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Long-term quantitative assessment of the influence of sediment-related reef disturbance on coral calcification using skeletal geochemical proxies and skeletal growth parameters, in Sumiyo Bay, Amami Oshima.

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Coral reefs are currently facing multiple disturbance (natural/anthropogenic factors) in local and global scale. Reef disturbance, especially, local sediment input caused by river runoff and coastal development would have a negative impact on reef growth. Coral calcification could be a quantitative scale of the influences of the sediment-related reef disturbance. Temporal and qualitative reef assessment, for example, coral bleaching observation and reef cover monitoring cannot quantify long-term changes in sediment load, and it is difficult to estimate the influences on coral calcification. Therefore, a long-term quantitative assessment which could simultaneously evaluate sediment load and coral calcification is required.

Massive coral skeletons (*e.g. Porites sp.*) which distributed through sub-tropical and tropical regions provide the archives of various proxies for environmental and climatic reconstructions with high-temporal resolution owing to their rapid extension rate. In addition, annual bands and seasonal variations in skeletal geochemical record provide quantitative coral calcification rate. Barium (Ba) is incorporated into the coral skeletons in close proportion to seawater concentration, therefore coral skeletal Ba/Ca ratio reflects the variation of Ba concentration, which is associated with river discharge and terrestrial input. Sumiyo Bay (nearby Sumiyo- and Yangachi-river mouth; eastern area of Amami Oshima, Japan) repeatedly suffered devastating damages by river-flood and landslide events caused by complicated background including mangrove-trapped sediment runoff at the river mouth and coastal land-use. In this study, we reconstruct sediment load and the responses of coral calcification in Sumiyo Bay during last 47 years, using skeletal geochemical records (Sr/Ca, Mg/Ca, Ba/Ca, δ^{18}O, and δ^{13}C) and skeletal growth parameters (annual extension rate (mm/yr), annual mean density (g/cm^3), and annual calcification rate (g*cm^{-2}/yr)).

Skeletal geochemical records showed freshwater- and sediment-runoff signals during the heavy rainfall events. Especially, skeletal Ba/Ca record indicated the coral responses to habitat environmental changes by sediment load. The baseline of skeletal Ba/Ca was characterized by increasing trend toward the present day. There was significant negative correlation between the baseline of skeletal Ba/Ca and all of the growth parameters (R = -0.48 to -0.59; P < 0.001). In addition, annual calcification rate significantly decreased with increasing precipitation during recent several years (R = -0.96; P < 0.001). These results suggest that sediment load associated with becoming active in the coastal development and increasing of the frequent localised heavy rainfall will lead the disturbance of coral calcification in Sumiyo Bay. We conclude that skeletal geochemical records reflect reef environmental changes by sediment load, and it would be a useful archive of local-based natural/anthropogenic reef disturbance. Additionally, long-term quantitative assessment of coral calcification combined with skeletal geochemical proxies could thus help to predict coral survival under local sediment stress.