Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

ACG33-P01 Room:Convention Hall Time:May 26 18:15-19:30

Primary production in the eastern part of the Seto Inland Sea

ANBUTSU, Kaori[1*] ; ICHIMI, Kazuhiko[2] ; YAMAGUCHI, Hitomi[3] ; OMI, Hiroiaki[4] ; AKIYAMA, Satoshi[4] ; MIYAHARA, Kazutaka[5] ; YAMAMOTO, Masayuki[6] ; KASAI, Akihide[7]

[1]CoHHO Eucational Unit, Kyoto Univ, [2]Seto Inland Sea Regional Res Cntr, Kagawa Univ, [3]Faculty of Agriculture, Kagawa Univ, [4]Res Ins Env Agr Fish, Osaka Pref, [5]Hyogo Fish Technol Inst, [6]Kagawa Pref Fish Exp Stn, [7]FSERC, Kyoto Univ

In the 1970's and 80's, the Seto Inland Sea was affected by eutrophication. Since the 1980's anthropogenic nutrient loads from rivers have been reduced and subsequently the occurrence of environmental problems has decreased. However, new problems such as reduced fishery yields and nutrient deficiencies for seaweed culture have occurred. This implies a change in the ecosystem structure from the 1970's to the present. Primary production in the Seto Inland Sea was extensively surveyed during the 1960's - 90's, but recently information is more limited. In this study, we investigated primary production in the eastern part of the Seto Inland Sea and compared the results with those in the 1980's and 90's.

We measured primary production at 7 stations in Osaka Bay (2), Harima Nada (2), Bisan Seto (2), Hiuchi Nada (1). Water samples were taken from five different depths, corresponding to 100, 48, 33, 14, 8.3% photon fluxes. The water samples were then transferred into replicate 1-L polycarbonate bottles in the laboratory. After the addition of $NaH^{13}CO_3$, the samples were incubated for 2 hours in a Plant Growth Chamber. The incubations were conducted at in situ temperature under the corresponding light intensity regulated using filters. Photosynthetic rate at each depth was calculated according to the ^{13}C methods of Hama et al. (1983). A trapezoidal integration was applied to calculate primary production throughout the euphotic zone. These investigations were carried out in September, November, 2013, and February, May, August, 2014.

The estimated primary production varied among the dates (Fig. 1). Primary production in February and May, 2013, was lower than that in September and November, 2013, and August, 2014. Uye et al. (1987) and Tada et al. (1998) described that primary production in the Seto Inland Sea was low in winter. Their results also showed that the primary production in spring was similar to those in summer and autumn. The trends shown in our results differ with the previous studies.

Primary production measured in summer and autumn (September and November, 2013 and August, 2014) varied widely among the stations. Primary production in the central part of Osaka Bay and Hiuchi Nada were consistently lower throughout the investigation period. Primary production changed largely at the inner part of Osaka Bay, Harima Nada and Bisan Seto. The maximum production was observed at Harima Nada in September and November, 2013, and at the inner part of Osaka Bay in August, 2014. Primary production showed a peak at the inner part of Osaka Bay and showed decreasing trends through Harima Nada to Bisan Seto in February, May and August, 2013. On the other hand, primary production showed a different distribution pattern in September and November, 2014, when high primary production was also observed at Bisan Seto. These results are different from those of Tada et al. (1998), in which they noted low primary production in Bisan Seto.

In the present study, the maximum primary production ranged from 1.0 to 1.6 gC m^{-2} day^{-1} in summer and autumn. This range was similar to the value observed in the same season in the 1990's. However, we also found differences in trends between previous studies and the present study. In order to examine structural changes in the primary production in this region, further analysis is needed on the factors controlling the distribution pattern of primary production.

References

Hama et al. (1983): Marine Biology, **73**, 31-36.
Tada et al. (1998): J. Oceanogr., **54**, 285-295.
Uye et al. (1987): J. Oceanogr. Soc. Japan, **42**, 421-434.

Keywords: the Seto Inland Sea, primary production, phytoplankton

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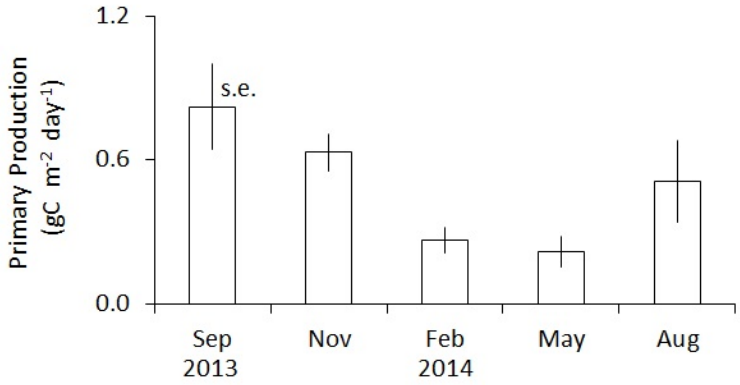

Fig. 1 Primary production in the eastern part of the Seto Inland Sea .

