Carbon and oxygen isotopes in Porites coral skeleton controlled by relative intensity of kinetic and metabolic isotope effects

Tamano Omata[1]

[1] Marine Ecosystem Research Dept., JAMSTEC

Kinetic and metabolic isotope effects reconstructed in coral skeleton

Tamano Omata1, Atsushi Suzuki2, Hodaka Kawahata2,3, Mineo Okamoto4
1 Marine Ecosystems Research Department, Japan Marine Science and Technology Center (JAMSTEC)
2 Institute for Marine Resources and Environment, National Institute of Advanced Industrial Science and Technology (AIST)
3 Graduate School of Science, Tohoku University
4 Department of Marine Science and Technology, Tokyo University of Fisheries

We examine the relationships between skeletal carbon and oxygen isotopes in Porites colonies of different growth rates ranging between 2.4 and 8.0 mm yr-1. Coral samples were collected in the Sekisei Reef of the southern Ryukyu Islands, Japan (25N, 125E) at depths between 11.6 and 15.1 m below mean sea level. The oxygen isotope variations of all colonies showed cyclic fluctuations corresponding well to annual sea-surface temperature (SST) variations. Although skeletal carbon isotopes showed annual cyclic fluctuations, the correlation between carbon and oxygen isotope fluctuations showed differences for growth rate. Faster-growing corals more than 4.8 mm /yr showed an negative correlation between carbon and oxygen isotope ratios, which is also consistent with previously reported relationship for corals at low tide-line in the region. The negative relationship is caused by metabolic effect, which is photosynthetic 13C enrichment in coral skeleton due to strong solar radiation in summer, together with more depletion in 18O due to higher SSTs (Fairbanks and Doge, 1979). On the other hand, slower-growing corals below 4.8 mm/yr showed a positive correlation between oxygen and carbon isotope ratios. We employed a vector notation technique for evaluating each of co-existing factors affecting isotope values of coral skeleton. The positive correlation for slower-growing corals is probably due to the dominance of kinetic isotope effect because of the absence of active photosynthesis in low irradiance condition. The domination of kinetic isotope effect comparing with metabolic isotope effect for slower growing corals corresponds to the result of Pavona in Ecuador reported by McConnaughey (1989).

References:

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