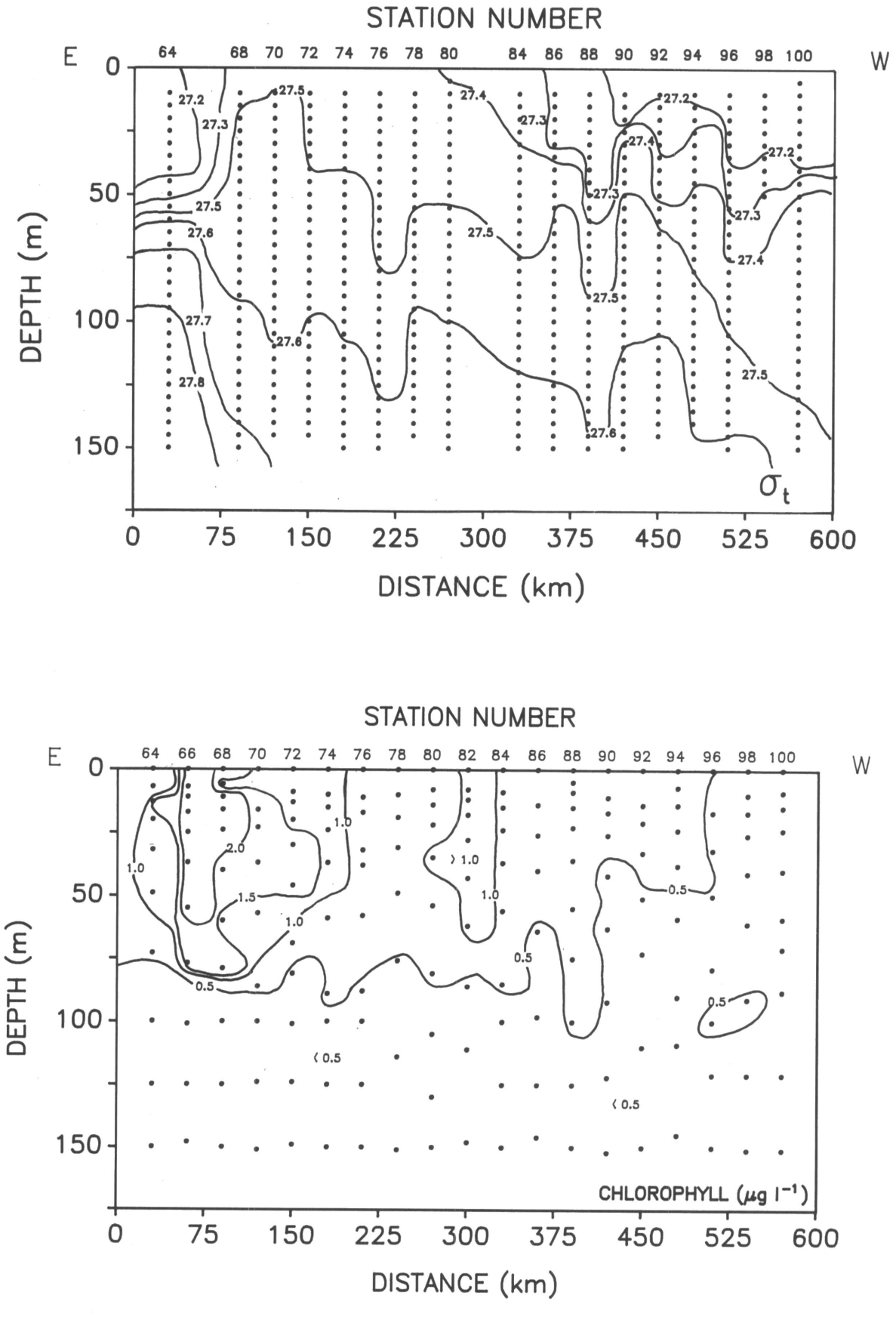

Figure 3. Vertical distribution of density (expressed as σ_t) and chlorophyll in micrograms per liter along the northern transect (72°30′S). Samples were collected from 28 to 30 January 1990. (m denotes meter. km denotes kilimeter.)