Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

BBG21-01 Room:213 Time:May 1 09:00-09:15

Ocean Acidification and its effect on calcification since the late 19th century revealed by d11B of Ogasawara coral

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Boron isotopes ($d^{11}B$) of coral skeleton are known as a pH meter in the seawater. As pH of seawater is closely related to partial pressure of CO_2 (pCO_2) in the atmosphere, it is expected that $d^{11}B$ becomes pCO_2 indicator in the geological past too. However, $d^{11}B$-pH is under scrutinized since coral calcification itself probably affects the relationship. Although many studies have focused on $d^{11}B$ measurements for cultured corals under pH-controlled aquarium, those for living corals outdoors have rarely measured, which are limited to, for example, Great Barrier Reef and Guam. Here we show 125 years-records (AD1873-1998) of $d^{11}B$ and boron concentration (B/Ca ratio) for long-lived massive coral (Porites sp.) that was sampled at Chichi-jima, Ogasawara Islands, North West Pacific. They clearly reveal Ocean Acidification after the industrial revolution. We will discuss a relationship between ocean acidification and coral calcification from a slope of pH decline that is obtained from observational data. We will also discuss how B/Ca of calcium carbonate skeleton that is produced by marine calcifiers is reliable proxy for seawater pH, which is being paid a great attention mainly due to relative easiness to measure compared to isotopes.

Keywords: boron, Ogasawara, coral, calcification, Ocean Acidification

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Ocean acidification influences on coral growth of temperate species

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Carbon dioxide concentration in the atmosphere has steadily increased since the industrial revolution due to burning of fossil fuel and will cause the global warming and ocean acidification. It will raise the ocean temperature around Japan and reduce the seawater pH and then it may bring serious threat to corals dwelling around Honsyu Island, Japan. Last year, our research group did temperature-controlled culture experiments of temperate coral species from the Pacific side of Honsyu Island of Japan under the present level of the partial pressure of CO_2 (pCO_2). But, synergetic effect of the global warming and ocean acidification on these corals has not been tested yet in detail. In this study, we focus on the how the different pCO_2 levels (past, present, and future) can influence skeletal growth of temperate *Acropora* coral species under the different temperature setting using a precise control system. This system was used to generate six different pCO_2 levels: (i) pre-industrial, ˜300 μatm, (ii) present-day pCO_2, ˜400 μatm, and at four near-future conditions, (iii) ˜550 μatm, (iv) ˜750 μatm, (v) ˜1000 μatm and (vi) ˜1200 μatm at three temperature conditions (17, 25, and 27 deg C). Our early results suggested a negative influence of higher pCO_2 levels on skeletal growth of temperate *Acropora* corals, but not so sensitive compared to tropical and subtropical *Acropora* corals.

Keywords: Ocean acidification, temperate coral, calcification, global warming

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Projecting impacts of rising water temperature on the distribution of seaweeds around Japan

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Using monthly mean sea surface temperature (SST) from 1950 to 2035 obtained by a high-resolution climate projection model (MIROC4h) and SST-based indices of the distribution of tropical-subtropical and temperate seaweeds (*Sargassum duplicatum* and *Ecklonia cava*, respectively), we evaluated the effects of SST rises on the potential distribution of the species in seas close to Japan. Estimated distributions from the 1950s to 2000s showed that the potential southern limit of the temperate seaweed shifted to higher latitudes due to rising water temperature-induced barren ground, while there was little change in the potential northern limit of them. In contrast, the tropical-subtropical seaweed *S. duplicatum* expanded their distribution polewards during the same period. Under the global warming scenario (RCP4.5), the potential distribution of *S. duplicatum* can replace the one of *E. cava* in coastal area of Kochi Prefecture by the 2010s. This replacement of the temperate seaweed species with the tropical-subtropical one could consequently change coastal productivity and food web structure, and therefore may affect ecosystem services around Japan.

Keywords: seaweed bed, global warming, climate model, Ecklonia cava, Sargassum duplicatum

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Standing genetic variation of coral populations under changing environments

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How genetic diversities affect ecosystem functions is one of key questions to understand the maintenance of genetic diversities and their roles in ecosystem. To evaluate the functional genetic diversities of corals which are main composers of coral reefs, I genotyped 20 colonies (collected in front of Sesoko Station) of *Acropora digitifera* which is one of dominant coral species around the Ryukyu Archipelago where is the northern peripheral area of coral reefs, and performed common garden experiment using five clonal fragments from each colony (to reduce accidental response in each genotype) to estimate variations of growth and photosynthetic efficiencies among colonies, namely, genotypes. Genotyping was performed with microsatellite markers for coral host and ITS2 direct sequencing for symbiotic algae, indicating that all host colonies were genetically distinct and belonging to major populations around the Ryukyu Archipelago and mainly maintaining clade C symbionts which are dominant around this region. In common garden experiment, all colonies showed different growth patterns whilst the photosynthetic efficiencies showed similar optimal peaks among colonies. The experimental approach above suggests that there are standing genetic variations in host itself of *A. digitifera*, which might guarantee the adaptive potential of coral population for future global warming in northern peripheral reef area. These genetic variations might also contribute to the change of material cycles in future coral reefs.

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Carbon flows in estuarine and shallow waters: blue carbon study

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Blue Carbon, which is carbon captured by marine living organisms, has recently been highlighted as a new option for climate change mitigation initiatives. In particular, coastal ecosystems have been recognized as significant carbon stocks because of their high burial rates and long-term sequestration of carbon. However, unlike sequestration in terrestrial ecosystems, coastal carbon burial does not lead directly to an uptake of atmospheric CO_2. This is because the water column separates the atmosphere from benthic systems, and buried sedimentary carbon is composed of allochthonous sources in addition to autochthonous sources. Our research project is aiming to in situ measurements of carbon flows, including air-sea CO_2 fluxes, dissolved inorganic carbon changes, net ecosystem production, and carbon burial rates in estuarine and shallow waters.

Keywords: climate change, carbon sequestration, carbon storage, blue carbon, seagrass meadows, estuarine waters