A STUDY OF A MULTI-CENTURY CORAL STABLE ISOTOPE RECORD FROM RAROTONGA, SOUTHWEST SUBTROPICAL PACIFIC, FOR THE PERIOD 1726-1997

by

Lei Ren

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ABSTRACT

This study presents a 271-year (1726-1997) subseasonal oxygen and carbon isotopes ($\delta^{18}O$ and $\delta^{13}C$) records from a coral colony of *porites lobata* at Rarotonga (21.5°S, 159.5°W) in the southwest subtropical Pacific. A new method is introduced whereby the effects of sea surface temperature (SST) can be separated from those of seawater $\delta^{18}O$ composition ($\delta^{18}O_{sw}$) on coral $\delta^{18}O$ by using the coupled coral Sr/Ca and $\delta^{18}O$. The reconstructed $\delta^{18}O_{sw}$ at Rarotonga using this method shows that it contributes significantly to the annual changes of coral $\delta^{18}O$ for the period 1726-1997. While changes of $\delta^{18}O_{sw}$ account for ~39% of the total coral $\delta^{18}O$ variation, changes of SST account for ~61%. The reconstructed $\delta^{18}O_{sw}$ also shows a positive linear correlation with a satellite-based estimated salinity for the period 1980-1997 (r=0.72). This linear correlation between reconstructed $\delta^{18}O_{sw}$ and salinity makes it possible to use the reconstructed $\delta^{18}O_{sw}$ to estimate the past interannual and decadal salinity changes in this region.

Applying a similar method to coral $\delta^{13}C$, the effects of kinetic and metabolic activity on coral $\delta^{13}C$ were also quantitatively separated. The results show that the variation of coral $\delta^{13}C$ appears to be mainly caused by variation of metabolic activity rather than that of kinetic activity in both tropical and subtropical regions. For the tropical regions, $\delta^{13}C$ variation in corals is predominantly influenced by changes of metabolic activity (~90%), while for subtropical regions, approximately 70-75% of the total variation of coral $\delta^{13}C$ is due to the effects of metabolic activity.

The interannual and interdecadal variability in coral $\delta^{18}O$ at Rarotonga for the period 1726-1997 was also examined. The results suggest that although Rarotonga is located outside of the center of action of ENSO, it is generally sensitive to ENSO variability in this region. In addition, the decadal variability (~12 yr) was further differentiated from the interdecadal-scale variability (~32 yr) for the period 1726-1997 at Rarotonga. Based on the analysis of both tropical and subtropical coral data and comparisons with the Nino3.4 SST index and PDO index, it was hypothesized that the decadal and interdecadal variability might result from separate forcing mechanisms.

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