Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

BBG020-01 Room:201B Time:May 24 16:30-16:45

Coral bleaching as indices for global warming effect to coastal ecosystem

Yutaka Tateda[1*], Kenji Iwao[2], Hiroki Taniguchi[2], Isamu Sakaguchi[3], Gyo Itani[3]

[1]Environmental Science Research laborator, [2]Akajima Marine Science Laboratory, ETMER, [3]Kochi University

Coral bleaching is the obvious effect of global warming SST increase on coastal organism and ecosystem at tropical and sub tropical area. In turn, at temperate coast, scallop and oyster were reported to be died last 2010 hot summer in Japan. However, ecosystem change in urbanized temperate coastal area could be caused not only by water temperature rise but also by other environmental factors, thus it is difficult to derive these mass mortality solely to be related to global warming. To evaluate the index appropriateness of coral bleaching as global warming effect on other coastal ecosystem, we used the same in-situ type underwater respirometer at Okianwa and Kochi at Japan main island to evaluate metabolic response to high water temperature, both in coral being sensitive to high SST and blue mussel being extinction because of not tolerant to high water temperature, The result suggested that energy balances of both species turned to be minus at high water temperature, indicating correlation of both species extinction in each coastal ecosystems, within especially large scale warming trends. However, reef ecosystem degradation and topical local high temperature may prevent to one to one event correlation between coral bleaching and blue mussel mass mortality.

Keywords: Coral, Bleaching, Mussel, Global warming, Coastal ecosystem

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

BBG020-02 Room:201B Time:May 24 16:45-17:00

Ocean acidification impact on calcification of reef-dwelling foraminifera

Mana Hikami[1*], Kazuhiko FUJITA[2], Takahiro IRIE[3], Hiroyuki USHIE[1], Azumi KUROYANAGI[1], Yukihiro NOJIRI[4], Atsushi SUZUKI[5], Hodaka KAWAHATA[1]

[1]AORI, The Univ. of Tokyo, [2]Science, Univ. of the Ryukyus, [3]IBED, Univ. of Amsterdam, [4]CGER, NIES, [5]GSJ, AIST

Ocean acidification in response to rising atmospheric pCO2 is generally expected to reduce calcification by reef calcifying organisms, with potentially severe implications for coral reef ecosystems. Algal symbiont-bearing, reef-dwelling foraminifers mainly produce high-Mg calcite shells and are one of the most important primary and carbonate producers in coral reefs. Our previous laboratory experiments have shown that a decrease in pH causes Marginopora individuals to reduce their calcification rates [Kuroyanagi et al., 2009]. Here we report results of culture experiments using a high-precision pCO2 control system (the AICAL system) to investigate the effects of ongoing ocean acidification on foraminiferal calcification with possible near-future pCO2 conditions. We cultured asexually produced individuals of two foraminiferal taxa (Calcarina and Marginopora). These foraminifers were subjected to seawater with five different pCO2 levels from 300 to 1000 ppm for 4 weeks in an indoor flow-through system under constant seawater temperatures, light intensity, and photoperiod. After experiments, the shell weight of each cultured specimen was measured. The results showed that net calcification of Calcarina, which secretes a hyaline shell and is host to diatom symbionts, generally increased as pCO2 elevated. Contrary, Amphisorus, which secretes a porcelaneous shell and is host to dinoflagellate symbionts, tended to show reduced net calcification with higher pCO2 conditions. These different responses among taxa are possibly attributed to the decrease in carbonate ion concentration, an enhancement of calcification by CO2-fertilized photosynthesis of algal symbionts, and/or different calcification mechanisms among taxa. Our finding suggests that ongoing ocean acidification will be favorable for some hyaline taxa, but unfavorable for porcelaneous shells at higher pCO2levels.

Keywords: ocean acidification, reef-dwelling foraminifera, calcification, culture experiment

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

BBG020-03 Room:201B Time:May 24 17:00-17:15

Effects of rising sea surface temperature and ocean acidification on corals

Yumiko Yara[1], Meike Vogt[2], Claudine Hauri[2], Marco Steinacher[3], Masahiko Fujii[1*], Nicolas Gruber[2], Yasuhiro Yamanaka[1], Hiroya Yamano[4]

[1]Hokkaido University, [2]ETH, [3]University of Bern, [4]NIES

Increasing atmospheric CO2 concentration is considered to change distribution of corals in various ways via global warming and ocean acidification. For example, poleward range expansion of coral habitats is caused by rising sea surface temperature in response to global warming. On the other hand, lower saturation fraction of aragonite due to ocean acidification is presumably prominent with lower sea surface temperatures in higher latitudes. Therefore, the future distribution of coral habitats is considered to be determined by the net effects of global warming and ocean acidification. In this study, using climate model results cited in the IPCC 4th Assessment Report along with simplified indicators for coral habitats, we estimated future potential effects of global warming and ocean acidification on coral distributions in seas close to Japan. The model results suggest that the coral habitats will be strongly controlled by the poleward range expansion by rising sea surface temperature and the equatorward range impansion by ocean acidification at the same time, and that the effects will appear earlier, by the middle of the 21st century, than estimated in previous studies.

