Experimental Analysis of Effects of Ocean Acidification on Coastal Phytoplankton Community

CHANG KAI YUAN（筑波大学 生物学類）　　指導教員：濱　健夫（筑波大学 生命環境系）

Introduction

The continuous development of industry caused many environmental problems on the Earth. Nowadays, ocean acidification due to absorption of atmospheric CO_2 has become a serious global environmental issue and its effects on the marine ecosystems should be observed [1]. Phytoplankton, as a significant primary producer on the earth, is closely related to biogeochemical cycles of bioelements such as carbon nitrogen and phosphorus [2].

Materials and Methods

Change in phytoplankton composition was elucidated by using outdoor culture vessels under acidified and normal conditions in this study. The experiment was continued for 15 days after addition of inorganic nutrient (KNO_3, KH_2PO_4, $Na_2SiO_3 \cdot 9H_2O$). Samples were taken for 10 times during the experiment and phytoplankton composition was measured through flow-cytometric analysis and high-performance liquid chromatography (HPLC) analysis.

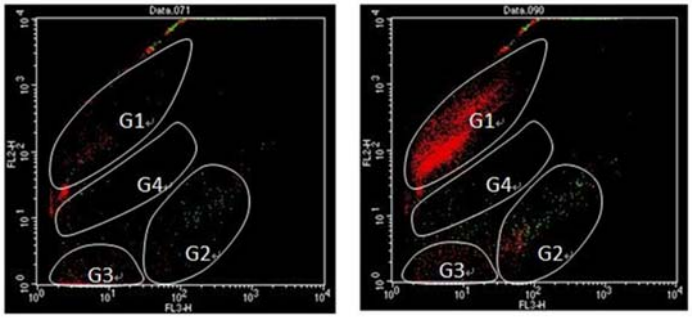

Fig. 1 Flow cytometric analysis of phytoplankton community on day 15 under the normal condition (left) and the acidified condition (right)

Results and Discussion

The increase in the concentration of Cyanobacteria cell numbers and corresponding zeaxanthin pigment under acidified condition were found in the latter part of the experiment (Fig 1). According to the size estimation by flow cytometry, Cyanobacteria was composed of picoplankton with cell size less than 2 μm which assumed to be *Synechococcus* sp. The increase in *Synechococcus* group responding to the addition of nutrients under acidified environment has not been observed so far and this is the first observation. One possible reason of the increase in picoplankton under acidified environment is that high pCO_2 is favorable for picoplankton due to the ability to diffuse inorganic carbon readily within their small cells with less energetic cost. The change in phytoplankton compposition dominated with picoplankton in the future ocean will lead to global change since dominance of picoplankton decrease the vertical transport of organic carbon from surface to bottom. Since this vertical transportation of carbon has a significant role to isolate carbon from the Earth's surface to deep ocean, the decline in the efficiency of carbon isolation likely implies that ocean acidification will be positive feedback to global warming [3, 4].

References

[1]IPCC (2013) http://www.ipcc.ch/report/ar5/wg1/

[2]Lalli C, Parsons, T (1995) Biological Oceanography: An Introduction, Second Edition, Butterworth-Heinemann.

[3] John A. Raven and Andrew ikf. Johnston (1991) Mechanisms of inorganic-carbon acquisition in marine phytoplankton and their implications for the use of other resources.

[4] Schulz, Kai Georg; Bellerby, Richard GJ; Brussaard, Corina; Büdenbender, Jan; Czerny, Jan; Engel, Anja; Fischer, Matthias; Koch-Klavsen, Stephanie; Krug, Sebastian; Lischka, Silke; Ludwig, Andrea; Meyerhöfer, Michael; Nondal, G; Silyakova, Anna; Stuhr, A; Riebesell, Ulf (2013): Temporal biomass dynamics of an Arctic plankton bloom. doi:10.1594/PANGAEA.815226