and may have resulted from the density stratification that characterizes this region. In each of these profiles, the record abundances of aggregates in the bottom nepheloid layer may be indicative of resuspension or lateral transport of phytoplankton debris.

Although these profiles are "snapshots" of aggregate abundance, other data confirm earlier hypotheses that these suspended aggregates are eventually scavenged from the water and contribute to vertical flux (Asper et al. 1992). All of the sediment-trap samples collected by Dunbar, Leventer, and Stockton (1989) in the McMurdo Sound showed substantial increases in vertical flux near the seafloor. In one case, the total flux was more than 10 times greater at 700 m than it was near the sea surface. These samples were dominated by biogenic silica, which showed even greater increases than total mass flux. These data were interpreted as indicating resuspension of aggregated diatom remains from the seafloor and lateral transport of the material via the general clockwise circulation existing in McMurdo Sound.

An important characteristic of these aggregates is their large size and the fact that conventional particle detectors, such as transmissometers, do not accurately assess their abundance. In figures 1 and 2, beam attenuation is plotted along with aggregate abundance, and in all cases, the transmissometer detected a nepheloid layer but underestimated its magnitude. In figure 2, the transmissometer found the highest concentrations of the fine particles to which it is most sensitive near the surface, the lowest concentrations at mid depths and a slight increase near the seafloor. In contrast, the aggregate data show a continuous increase in abundance with depth. An intriguing aspect of this data set is that these high abundances were obtained at a time when all other indicators of productivity were low, including high nutrient levels, low pigment levels, and low carbon-14 uptake rates. The source of these aggregates remains somewhat of an enigma, but it can be inferred from these studies that aggregate data are required if one is interested in detecting the large particles that are thought to be important in the vertical flux of particulate matter.

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Palmer LTER: Hydrogen peroxide in the Palmer LTER region: I. An introduction

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The Palmer long-term ecological research (LTER) program is a coordinated multi-investigator and interdisciplinary study of an ice-dominated, high-latitude marine ecosystem. Our interest in studying hydrogen peroxide (H_2O_2) dynamics in this southern oceans habitat was inspired by two ecological applications of these data. First, it has been suggested that H_2O_2 concentrations, when coupled with production and decay rates, can be used as a tracer for vertical advection in surface ocean waters (Johnson et al. 1989). To the extent that vertical mixing is a critical variable in determining the production of southern oceans ecosystems (Mitchell and Holm-Hansen 1991), this information is fundamental to the objectives of the Palmer LTER program. Second, because H_2O_2 is a common intermediate or reaction product of photochemical reactions of oxygen with organic compounds (Zafiriou 1983), it may provide a convenient analytical procedure for assessing photolytic alteration of dissolved organic matter (DOM) in sea water. Recent studies suggest that photochemical processes may play a previously unrecognized role in the global carbon cycle (Mopper and Zhou 1990).

We considered it essential, for several reasons, to evaluate the magnitude of these potential photochemical processes in

the context of our study, which is focused on the biological cycling of DOM. The increased ultraviolet light fluxes associated with destruction of the stratospheric ozone layer (Frederick and Snell 1988) are expected to accelerate photolytic degradation processes in the future. Consequently, it is important to establish a baseline and to assess the ecological significance of photolytic effects prior to further erosion of the ozone layer. In addition, the microorganisms and bulk organic matter contained within the ice habitats that dominate much of the southern oceans (Karl 1993) may be particularly vulnerable to photolytic effects because of their direct, prolonged exposure to high-intensity radiation and elevated dissolved oxygen fugacities, especially during the austral summer.

H_2O_2 is a highly soluble gas with numerous sources and sinks in the global ecosystem. An atmosphere-to-ocean flux of H_2O_2 is one potential source term for the southern oceans. H_2O_2 is a major photooxidant in the troposphere, and its aqueous and gas phase free radical chemistry are well-studied (Logan et al. 1981; Chameides and Davis 1982; Sakugawa et al. 1990). Atmospheric production of H_2O_2 is also expected to vary with changes in natural and anthropogenic pollutant loading (Kok 1980; Weller and Schrems 1993). A recent analysis of H_2O_2 preserved in Greenland ice cores shows that the atmospheric H_2O_2 burden has increased by approximately 50 percent during the past 200 years (Sigg and Neftel 1991).

Because H_2O_2 occupies an intermediate state between oxygen (O_2) and water (H_2O), it may contribute to the control of the redox potential in oxic sea waters (Breck 1974). In the surface waters of the global ocean, H_2O_2 can be produced by photochemical processes including reactions with DOM compounds (Cooper and Zika 1983; Zafiriou 1983) and disproportionation of superoxide (Petasne and Zika 1987). In antarctic ecosystems, the strength of the photochemical source varies substantially with latitude, season, water depth, and DOM loading. H_2O_2 can also be produced via *in situ* microbiological production, either by phytoplankton (Palenik, Zafiriou, and Morel 1987; Zepp, Skurlatov, and Pierce 1987) or bacteria (Jones 1982). Selected source pathways are light-independent, so they could theoretically occur at any depth, any season or under different conditions of ice cover.

Potential sinks for H_2O_2 include chemical interactions with various dissolved constituents or biological processes including peroxidase and catalase enzyme activities (Zepp et al. 1987). In the presence of light or certain trace metals (for example, copper and iron), H_2O_2 may contribute to the production of OH free radicals potentially resulting in further photo-oxidation of DOM. H_2O_2 must, therefore, be viewed as an important intermediate compound with oxidizing, reducing, and nucleophilic potentials (Petasne and Zika 1987).

In the following three articles (Resing et al.; Tien and Karl; Karl and Resing; *Antarctic Journal*, in this issue), we present data on the distributions of H_2O_2 in the 2×10^5 square kilometer Palmer LTER study area and summarize our preliminary results on H_2O_2 sources and sinks for the local antarctic coastal region.

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