【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Mathematical and physical sciences)

Title of Project : Study on ocean acidification and mass extinction of biosphere in the earth surface' environmental system

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Research Area : Mathematics and Physics, Earth Planetary Science, Geology, Environmental Geology

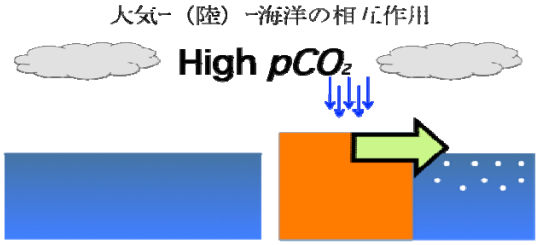
Keyword : Environmental change, Ocean science, Geochemistry, Biomineralization

【Purpose and Background of the Research】

The rising level of pCO_2 is making the world's oceans more acidic. The pH dropped from about 8.15 in the pre-industrial time to about 8.06 today and is projected to further drop to 7.9 by the end of this century (Keypads, 1999). This acidification will in turn reduced the degree of carbonate ion saturation for the global ocean. Modern-day surface [CO_3^{2-}] varies meridionally by more than a factor of two, from average concentrations in the Southern Ocean of 105 µmol kg^{-1} to average concentrations in tropical waters of 240 µmol kg^{-1}. This low [CO_3^{2-}] is due to (1) low SST and CO_2-system thermodynamics and (2) large amounts of upwelled deep water, which is more acidic from organic matter remineralization. The degree of saturation will be even lower for aragonite, which is less stable form of $CaCO_3$ than calcite. Orr et al. (2005) suggest that the entire Southern Ocean and the subarctic Pacific will be under saturation with respect to aragonite by 2100, while seawater would be close to saturation with respect to calcite.

【Research Methods】

In order to accomplish these objectives, we will conduct the research from 4 kinds of approach: (1) Culture experiments on corals, foraminifers and pteropods, will be conducted under the precisely controlled condition in order to understand the response to varying pH. (2) The development of chemical analysis by ICP-MS laser ablation system will be carried out in order to do the long-term reconstruction of sea surface temperature and calcification in response to pH. (3) To verify the hypothesis of "Mass extinction by ocean acidification in the past ", the environments will be reconstructed in the P/E boundary and Cretaceous, when Π was enhanced. (4) In order to understand nuetralization by terrestrial weathering, chemical composition of river water, groundwater and spring water in Japan and in big rivers in the world will be analyzed.



At modern state, rapid ocean acidification occurs due to abundant burning of fossil fuels. In contrast, during the Cretaceous, when PCO_2 was estimated to be more than 1,000 ppm, weathering process was responsible for the neutralizing ocean to provide abundant production and precipitation of biogenic carbonate.

【Expected Research Achievements and Scientific Significance】Ocean

It is expected to evaluate the impact of seawater pH on carbonate-producing planktons and benthic foraminifera, to develop proxies for environmental reconstruction by using ICP-MS laser ablation system, to reconstruct ocean acidification in the past and to make a quantitative estimation of the impact of chemical weathering on the continent.

【Publications Relevant to the Project】

Kawahata, H., Ocean Global Marine Environments: Interpreting from the Biogeochemical Cycle, University of Tokyo Press, ISBN978-4-13-060752-0, 1-280, 2008.
Kleypas, J.A. et al.,, Impacts of Ocean Acidification on Coral Reefs and Other Marine Calcifiers: A Guide for Future Research, report of a workshop held 18–20 April 2005, St. Petersburg, FL, sponsored by NSF, NOAA, and the U.S., 1-88, 2006.

【Term of Project】 FY2010-2014

【Budget Allocation】 109,700 Thousand Yen

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