

## 【Grant-in-Aid for Scientific Research(S)】

### Integrated Science and Innovative Science (New multidisciplinary fields)



Title of Project : Ultra-high resolution past marine environmental reconstruction using a NanoSIMS

Yuji Sano  
( The University of Tokyo, Atmosphere and Ocean Research Institute, Professor )

Research Area : New multidisciplinary field

Keyword : Global environmental change

#### 【Purpose and Background of the Research】

Marine biogenic calcium carbonate, such as coral skeleton, foraminiferal shell, bivalve shell and fish otolith 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. Past climate reconstruction from the carbonate greatly contributes to understanding of the climate system and global warming. However, the effect of climate change on meso-scale weather is relatively unknown due to the limited history of instrumental observation.

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. Past environmental information may be useful to improve the prediction of future climate change. Application of the technique to fish otolith may provide new type of insights on fish ecology such as migration history and nursery environment.

#### 【Research Methods】

Various kind of marine biogenic calcium carbonate would be analyzed by a laterally high-resolution secondary ion mass spectrometry (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 may comprise with the



Fig. 1 NanoSIMS

improvement of a NanoSIMS instrument by a fine tuning of analytical settings and to make motor drive of aperture and slits, preparation of

matrix-matched standard reference materials, and development of new analytical procedures. Evaluation of the proxy at a few micron scale will be also performed. Calcifying organisms such as coral, foraminifera and bivalve will be cultured under well-regulated conditions and will be sampled from well-monitored environmental settings. The skeletal composition as well as shell chemistry will be analyzed by a NanoSIMS, and will be compared with environmental parameters. In the later stage of this project, these new techniques and proxies will be applied to modern and fossil samples collected from several areas and ages, to perform the ultra-high resolution marine environmental reconstruction.

#### 【Expected Research Achievements and Scientific Significance】

The spatial resolution of a conventional past environmental reconstruction was several tens to hundreds of micrometer conducted with a micro-drilling and chemical analysis or a laser ablation ICP-MS technique. Improvement of spatial resolution by one to two orders of magnitude will provide new insights on the past ocean environment and ecology.

#### 【Publications Relevant to the Project】

Sano Y et al., (2012) Past daily light cycle recorded in the strontium/ calcium ratios of giant clam shells. *Nature Communications* 3:761 doi: 10.1038/ncomms1763

Shirai K et al., (2008) Minor and trace element incorporation into branching coral *Acropora nobilis* skeleton. *Geochimica et Cosmochimica Acta* 72:5386-5400.

【Term of Project】 FY2012-2016

【Budget Allocation】 149,700 Thousand Yen

#### 【Homepage Address and Other Contact Information】

<http://co.aori.u-tokyo.ac.jp/macg/home.html>  
ysano@aori.u-tokyo.ac.jp