Study on the coral skeleton of Porites australiensis response to light under long-term rearing experiments

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Several geochemical tracers in coral skeletons have been used as proxies for sea surface temperature (SST). However, it is reported that these values are influenced by coral skeletal growth. Coral skeletal growth is strongly affected by environmental factors, such as temperature and light, but it is almost unknown how these environmental factors have influence on the geochemical tracers. This study was designed to investigate the effect of skeletal growth rate on trace elements (Mg/Ca, Sr/Ca, U/Ca ratios) in the skeleton of the coral Porites australiensis by long-term rearing experiment with different light conditions.

Three donor colonies of Porites australiensis that have different genotypes were reared in flow-through aquarium system under three light intensity regimes (250, 400, 600; 12h:12h light:dark photoperiod) and constant temperature for about four months. Skeletal growth rate of coral nubbins were calculated by buoyant weight of these nubbins. After finishing rearing experiments, zooxantellae density, chlorophyll, photosynthesis parameters by PAM were measured.

The results showed that skeletal growth rate depends on light intensity and colony It is suggested that the pattern of growth response to light intensity varied among the colonies. Additionally, skeletal growth rate did not showed significant correlation with zooxantellae density, chlorophyll, maximum quantum yield of PS2(Fv/Fm), maximum electron transfer rate(ETRmax).

Skeletal trace elements in coral skeletons used in the rearing experiments above were analyzed by ICP-MS. The results showed that skeletal growth rate has positive correlation with Mg/Ca ratio, as shown in previous studies. On the other hand, Sr/Ca ratio showed negative correlation with skeletal growth rate. The colony which shows strongest correlation between the skeletal growth rate and Sr/Ca ratio caused 2.9C deviation from inferred temperature led by the 5 times faster growth rate than other colonies. Then, U/Ca ratio also showed negative correlation with skeletal growth rate, and the colony which shows strongest correlation between the skeletal growth rate and U/Ca ratio caused 4.0C deviation from inferred temperature led by the 5 times faster growth rate than other colonies.

Thus, in this study, the Sr/Ca and U/Ca ratios used as thermometer were suggested to be affected by skeletal growth rate even within the same colony (namely, same genotype). In conclusion, we should use Sr/Ca and U/Ca ratios carefully, because biological effects may lead the deviation from inferred temperature by using Sr/Ca and U/Ca ratios.