Steady state hydrogen peroxide concentrations across the Subtropical Convergence east of New Zealand

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Abstract. Hydrogen peroxide (H_2O_2) is recognized as the most stable of the reactive oxygen species produced by sunlight-driven photochemical reactions in natural waters. To assess the influence of the Subtropical Convergence (STC) on levels of hydrogen peroxide, we determined the hydrogen peroxide concentrations in surface seawater along a transect east of New Zealand. Our results show that levels of hydrogen peroxide increase near the Subtropical convergence and seem to be correlated with variations in chlorophyll values

Introduction

Hydrogen peroxide (H_2O_2) is naturally formed in seawater as a result of several processes, including photochemical formation, biological production, and wet deposition. Concentrations of H_2O_2 in open ocean water can reach up to 250 nM (Miller *et al*. 2005). Hydrogen peroxide is an important mediator of redox processes in natural waters (Cooper and Zika 1983). For example, H_2O_2 can affect the fate of organic material and the bioavailability of nutrients (Cooper and Lean 1992; Scully *et al.* 1996). The Subtropical Convergence (STC) zone east of New Zealand is an area of dynamic biological and chemical activity. The objective of this work was to ascertain the influence of the Subtropical Convergence on H_2O_2 concentrations in surface seawater.

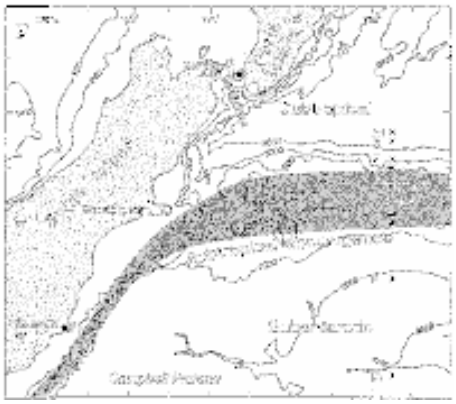

Figure 1. The Subtropical Convergence zone

Hydrogen Peroxide Measurements

In late February 2005, hydrogen peroxide concentrations were measured in surface seawater east of New Zealand on a transect from 46°38'S to 41°10'S along the 178°30'E meridian, aboard the New Zealand National Institute of Water and Atmosphere (NIWA) research vessel R/V Tangaroa. Hydrogen peroxide was measured using flow injection analysis with chemiluminescence detection (FIA-CL) (Miller *et al*. 2005). Chlorophyll measurements employed a Turner model 10-D digital fluorometer equipped with a chlorophyll-a filter set and a flow cell. Samples were collected from the ship's scientific seawater supply, which provided a continuous supply of surface seawater to the temperature controlled lab on the factory deck of the ship. Samples from greater depths were collected using 10 L General Oceanics Go-Flo bottles mounted on a standard CTD rosette.

Results and Discussion

Concentrations of H_2O_2 in the surface seawater ranged from 43.9 nM to 138.5 nM (figure 2). The highest concentrations of H_2O_2 were measured between 44° S and 45° S, in the vicinity of the Subtropical Convergence, where subantarctic water mixes with subtropical water. Average concentrations of H_2O_2 were 78.9 nM in the convergence zone (n=31), 70.8 nM in subtropical water (n=30), and 68.4 nM in subantarctic water (n=27).

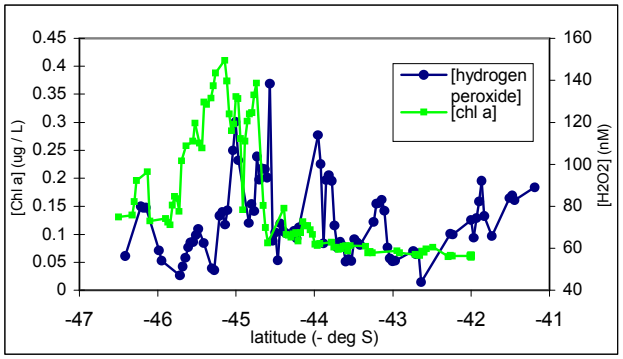

Figure 2. Concentrations of hydrogen peroxide and chlorophyll-a (Raw values) across the subtropical convergence (February 2005).

