Combined sclerochronological and oxygen isotope analysis of the large bivalve Glossocardia obesa in a submarine cave

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Dark submarine caves on fore-reef slopes are unique habitats from which most coastal species are excluded owing to darkness, marked oligotrophy and reduced water circulation. Many bivalves have been found in caves of tropical West Pacific coral reefs, but nearly all species are very small in adult shell size, generally less than 5 mm in length. This small size is inferred to be an adaptation to oligotrophic conditions for suspension feeding. However, the Glossocardia obesa (Trapezidae) is found in many submarine caves, but grows to 70 mm in adult shell length. To elucidate the mystery of its unusually large size, we performed oxygen isotope analysis and growth-increment observations (sclerochronology) on a G. obesa (72 mm in shell height) collected alive in a submarine cave at Ie Island, Okinawa Islands. Sclerochronological analysis shows that translucent growth lines are present in the outer shell layer, and that the d18O record is divided into early and late-growth phases. There are no systematic changes in d18O values in the early-growth phase. However, the d18O record for the late phase contains six cycles, in which the wavelength and amplitude become shorter and smaller, respectively, with growth. Translucent growth lines correspond to light d18O values in each cycle, implying that this growth took place in the warm season. Comparing the d18O-derived temperatures from G. obesa with water-temperature records in the cave shows that the d18O cycles reflect seasonal variations in water temperature, and that the pattern and rate of shell growth resemble those of bivalve species in the open sea. We infer that greater growth efficiency permits G. obesa to maintain its exceptionally large size under the oligotrophic conditions in submarine caves. We also suggest that the d18O records of G. obesa have a high potential for providing summer temperatures around Okinawa. This content is wrote by Akihisa Kitamura, Keigo Tada (Now Hokkaido Univ.), Saburo Sakai, Nagisa Yamamoto, Tsuzumi Miyaji (University of Tokyo) and Tomoki Kase (National Science Museum).