Keywords: global warming, ocean acidification, corals, climate model, simplified indicator

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

BBG020-04 Room:201B Time:May 24 17:15-17:30

SSpCO2 Distribution in Tropical Indonesian Seas and Its Implication to Blue Carbon Proposal

Aditya R. Kartadikaria[1*], Atsushi Watanabe[1], Kazuo Nadaoka[1], Muswerry Muchtar[2], Hanif Budiprayitno[2], Novi Susetyo Adi[3], Adi Purwandana[2], Suharsono[2]

[1]Tokyo Institute of Technology, [2]Research Center for Oceanography,LIPI, [3]Ministry of Marine Affairs & Fisheries

Blue carbon mechanism proposed by UNEP is one of the most powerful approaches to intelligently measure the role of ocean in binding polluted atmospheric CO_2. With a basic assumption of nature's ingenuity of ocean as carbon capture and storage, the proposal brings spirit to keep the healthy ocean away from anthropogenic environmental threat. From our observation data, we found that during northwest and first transition monsoon season, surface water of Java, Flores and Banda Sea had pCO_2 of around 391 ppm. In average, ocean had 11 ppm higher than the mean of CO_2 in Indonesia's atmosphere during these periods, 380 ppm. That means that 13 billion tons of CO_2 per month were emitted to the atmosphere during these periods from the area of the measurements of 2500 km^2. Those results agree with predictive assumption that tropical oceans act as CO_2 source rather than CO_2 sink. The condition is worse in coastal area, where biological pump never take place, even though photosynthesis from marine vegetation in coastal tropical sea is abundant. Therefore, policy instruments of carbon credit in marine, especially for tropical oceans that naturally emit CO_2, should be different from those for land. The policy should take into account the capability of tropical ocean to absorb anthropogenic CO_2.

Keywords: blue carbon, SSpCO2, sink-source, Indonesian seas

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

BBG020-05 Room:201B Time:May 24 17:30-17:45

A simulation model for coral reef formation: growth patterns responding to relative sea-level histories

Takashi Nakamura[1*]

[1]Tokyo Tech.

Coral reef topographies and reef growth patterns are influenced from relative sea-level histories. Several types of reef growth patterns responding to the relative sea-level histories, e.g. balanced aggrading/onlapping, seaward prograding, back stepping, etc., have been identified in previous studies. Recently, Nakamura and Nakamori (Coral Reefs 2007, 26, 741-755) developed a geochemical model for coral reef formation based on diffusion-limited and light-enhanced calcification, and the model reconstructed well the reef topography and Holocene reef-growth history. In this presentation, the model is modified, and simulated it on four scenarios of relative sea-level histories. The simulation result on the first scenario, which is similar with global sea level history between 8,000 years B.P. and present, is very similar with balanced aggrading/onlapping type of Holocene fringing reefs. The simulations on the scenarios of stable sea level and gradual sea level falling are well-reconstructed seaward prograding type reefs. The result of the simulation on the scenario of faster sea-level rising is similar with back-stepping type reefs. Therefore, the reef topographies and growth pattern responding to relative sea level histories simulated by the model were in general well-reconstructed concerning Holocene reefs observed in nature.

Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

BBG020-06 Room:201B Time:May 24 17:45-18:00

Atmospheric nitrogen deposition: magnitudes, seasonal variation and potential impacts on Yaeyama coral reefs

Toshihiro Miyajima[1*], Chikage Yoshimizu[2], Takahiro Yamamoto[3], Ichiro Tayasu[2], Toshi Nagata[1], Naoko Morimoto[1], Atsushi Watanabe[3], Kazuo Nadaoka[3]

[1]The University of Tokyo, [2]Kyoto University, [3]Tokyo Institute of Technology

Roughly half of nitrogen (N) emitted anthropogenically to the atmosphere is said to be deposited on the coastal sea, with deposition rates depending on the proximity to pollution sources and the wind regime. Ecological impacts of N deposition would be particularly large in originally oligotrophic coastal areas including coral reefs. However, few studies have ever been conducted on N deposition on reef areas. We studied wet deposition of dissolved inorganic nitrogen (DIN) on coral reefs around Yaeyama Islands (southwestern Japan) that are close to large pollution sources (Continental China and Taiwan). Rain waters were collected at 11 coastal sites surrounding Ishigaki and Iriomote Islands during 12 survey periods spanning from March 2009 to January 2011 and analyzed for DIN concentration and related parameters. The deposition rate of DIN was usually high in winter (up to $>$100 uM as concentration in rain water) and low in summer (normally $<$10 uM). However, ephemeral increases to $>$50 uM have been observed in summer months of 2009. In most case 50% - 80% of the rainwater DIN was nitrate, with the rest being ammonium. Concentrations of nitrate and ammonium were correlated to each other (r = 0.908). Rainwater pH was often as low as 4.3 in winter. The delta-^{18}O of deposited nitrate was typically high (70 - 80 permil vs. VSMOW), although it was as low as 50 permil when the deposition rate was lowest, indicating at least two pollution sources with different isotopic signatures. We are now identifying source locations and transport pathways of atmospheric DIN using both wind regime simulation by the regional meteorological model and the O/H isotopic compositions of rainwaters. On the annual basis, the calculated DIN deposition rate on Shiraho reef area (well-studied fringing reef of Ishigaki Island) was roughly comparable to the biological nitrogen fixation rate estimated from literature data, when only direct precipitation to the reef area was considered. The range of delta-^{15}N of deposited nitrate (-3 to +3 permil vs. atm. N_2; -1.4 permil on average) was also similar to that of N delivered by biological N_2 fixation (-2 to 0), which makes it difficult to discriminate the provenance of N for reef biota using the tissue delta-^{15}N. The high DIN deposition rates would cause eutrophication of the water column of reef areas, which might benefit temporarily reef corals that can utilize DIN. However, eutrophication also leads to higher abundance of phytoplankton, which may enhance the larval survival of crown-of-thorns starfish and consequently lead to coral degradation. The influential area of atmospheric N deposition extends far offshore compared to that of terrestrial nutrient loading due to rivers and groundwaters. Close examination of ecosystem responses of coral reefs to the atmospheric N deposition is needed in future studies.

Keywords: coral reefs, eutrophication, East China Sea, transboundary pollution