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Distribution of benthicmicroalgae and nutrients in tidalflat sediments estimating from chemical composition and delta13C

YAMAMOTO, Mariko[1*] ; HARADA, Naomi[2] ; SATOU, Miyako[2] ; UENO, Shinichiro[1] ; SUGITANI, Kenichiro[1]

[1]Graduate School of Environmental Studies, Nagoya University, [2]Japan Agency for Marine-Earth Science and Technology

Community compositions of microalgae that respond to environmental fluctuations have been often used as indicators of paleoenvironmental ploxis, organic water pollution, and so on. Benthic microalgae potentially adapt to wide ranges of environmental conditions, and their growth is mainly controlled by intensity of light and feeding pressure. However it is possible that specific nutrients determine the community compositions under the similar physical conditions. In order to contribute to our knowledge about relationship between community compositions of benthic microalgae and nutrients in estuarine tidal flat, this study provides the results of analyses of chlorophyll *a*, elemental compositions, δ^{13}C ratio and δ^{15}N ratio in tidal flat sediments.

Study site is located at Fujimae-higata inner part of Nagoya Port in Aich Prefecture, central Japan. Samples of surface sediments (1.5 cm depth, n=25) were subjected to analyses of chlorophyll *a*, TOC, TN, SiO_2, TiO_2, Al_2O_3, Fe_2O_3, MgO, MnO, CaO, Na_2O, K_2O, P_2O_5, Cr, Cu, Pb, Zn, Zr, δ^{13}C and δ^{15}N.

The surface sediments are characterized by high positive correlations of chlorophyll *a* with TN ($r = 0.70$, $p<0.001$) and TOC ($r = 0.68$, $p<0.001$). On the other hand the correlation between chlorophyll *a* and excess-P that is available for microalgae is very low ($r = 0.09$, $p>0.5$). Based on analysis of principal component chlorophyll *a* and other elements can be categorized into three groups, i) elements associated with coarse-grained materials, such as Al, Ca, and K, ii) elements adsorbed and /or bounded to fine-grained materials such as Cr, Cu, Pb, Zn, Fe, and P, iii) elements associated with organic matter, such as TOC, TN, and chlorophyll *a*. According to these results, three segments were identified for Fujimae-higata, including Segment 1 closest to the river mouth where sediments are dominated by coarse-grained materials, Segment 2 away from the river mouth, characterized by fine-grained materials, and Segment 3 between Segments 1 and 2, characterized with organic matter. Values of δ^{13}C of surface sediments (average = -25.99 ‰, n = 25) are almost the same as those of suspended matter in the closest river (average = -25.94 ‰, n = 9). Benthic microalgae tend to have heavier δ^{13}C ratio (approx. -18 ‰) than phytoplankton and the highest δ^{13}C ratio in the analyzed sediment samples is -24.6 ‰. This suggests that the contribution of benthic microalgae to the sediment organic matter is small. The organic matter in Fujimae-higata sediments is likely supplied largely by riverine inflow.

Keywords: benthic microalgae, nutrients, tidal flat sediments

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Geochemical investigation for evaluation of submarine groundwater discharge in Suruga Bay

ONO, Masahiko[1*] ; IKAWA, Reo[1] ; MACHIDA, Isao[1] ; MARUI, Atsunao[1] ; MURANAKA, Yasuhide[2] ; KAMITANI, Takafumi[2] ; OHYAMA, Koichi[2] ; ITO, Akira[2]

[1]National Institute of Advaneced Industrial Science and Technology, [2]Shizuoka Institute of Environmental and Hygiene

Submarine groundwater discharge (SGD) has been recognized as an important pathway for material transport from land to ocean and it is expected as ubiquitous phenomenon in coastal area. Our study site, Suruga Bay is adjacent to the southern foot of Mt. Fuji where the permeable lava flow deposits and the active groundwater flow system exist. Therefore, large amount of SGD could be occurred at the coastal area.

To estimate the spatial distribution of SGD, geophysical surveys such as multi-beam sonar, side scan sonar and sub-bottom profiler, have been conducted in this area. This study attempts to evaluate SGD by using geochemical tracers, such as radon and radium in coastal water. We will show the spatial distribution of these tracers in Suruga Bay and discuss their relationship to SGD.

