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Minor and trace element incorporation into branching coral Acropora nobilis skeleton

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The stable isotopic ratio and minor and trace element compositions in marine biogenic calcium carbonate, such as coral skeleton and bivalve shells, are useful tools for the paleoclimate reconstruction. However, these chemical compositions are also affected by biological processes (vital effect). For the accurate paleoclimate reconstruction, understanding the vital effect mechanism is essential.

To investigate the elemental incorporation mechanism into coral skeletons, chemical and isotopic compositions of Acropora nobilis skeleton were analyzed at various spatial resolutions. Branching coral Acropora consists of fast-growing axial corallite and slowly growing radial corallite at the visible scale. On the other hand, at the micro-scale, there are several types of skeletal elements precipitated under different calcification rate. The chemical profiles of both axial and radial corallite along with growth axes were measured by conventional ICP-MS and Stable Isotope Mass Spectrometry. The tip and basal parts of Acropora nobilos skeletons were also analyzed at micro-scale. The Mg/Ca, Sr/Ca, Ba/Ca, and U/Ca ratios were measured in ˜8um diameter spots by using NanoSIMS, and Mg, Sr, Ca, and S distributions were analyzed by Electtron Probe Micro Analyzer (EPMA), with a spatial resolution of ˜2um. Based on the elemental distribution obtained by EPMA, the Acropora's skeleton are composed of more than three types of the skeletal elements, 'Framework', 'Infilling' and 'High Mg Low S' skeletons. Observation of skeletal structure revealed that the skeletal porosity decreased with distance from the tip, since 'Infilling' skeletons filled the voids of 'Framework' skeletons. Micro-scale elemental analyses (EPMA and NanoSIMS) revealed that 'Infilling' skeletons have lower Mg/Ca and higher Sr/Ca and U/Ca than 'Framework' skeletons. Since the 'Infilling' skeletons were probably formed under the slower calcification rate than 'Framework' skeletons, the elemental fractionation pattern between two skeletal elements is consistent with the Rayleigh fractionation model. The chemical profiles of axial corallite along with the growth were significantly affected by the proportions of 'Infilling' skeletons.