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Ultra-high resolution past environmental reconstruction-Insolation extracted from giant clam shells-

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Marine biogenic calcium carbonate such as coral skeleton and bivalve shell may record past environmental and/or ecological information as the chemical and isotopic compositions. These past information have been studied by the analyses of modern and fossil materials [1]. Past climate reconstruction from the carbonate greatly contributes to understanding of the climate system and global warming. However, the climate change of tropical and sub-tropical region is relatively unknown due to the limited instrumental observation, luck of historical documents and insufficient dendrochronology. The aim of this study is to reconstruct the past marine environment at ultra-high resolution by the analysis of biogenic calcium carbonate using state-of-the-art micro-analytical technique (NanoSIMS). The NanoSIMS is capable to analyze the solid sample surface with a high sensitivity and a high precision at sub-micron scale. Initial stage of this project comprised with the matrix-matched standard reference materials, and development of new analytical procedures at a few micron [2].

We have measured minor (Mg and Sr) and trace (Ba) elements of living giant clam and fossil clam shells. Living sample (Tridacna derasa) was cultivated from March 2002 to October 2005 at Kabira coral reef of Ishigaki Island in the southwestern part of the Ryukyu Archipelago, southern Japan. A clear seasonal variation in Sr/Ca ratio is observed in longer set of measurements with 50 micron resolution. In addition the ratio exhibits striking diurnal variations by 2 micron resolution, reflecting the daily light cycle. Light-enhanced calcification and elemental transportation processes, in giant clam and symbiotic algae, may explain these annual and diurnal variations [3]. About 5000 years old fossil sample (Tridacna gigas) was collected in August 2007 at Shiraho coast of the same island. The Sr/Ca ratios in the winter layers of the sample are characterized by a striking diurnal cycle consisting of narrow growth lines with high Sr/Ca ratios and broad growth bands with low Sr/Ca ratios. These variations, which are consistent with those of the cultivated clam shell, indicate the potential for the reconstruction of the variation in solar insolation during the middle Holocene at a few hours resolution [4].

[Reference]

[1] Henderson (2002) *Earth Planet. Sci. Lett.* 203, 1-3. [2] Sano et al. (2005) *Anal. Sci.* 21, 1091-1097. [3] Sano et al. (2012) *Nature Commun.* 3, 761. [4] Hori et al. (2015) *Scientific Reports*, in press.

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