

高 pCO₂ 海水における大型有孔虫殻の酸素炭素同位体比 The effect of high pCO₂ seawater on foraminiferal oxygen and carbon isotopes

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Ocean acidification in response to rising atmospheric pCO₂ is generally expected to reduce rates of calcification by reef calcifying organisms, with potentially severe implications for coral reef ecosystems. Various studies have revealed potentially dramatic responses in a variety of calcareous organisms to the range of pCO₂ values projected to occur over this century. In our previous culture experiment with two algal symbiont bearing, reef dwelling foraminifers, *Amphisorus kudakajimensis*, which hosts dinoflagellate symbionts, and *Calcarina gaudichaudii*, which host diatom symbionts, in seawater under five different pCO₂ conditions, net calcification of *A. kudakajimensis* was reduced under higher pCO₂, whereas calcification of *C. gaudichaudii* generally increased with increased pCO₂. These different responses among the two species are possibly due to differences in calcification mechanisms (in particular, the specific carbonate species used for calcification), and to links between calcification by the foraminiferal hosts and photosynthesis by the algal endosymbionts. However, knowledge about the factors of different calcification responses is poorly understood. To shed light on the factors leading to different calcification response to ocean acidification between perforate and imperforate, we analyzed the stable isotope composition of reef-dwelling foraminifers: *Amphisorus hemprichii*, belong to imperforate species, *Baculogypsina sphaerulata* and *C. gaudichaudii* belong to perforate species, subjected to five varied acid seawater for twelve weeks almost same as above-mentioned culture experiment. Oxygen isotope ratio value of cultured foraminiferal tests under five varied pCO₂ seawater, which temperature and intensity of light was adjusted constantly for experimental period, indicated no significant correlation to pCO₂. The results show that oxygen isotope ratio stay constant within narrower range from CO₃²⁻ concentration (111 to 264 μmol/kg). On the other hand, carbon isotope ratio of foraminiferal tests indicated heavy trend with increasing pCO₂. Alteration of carbonate chemistry result from ocean acidification may be effect strongly on carbon isotope composition relate to metabolic system (i.e. photosynthesis and respiration). In perforate species, both of oxygen isotope ratio and carbon isotope ratio was lighter than that in imperforate. For oxygen isotope ratio variation possibility among species would be caused by their Mg-content concentration in calcite shells. The distinct difference in the level of carbon isotope ratio values between imperforate and perforate foraminifera indicates different amounts of metabolic CO₂ used for shell construction. Therefore, oxygen and carbon isotopes ratio of foraminiferal test have the potential to reveal calcification mechanism of two species.

キーワード: 海洋酸性化, サンゴ礁棲有孔虫, 飼育実験, 酸素炭素同位体, 石灰化

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浅海生底生有孔虫細胞内での硝酸態窒素利用の酸化/還元環境下での違い Differing utilization of nitrate nitrogen in shallow-water benthic foraminiferal cells under oxic/anoxic conditions

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Some benthic foraminiferal species have been reported to respire nitrate under dysoxic conditions. However, it is still unknown whether they can actually respire nitrate or symbiotic bacteria contribute to the nitrate respiration. We incubated a shallow water benthic foraminifera, *Ammonia beccarii*, under oxic or anoxic conditions to see their nitrate utilizations. We added nitrate intermittently to the cultured bottles and incubated them for 1 month. After the incubation, we measured the d15N of amino acids from cytoplasm and organic matters embedded in carbonate test. The measured nitrogen isotopic ratios indicated that enhanced utilization of nitrate under anoxic conditions. Trophic levels of *A. beccarii* under anoxic conditions suggest large contribution of prokaryotes to the observed nitrate utilizations.

キーワード: 堆積物 水境界, 底生有孔虫, 硝酸塩, 同位体ラベル実験, アミノ酸同位体比

Keywords: Sediment-water interface, Benthic foraminifera, Nitrate, isotope tracer, Amino acid isotopes

マイクロ蛍光 X 線分析と X 線吸収微細構造からみるシャコガイ殻の硫黄濃度変動と化学状態

Element profile and chemical environment of sulfur in clam shell: insights from micro-XRF and XANES

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Element profiles of sulfur and strontium in the inner layer of a clam shell (*Hippopus hippopus*) were investigated by means of micro X-ray fluorescence, and sulfur K-edge X-ray absorption near-edge structure (XANES) were used to evaluate the local environment of sulfur in aragonitic and calcitic bivalve shells. The spectra of S K-edge XANES collected from bivalve shells and S-bearing organic and inorganic reference materials indicated that inorganic sulfate was present in calcitic bivalve shells. However, XANES results did not permit us to discriminate between organic and inorganic sulfate in aragonitic shells. Strontium fluctuations and thin section observations suggested that Sr was incorporated into the shells at high growth rates during warm seasons. The first-order fluctuations of sulfur in the inner shell layer showed clear annual fluctuations, with sulfur concentrations being lower during periods of faster growth. Bivalve shells consist of well-crystallized CaCO₃ and amorphous CaCO₃ containing organic matter, and the proportion of crystalline CaCO₃ increases during the high growth season. Our results suggest that trace sulfur profiles in aragonitic shells could be the result of cyclic changes of shell crystallization related to bivalve physiology and environmental factors.

キーワード: 硫黄, マイクロ蛍光 X 線分析, 放射光, X 線吸収微細構造, ストロンチウム

Keywords: Sulfur, micro-XRF, Synchrotron radiation, XANES, Strontium