Oceanographic Variability at Clipperton Atoll Since the 1880s: Stable Isotopic Evidence from Massive Corals

Braddock K. Linsley and Robert B. Dunbar

Abstract

Clipperton Atoll (10°18'N, 109°13'W), lies within the eastern Pacific elongated warm water pool centered at 10°N and is situated at the boundary of the North Equatorial Counter-Current (NECC) and westward-flowing eddy currents moving away from Central America. This area is on the periphery of the influence of ENSO's warm events, with SSTs anomalies averaging +1°C. The stable SST field drives convection in the eastern Pacific intertropical Convergence Zone, resulting in rainfall that exceeds 3 meters/year. Fifteen coral cores were collected from massive heads of *Porites lobata* in April 1994 for the purpose of reconstructing oceanographic and climatic conditions at this open ocean site in the eastern Pacific. The colonies were all growing near the outer edge of a 10-13 meter terrace surrounding the atoll. The four longest coral cores from different heads extend back into the 1880s, even with the exceptionally high growth rates, which average 2.2 centimeters/year.

Sub-annual $\delta^{18}O$ and $\delta^{13}C$ analyses were performed on selected cores at intervals of about 10 to 20 samples per year, and annually averaged samples were analyzed on three cores to examine long-term trends back to the 1880s. Calibration of the isotopic data was performed using *in situ* and satellite derived SSTs. MSS estimated precipitation, monthly cloud cover, and wind fields, and a salinity climatology. The annual 1-2°C range in SST appears to be accurately record by the $\delta^{18}O$ composition of these corals with only a small effect of salinity or the $\delta^{18}O$ (sub-seawater). The long-term $\delta^{18}O$ annually-averaged records all demonstrate that SST in this region has been generally stable for the past 120 years with the exception of the last 10 years, which show a 0.5°C warming in concordance with SST data and the more frequent occurrence of ENSO events. For $\delta^{13}C$, the subannual sampling reveals that $\delta^{13}C$ minima coincide with $\delta^{18}O$ minima, with the most depleted values occurring at the end of the dry season when SST is at a maximum. This correlates with the initiation of the low density portion of annual skeletal growth. The annually averaged $\delta^{13}C$ data reveal generally stable $\delta^{13}C$ values from the 1880s until the mid-1960s, when a >1‰ trend toward depleted values occurs that continues through April 1994. The origin of this $\delta^{13}C$-depleted trend is unclear. CZCS data reveal that tradewind-induced coastal upwelled waters from central Mexico extend west past Clipperton. We hypothesize that this change in coral $\delta^{13}C$ is the result of increased westward advection of upwelled coastal waters and decreased influence of the NECC at Clipperton.

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