INTRODUCTION

The eastern upwelling sector of the equatorial Pacific is one of the world’s largest high-nitrate low-chlorophyll (HNLC) regions where growth of siliceous plankton (mainly diatoms) is limited by low iron concentrations (Coale et al. 1994) and may be further limited by silicon availability (Ku et al. 1995; Duggan et al. 1995). In the warmer waters of the western equatorial Pacific, rates of biogenic silica production are also depressed by low silicon concentrations (Leynaert et al. 2001). Although silicon dynamics are well characterized in the eastern equatorial Pacific, there is little information on diatom productivity and silicon cycling across the biogeochemical gradient extending from HNLC waters in the east to the warm pool of the western Pacific.

RESEARCH OBJECTIVE

The goal of this study was to examine E-W variations in silicon cycling and the productivity of siliceous plankton in surface waters of the equatorial Pacific.

STUDY AREA

Samples were obtained from stations located 2°N, 2°S and the Equator from 140°W to 180°E.

VERSATILE VARIATIONS OF BIOGENIC SILICA CONCENTRATIONS AND PRODUCTION RATES

Biogenic silica production rates ($\mu$g, gross) were measured at 6 depths in the euphotic zone (100% to 0.1% $\rho$) using the radioactive $^{32}$Si tracer.

- Biogenic silica concentrations ([BSi]) and production rates ($\mu$) decreased from 140°W to 180°E and with depth in the water column.
- [BSi] reached a minimum at 125-150 m at all stations and slightly decreased below these depths, likely indicating earlier export events.
- An increase in deep [BSi] was most evident in the eastern portion of the basin.

SILICON LIMITATION OF BIOGENIC UPTAKE RATES

- Enh statistics were > 1 at all stations, suggesting Si limitation of biogenic silica production in the entire equatorial band.
- Enh statistics increased from 140°W to 180°E, indicating that limitation was more severe in the western Pacific than in the HNLC region.
- Biomass-specific Si uptake rates ($V_{\text{Si,sw}}$) decreased from 140°W to 180°E.

KINETICS OF SILICON UPTAKE

- The maximum rate of uptake ($V_{\text{max}}$) was the same at both equatorial stations.
- The half-saturation constant ($K_s$) was twice as high in the western area (Station 14), indicating a lower affinity for Si(OH)$_4$.
- Ambient [Si(OH)$_4$] at Station 14 (0.5 µmol L$^{-1}$) and at Station 8 (1.2 µmol L$^{-1}$) were 19 and 4 times lower than the $K_s$ at each station, respectively.
- This implies that ambient [Si(OH)$_4$] supported 9% and 23% of $V_{\text{max}}$ at Station 14 and Station 8, respectively.

INTTEGRATED GROSS AND NET BIOGENIC SILICA PRODUCTION, AND SILICA DISSOLUTION RATES

Gross BSi production rates were measured from 100 to 0.1% $\rho$ using the $^{32}$Si tracer.

- Eastern HNLWs (140°W):
  - Net BSi production rates were positive in the euphotic zone.
  - Integrated silica dissolution rates varied from undetectable to 0.2 mmol m$^{-2}$ d$^{-1}$.
- Western waters (170°W):
  - Net BSi production was negative at every depth of the euphotic zone.
  - Integrated silica dissolution varied from 0.46 to 4.24 mmol m$^{-2}$ d$^{-1}$.
  - Integrated silica dissolution rates ( ΔD) exceeded gross BSi production rates (V.BSi).

SUMMARY AND CONCLUSIONS

- This study shows large E-W differences in the productivity of siliceous plankton and silicon dynamics in surface waters within the equatorial band.
- HNLW surface waters were characterized by higher rates of gross silica production and higher biogenic silica concentrations compared to the western equatorial Pacific.
- The HNLW region showed net production of biogenic silica, while dissolution completely surpassed gross silica production in the euphotic zone of the western region.
- In the west equatorial Pacific, there was a large net imbalance in and loss of BSi from the euphotic zone. This imbalance extended down to 300 m.
- Data indicate Si limitation by siliceous plankton occurred within the entire area, with limitation most severe in the western equatorial Pacific.
- These results imply greater potential for Si export in HNLW waters than in the western region, although silicious plankton appear to contribute very little to the downward flux of silica and other nutrients within the entire study area.

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