Aspartic acid in coral skeleton: a potential bio-indicator of coral growth

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Coral skeleton is a remarkable high resolution recorder of fluctuations in the marine environment, in which the corals grow. The skeletal isotopes (carbon and oxygen) and elements (Sr, Mg, Ca, U etc.) provide useful proxies for monitoring such fluctuations in the past. Although carbon isotope data provide clues to photosynthesis, respiration, reproduction in corals, the information on these biological processes gets mixed with fluctuations in dissolved inorganic carbon content of seawater. In order to monitor activity of coral as an organisms, an independent parameter is required. Since amino acids are closely associated with biomineralization of the coral skeleton, they have potential to provide clue to changes in coral activity. Therefore, we examined changes in amino acid (AA) composition along the growth axis of a coral colony. Here we report seasonal variations in aspartic acid (Asp; an AA) content of the coral skeleton and discuss its implications as a new biomarker to monitor coral growth.

A coral core collected from Ishigaki island, Japan was sliced, cleaned, x-rayed and sampled along the growth axis. Approximately 1 mg sample was collected from every 2x2x0.4 mm3 section of the coral core. For amino acid analysis, sample was hydrolyzed with 6N HCl in a pre-combusted glass ampoule which was flushed with argon gas, sealed and placed in an oven at 110 degree C for 22 hrs (Gupta and Kawahata, 2000). AAs were detected and quantified by using the Waters AccQ-Tag method, which uses AccQ-Fluor reagent (6-aminoquinolyl-N-hydroxysuccinimidyl carbamate) for pre-column derivatization of AAs. Stable isotopes of carbon and oxygen were also analyzed in adjacent sample by using a Micromass Optima spectrometer. The total hydrolysable AA (THAA) concentration in the samples varied from 1.1 to 3.6 mmole/g (average 2.3 mmole/g) or 13 to 43 mg/100 g of coral. This range of THAA concentration is comparable to that (29 - 87 mg/100 mg coral) reported by Ingalls et al. (2003). Among all AAs analyzed, only Asp relative mole content profile shows regular seasonal variation with minimum during winter and maximum during summer. The stable isotope of oxygen data from the adjacent samples corroborate this seasonal pattern. Results from our study show that Asp is closely related with calcification. The sequence of events in coral growth seems to be that rise in temperature leads to higher production of Asp, which in turn leads to higher rate of calcification.

Gupta, L.P., Kawahata, H., 2000. Amino acid and hexosamine compositions and flux of sinking particulate matter into the equatorial Pacific at 175 longitude. Deep-Sea Research 47 (10), 1937-1960.

Ingalls, A.E., Lee, C., Druffel, E.R.M., 2003. Preservation of organic matter in mound-forming coral skeletons. Geochimica et Cosmochimica Acta 67 (15), 2827-2841.