Keywords: submarine groundwater discharge, Suruga Bay, geochemical tracer

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Investigation of environmental factors related to regional differences in radon concentration in Japanese coasts

HONDA, Hisami[1*] ; TANIGUCHI, Makoto[1] ; ONO, Masahiko[2] ; HOSONO, Takahiro[3] ; UMEZAWA, Yu[4] ; SUGIMOTO, Ryo[5] ; YAMADA, Makoto[1]

[1]Research Institute for Humanity and Nature, [2]National Institute of Advanced Industrial Science and Technology, [3]Kumamoto University, [4]Nagasaki University, [5]Fukui Prefectural University

In recent years, submarine groundwater discharge (SGD) have received considerable attention in hydrology and oceanography. Radon-222 (^{222}Rn) is a useful tracer to detect SGD because ^{222}Rn in groundwater has extremely high concentration compared with surface waters. In Japanese coasts, many researches have been done SGD observations using ^{222}Rn tracer techniques. If we compiled ^{222}Rn data from many coasts with different environmental condition, we can get generality related environmental parameters to SGD. Therefore, objectives of this study are to compile the existing observed data in Japanese coasts and to evaluate environmental parameters concerning the regional difference in ^{222}Rn activities. Firstly, we consolidated ^{222}Rn data in coastal waters at 10 sites from the northern part to the southern part of Japan. We also prepared environmental parameters in each watershed such as precipitation, geological data and geomorphological characteristics to examine and effect of driving forces on the regional difference of ^{222}Rn activity. In this presentation, we will show the regional difference of ^{222}Rn activities in Japanese coasts and statistical analysis results of relationship between compiled ^{222}Rn data and environmental parameters.

Keywords: 222Rn, SGD

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Using stable isotopes to measure the groundwater connection between land and sea in the Wakasa area

YAMADA, Makoto[1*] ; SUGIMOTO, Ryo[2] ; SHOJI, Jun[4] ; HONDA, Hisami[1] ; KOBAYASHI, Shiho[3] ; TOMINAGA, Osamu[2] ; TANIGUCHI, Makoto[1]

[1]Research Institute for Humanity and Nature, [2]Fukui Prefectural University, [3]Kyoto University, [4]Hiroshima University

The Wakasa area within Obama city, Fukui Prefecture is a very small area where the mountain and the sea connect. Though groundwater is abundant, there is no conspicuous surface outflow in this area. Groundwater may flow into the sea directly. In order to clarify the connection of groundwater between the seabed of the coastal zone and the land, we sampled groundwater under the seabed and at inland wells, and analyzed the water's stable isotopes in this area. The piezometers for collecting groundwater samples in the seabed (depth: 1m) were installed in eight places along the shoreline. The groundwater from inland well was collected at six wells. The results of isotope analysis of these samples show that the groundwater from the seabed was different from groundwater from the inland well. The origin of groundwater collecting near the shore line recharged from a low elevation area. This result shows the possibility that the groundwater from inland well at the village flows at a deeper place, and discharges at a more offshore seabed.

Keywords: Submarine groundwater discharge, Stable isotope, Discharge area

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Seasonal variation in saline submarine groundwater discharge and associated nutrient fluxes into Obama Bay

SUGIMOTO, Ryo[1*] ; OMIYA, Kenji[1] ; YAMADA, Makoto[2] ; TANIGUCHI, Makoto[2]

[1]Fukui Prefectural University, [2]Research Institute for Humanity and Nature

Submarine groundwater discharge (SGD) is now recognized as a major conveyor of dissolved materials from land to the sea. Nutrient loads carried by SGD are commonly calculated as the product of SGD rate and concentrations of coastal fresh groundwater with the assumption that chemical transport through the coastal aquifer is conservative. However, most of the discharging water is usually saline groundwater (recirculated seawater) except in some karstic, volcanic and glacial areas where it is composed principally of fresh meteoric water. Recent studies have shown that biogeochemical processes in the subterranean estuary would have an important effect on concentrations of the dissolved species. Therefore, it still remains unclear how to identify endmember concentrations in a subterranean estuary for calculating SGD-derived nutrient fluxes. In this study, to evaluate nutrient fluxes through the saline SGD and their seasonality, we conducted monthly observation from March to November 2014 in the shallow coast in Obama Bay using a Lee-type seepage meter for SGD rate and piezometers for nutrient endmembers in the subterranean estuary. Estimated SGD rates which mainly composed of recirculated seawater ranged from 0.01 cm d^{-1} to 3.86 cm d^{-1}. This seasonal variation was dominated by integrated precipitation for 30 days before observation date with time lags of 1.5-2.5 months, suggesting that the recharging water takes time to percolate through the unsaturated zone to the water table. Assuming that endmember of nutrients concentrations is derive from saline groundwater in 0.9 m beneath the bottom, fluxes of dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorous (DIP) and dissolved silica (DSi) were 1.9-479.7 μmol m^{-2} d^{-1}, 0.1-15.1 μmol m^{-2} d^{-1} and 7.4-1092.6 μmol m^{-2} d^{-1}, respectively. If we used nutrient concentrations in fresh groundwater, fluxes of DIN and DSi were overestimated while DIP was underestimated, because nutrient concentrations in fresh groundwater were enriched in DIN and DSi while depleted in DIP. These results show that biogeochemical processes in subterranean estuary affect crucial impact on nutrient loads carried by saline SGD.

Keywords: saline submarine groundwater discharge, nutrient flux, seasonal variation, subterranean estuary