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Daily light cycle reconstructed by Sr/Ca in a fossil giant clam, *Tridacna gigas*, living in 4.6 ka, southern Japan

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Giant clams are long-lived bivalvia living in a shallow tropical ocean. Their aragonite shells are potential paleo-environmental archives, i.e., oxygen stable isotopic values record paleo-seawater temperatures. Generally, trace elements in calcium carbonates are also considered as a paleo-thermometer. However, the case of Tridacninae may not follow the traditional temperature dependent fractionation, but potentially reflects insolation. This is explained by ”trans-calcification”, which is one of photosynthetically induced calcification mechanisms. Enzymatic reaction pumping Ca^{2+} to host liquid of calcification results in relatively depleted Sr/Ca ratio in day time when photosynthesis activates. Following this hypothesis, we have reconstructed the past daily light cycle.

A fossil *T. gigas*, Stg04-b was collected at Ishigaki-jima Island in Okinawa Prefecture, Japan (N24 20’0.4” E124 09’22”). Two horizons of the specimen were dated by carbon-14 method at the accelerator mass spectrometry (AMS) center of Yamagata University. The micro analyses were performed for the outer layer of 1.4 cm thickness using an electron probe micro-analyzer (EPMA), JXA8900, and a micrometer-scale secondary ion mass spectrometer (NanoSIMS), CAMECA NS50 at the Atmosphere and Ocean Research Institute (AORI), the University of Tokyo. As a result, we found clear Sr lamination parallel to the daily increment of about 20 um thickness. The hourly insolation (P) was calculated from the difference of Sr/Ca ratio (Delta-Sr/Ca) following the equation: Delta-Sr/Ca = -*a* x P, where the parameter, *a*, is defined by analysis of modern *T. maxima* [1]. Using the technique, we distinguished the sunny and cloudy seasons in 4.6 ka.

Reference
[1] Sano, Y., Kobayashi, S., Shirai, K., Takahata, N., Matsumoto, K., Watanabe, T., Sowa, K., Iwai, K. 2012, Past daily light cycle recorded in the strontium/calcium ratios of giant clam shells. Nature Commun. 3, DOI: 10.1038/ncomms1763

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