Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

BPT03-P01 Room:Convention Hall Time:May 26 18:15-19:30

Intraspecific variation in isotopic composition and trace element concentrations of Pleistocene brachiopods

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Carbon and oxygen isotope composition ($\delta^{13}C_{VPDB}$ and $\delta^{18}O_{VPDB}$) in fossil rhynchonelliform brachiopod shells has been used as a powerful tool to reconstruct paleoenvironmental conditions. Several petrographic and chemical techniques, such as transmitted light microscopy, cathodoluminescence, scanning electron microscope (SEM), and trace element analysis were applied in those studies to select brachiopod shells that have not been diagentically altered and retain their original isotopic and chemical composition. However, there are few references that showed how the isotopic and chemical composition is modified by several processes operating during meteoric diagenesis. Therefore, we conducted a comparative study of isotopic composition and trace element (Na, Mg, Sr, Mn and Fe) concentrations in modern and fossil brachiopod (*Kikaithyris hanzawai*) shells. The modern and fossil specimens were collected off Amami-o-shima and the Upper Pleistocene Wan Formation in Kikai-jima, respectively. The isotopic profiles of inner shell surface along the maximum growth axis can be divided into three stages that were likely to be related to changes in life mode and shell morphology of this species. The trace element concentrations are irregularly varied on the sampling transects. There are some spots on the sampling transects, where Mn and Fe concentrations are anomalously high. These spots are likely generated by metabolic factor(s) because they are not associated with decreases in $\delta^{13}C_{VPDB}$ and $\delta^{18}O_{VPDB}$ values which are indicative of meteoric diagenesis. Our results suggest that brachiopods with complicated shell morphology which may be related to the change in life mode during the growth are not suitable for paleoenvironmental reconstructions based on their isotopic composition. It is also suggested anomalously high Mn and Fe concentrations cannot be used to identify diagenetically altered portions within brachiopod shells.

Keywords: carbon isotope, oxygen isotope, trace element concentration, brachiopoda, proxy, Pleistocene

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BPT03-P02 Room:Convention Hall Time:May 26 18:15-19:30

Assessment of skeletal compositions in *A. digitifera* coral as temperature proxies

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Introduction

While biogenic carbonates such as foraminifera and coccolithophorid are attractive tools to reconstruct the past environments, scleractinian corals also provide environmental data around tropical to subtropical region with much higher time resolution. For example, oxygen isotope ratio (δ^{18}O) and strontium-calcium (Sr/Ca) ratio have been used for reconstructing sea surface temperature and salinity by generally using *Porites* spp. In this study, we investigate the effect of temperature on skeletal δ^{18}O and Sr/Ca ratio in *A. digitifera* corals for evaluating temperature proxies for one of paleoceanographic applications.

Materials and Methods

Three colonies of *A. digitifera* were collected at Sesoko Island, Okinawa, Japan. We reared coral samples in seawater with 5 different temperature settings (18, 21, 24, 27, 30 ℃) and set 2 tanks in each temperature treatment (3 coral nubbins$\times$ 3 colonies in a tank). Calcification rate of coral nubbins was measured by buoyant weight technique every two weeks during the period of experiments. Oxygen and carbon isotope ratios (δ^{18}O and δ^{13}C) were analyzed by a stable isotope ratio mass spectrometer, and the ratios of trace elements (Sr/Ca, Mg/Ca, U/Ca and Ba/Ca) were measured by an inductively coupled plasma mass spectrometer (ICP-MS).

Results and discussion

Skeletal δ^{18}O of corals is often used as a seawater temperature proxy. In this study, a strong negative correlation was found between δ^{18}O and water temperature, and the temperature dependency was comparable with that of *Porites* spp. Thus δ^{18}O of *A. digitifera* is suggested to be useful as a temperature proxy without clear influence from growth rate. A negative correlation was also observed between Sr/Ca ratio and temperature, which is compatible with that of *Porites* spp., although the correlation was weaker than δ^{18}O. But variation of Sr/Ca ratio was not controlled by skeletal growth rate, suggesting that the dominant factor controlling the skeletal Sr/Ca ratio is water temperature. Thus, skeletal δ^{18}O and Sr/Ca ratio of *Acropora* spp., at least *A. digitifera*, can be useful as a proxies for seawater temperature as well as *Porites* spp., although more investigation would be required for Sr/Ca-thermometer of *Acropora* spp.

Keywords: coral skeleton, temperature, proxy

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BPT03-P03 Room:Convention Hall Time:May 26 18:15-19:30

Reliable stable isotopic compositions of individual Uvigerina spp. as sea environmental proxy

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The stable carbon and oxygen isotopic composition (δ^{13}C, δ^{18}O) of benthic foraminiferal carbonate shells have been used to reconstruct the past sea environment. Especially, *Uvigerina* spp. is often used to estimate the sea level changes and deep-sea circulations. However, it is difficult to analyze the isotopic compositions of individual foraminifera in the traditional analytical method, and thus the reliability of δ^{13}C and δ^{18}O of individual *Uvigerina* spp. as sea environmental proxy is still unclear. In this study, the isotopic compositions of individual *U. akitaensis* and *U. ochotica* were analyzed by using the micro-scale isotopic analytical system.

Surface sediment samples were collected from the four sites in the Sea of Okhotsk during cruise MR06-04 of R/V Mirai (JAMSTEC) in October 2006. Those samples were cut for each 1 cm (0-8cm below the seafloor) and used in this study. Then the living (Rose Bengal stained) individuals of *U. akitaensis* and *U. ochotica* from samples were analyzed by the micro-scale isotopic analytical system (Ishimura et al. 2008).

As a result, the isotopic dispersions of *Uvigerina* spp. indicated about <+/- 0.2 ‰ for both δ^{13}C and δ^{18}O in all sampling sites. In addition, isotopic values of *Uvigerina* spp. showed almost constant values in same species regardless of sediment depth, individual weight, and variation of shell structure. The observed homogeneous isotopic compositions of *Uvigerina* spp. were comparable with isotopic homogeneity and dispersions of NBS-19 (international isotopic standard). Therefore, we concluded that the individual *Uvigerina* spp. have highly reliable isotopic composition as sea environmental proxy. However, δ^{13}C values represented about 0.7 ‰ differences between *U. akitaensis* and *U. ochotica*, thus we have to consider this δ^{13}C difference in *Uvigerina* spp. when we reconstruct the past sea environment based on δ^{13}C of *Uvigerina* spp.

Our main conclusion in this study is that the individual *Uvigerina* spp. have highly reliable stable isotopic compositions as sea environmental proxy.

Keywords: stable isotope, benthic foraminifera, microscale analysis, Uvigerina