Maximum concentrations of both H_2O_2 and chlorophyll-a were measured in the vicinity of the Subtropical Convergence at ~ 45°S (figure 3). Depth profiles of the hydrogen peroxide concentrations, collected at either end of the transect, show maximum H_2O_2 concentrations at ~ 10 m depth, and decreases in the concentration of H_2O_2 at greater depths (figure 4 and 5).

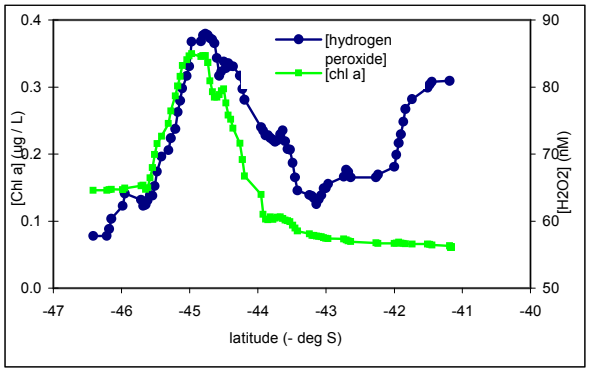

Figure 3. Concentrations of hydrogen peroxide and chlorophyll-a (moving averages) across the subtropical convergence (February 2005). Hydrogen peroxide moving average has a period of 19 points. Chlorophyll-a moving average has a period of 9 points.

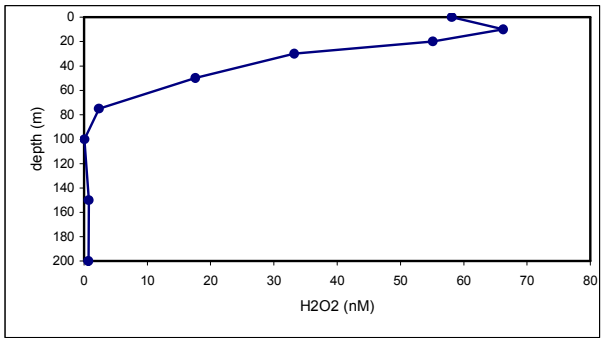

Figure 4. Hydrogen peroxide depth profile (southern mooring station) 0500 NZDST 25 February 2005.

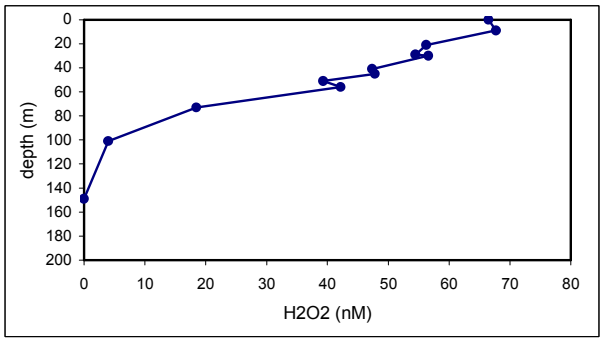

Figure 5. Hydrogen peroxide depth profile (northern mooring station) 2330 NZDST 26 February 2005.

No relationship between time of day and hydrogen peroxide concentration (diel cycle) was observed during the voyage.

Conclusions

Concentrations of hydrogen peroxide generally increased as the ship approached the Subtropical Convergence zone from the south, and then decreased as the ship moved north, away from the convergence zone. The variation in hydrogen peroxide concentrations appears to be correlated to variations in chlorophyll concentrations along the transect. Elevated steady-state concentrations of hydrogen peroxide around the STC may be attributable to increases in biotic and/or abiotic formation of hydrogen peroxide in the STC area.

Acknowledgements

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