# Different Responses of biosphere to Ocean Acidification

KAWAHATA, H[1], SUZUKI, A.[2]

[1] University of Tokyo, kawahata@aori.u-tokyo.ac.jp
[2] AIST, a.suzuki@aist.go.jp

The global ocean becomes increasingly acidic. Different factors (growth stage (juvenile-adult), species, water depth, and time scale) showed large variation of the response of biosphere. Previous studies including our results show that a more acidic environment has a negative effect on some calcifiers. Especially, our cultivation experiments showed that polyps (juvenile corals) showed decreased calcification versus $pCO_2$ significantly without no/little influence on adult corals. We found positive calcifying response of *Calcarina gaudichaudii*, a benthic foraminifer, dwelling in the coral reefs with high Mg-calcite to higher $pCO_2$. Protected cells and/or difference of symbiotic algae may be the likely factors. It suggests that calcifier assemblage will be modified in response to future ocean acidification.

In Cretaceous, higher $pCO_2$ (~1,000 – 5,000 ppm) brought global warming and oil formation without ocean acidification. Abundant carbonate deposition at a water depth of >3,000 m requires enhanced alkalinity by >20% by our 3-boxes model analysis. Chemical weathering, neutralizing acidification by consuming $CO_2$ and increasing alkalinity, worked efficiently by mild environmental change.

In contrast, the Paleocene/Eocene (P/E) transition, ~55 Ma, was characterized by large excursion in carbon isotope and the most dramatic extinction of ~50% of benthic foraminifera due to severe ocean acidification by the oxidation of huge amount of collapsed methane hydrate. We analyzed chemical properties and foraminiferal assemblage in the sediments at IODP Site 1220, which estimated not so high $pCO_2$ (~500 ppm) at ~55Ma. Chemical weathering could not catch up with rapid release of $CO_2$. "High speed" is the first factor to control acidification in Earth surface's system while "Level of $pCO_2$" is the second factor.

Current Anthropogenic $CO_2$ release is ~30 times larger than that at P/E boundary, making the P/E event a possible analog of the modern human perturbation. Increase in $pCO_2$ will bring severe ocean acidification in deep sea in near future because carbonate saturation state decreases versus depth due to increase solubility. Severe condition in deep sea will first occur around the Antarctic Sea around 2100 because cold undersaturated surface seawater in this area will sink and expand northward.