

大阪湾奥部の二酸化炭素の挙動 Carbon dioxide dynamics in coastal regions of Osaka Bay

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これまでの我々の研究より, 底層の酸素消費とCO₂生成は連動しており, 貧酸素・無酸素水塊中にはCO₂が高濃度で蓄積されており, 海水のpHが低下し, 海洋の酸性化が起きていることを示した. また, 風による吹送にともない躍層面が昇降を繰り返し, 底層に形成された貧酸素で二酸化炭素分圧(pCO₂)の高い水塊が動き, ときには水面まで湧昇することも観測された. これらのことから, 貧酸素化が問題となる沿岸海域のCO₂の吸収・放出は短期的に変動していることが推察される. 本研究では, 外海に比べて, 光合成・有機物分解速度が大きく, 短期的変動が大きい沿岸海域において, CO₂系の測定手法の開発と, 貧酸素水塊の発生・消滅に連動して変動するpCO₂の変動特性の解明を行った.

瀬戸内海沿岸域における堆積物中リンの放出ポテンシャル

Sediment phosphorus content and its potential release in the coastal area of Seto Inland Sea Japan

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Eutrophication is an important world-wide problem and became a heated debate recent years. In many coastal sea areas around the world, Such as Tokyo bay and Baltic Sea, the Phosphorus (P) plays a key role in this process; the Kojima bay is located in Okayama prefecture and is an important water flow to the Seto inland sea. the P load to the Seto inland sea appears to have important effect to the eutrophication in this area. Kojima Lake is formed by enclosing the dike in 1959, so research of the effect of P formation to the environment is important and interesting. Our studies is mainly focused on the effect of phosphorus in sediment and the overlying water samples in Kojima bay and Kojima Lake

Surface and core sediment samples were collected both in Kojima bay and Kojima Lake in this study. the surface sediment samples were collected by box sampler, the core samples in Kojima lake were taken by piston core sampler while the cores in Kojima bay is taken by diver. using acrylic tubes(7-8 cm diameter). Pore water samples were also extracted by centrifuge and the nutrient in pore water, near bottom and surface water samples were determined in the laboratory with a spectrophotometer (Bltec Swaat autoanalyser). We use the ²¹⁰Pb activity and ¹³⁷Cs activity to determine the sedimentation and dating data of the core samples. In this study, a Six step extraction method of P in sediment was used to describe the chemical species of P. by divided the P into active forms (loosely sorbed P, Redox sensitive P) and immobile forms (Oxide metal bound P, apatite P and residue P),

The sediment phosphorus content in surface sediment samples are higher in the lake samples(average 27micro mol/g in 7 sites) than in the bay samples(average 14micro mol/g in 20 sites), while the higher pore water samples and water samples both showed higher in bay samples than in lake, It may indicate that the higher stabilization form of Phosphorus in Kojima Lake surface sediment with lower possibility of transportation in releasing to pore water and overlying water. P fractionation results shows that redox sensitive P forms is the critical P forms leading the variation of phosphorus which related to the iron content in sediment, dissolved Iron and Manganese showed the lower content in lake water volume. The core samples showed that phosphorus content showed decreasing after it was deposited with the increasing of P content in pore water, The redox sensitive phosphorus content decrease sharply with the increasing of loosely sorbed phosphorus, pore water phosphorus and salinity at the down core, This indicates the releasing of phosphorus content form sediment after the sediment deposited with the low oxygen condition and higher salinity in the deep layer of the sediment. The relatively high Salinity with pH in Kojima bay will inhibit phosphate adsorption onto Fe oxides/hydroxides. Also, the concentration of Fe oxides/hydroxides is reduced in sulfide environments by the formation of solid Fe sulfides and if sulfate-reduction rates are controlled by sulfate concentrations. This may be able to be one of the main reasons for the variations of phosphorus content in sediment. The relatively high concentrations of dissolved P associated with riverine inputs are to some extent buffered by the relatively high concentrations of suspended sediments resulting from tidal flows. Phosphorus may be released during transport to the sea due to decreases in the active phosphorus forms, increases in salinity and release from bottom sediments as a result of low oxygen conditions.

Keywords: Sediment, Kojima Bay, Phosphorus, Fractionation, Release

黒潮による栄養塩の3次元輸送が西部北太平洋における陸海間の生物地球化学的相互作用に果たす効果について Impacts of the 3D nutrient-transport by the Kuroshio on the land-sea biogeochemical interaction in the western North Pac

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The Kuroshio, the western boundary current in the North Pacific, plays major roles in transporting heat and organic/inorganic materials from the subtropical region to the subarctic one, and moreover from the coastal region to the offshore one. The Kuroshio undoubtedly must impact on the ecosystem in its neighboring and downstream regions, however it is generally recognized as a mere boundary between the oligotrophic Subtropical waters to the south and the more productive coastal or subarctic waters to the north. Surprisingly neither quantitative nor qualitative researches have advanced to clarify the actual distribution of nutrients in the Kuroshio region with focus on the impacts of the jet, the core of the current maximum. The transport of nutrient and its impacts on the ecosystem have been still unknown mainly because of lack of simultaneous measurement of both horizontal and vertical fluxes of nutrients around the jet.

In order to clarify the 3D distribution of the water properties in the Kuroshio region and to estimate horizontal and vertical fluxes of nutrients and their impacts on the productivity in the surrounding and downstream regions, an intensive observation was conducted in Apr. 2009 and historical hydrographic data were analyzed. The observation was carried out by the R/V Tansai-maru at intervals of 10 miles along the 5 lines crossing the Kuroshio south of Japan. It obtained the 3D distribution of the water properties by CTD with multi-profilers and bottle-samplings, the horizontal velocity by the shipboard and lowered ADCP, and the vertical turbulent diffusivity by the microstructure profiler. As a result we detected that maxima of nitrate, silicate, phosphate and AOU were located along the jet on the isopycnal surface of 24.5-26.0sigma-theta. It is the first detection of the nutrient/AOU maximum along the Kuroshio jet, and the structure is analogous to the characteristic one well-known as Nutrient Stream found in the Gulf Stream region. Moreover, the nutrient/AOU maximum along the Kuroshio jet was also detected on the 24.5-25.5sigma-theta surface in spring in the whole region of the Kuroshio, by analyzing the historical data of JODC.

It should be emphasized that the nutrient concentration on the isopycnal surface of 24.5-25.5sigma-theta gradually decreases along the jet toward the downstream region. It implies that the high nutrient water is originated from the upstream and its adjacent coastal regions and transported downstream epipycnally along the Kuroshio as is the case with the Gulf Stream. Our observation estimated the maximum of the epipycnal nitrate flux at $10\text{mmolNm}^{-2}\text{s}^{-1}$ around the 26.0sigma-theta surface just beneath the current maximum of the Kuroshio jet. A part of the flux is served out to both the northern and southern sides of the jet due to eddy diffusivity, and especially on the northern side the nutrient transport is important for the new production under sufficient irradiance.

Moreover our observation clarified quantitatively that nutrient is supplied upward more intensively on the jet and its inshore side than the offshore side due to higher diapycnal mixing observed by direct measurement of microstructure. The diapycnal flux of nitrate amounts to $3.0\times 10^{-6}\text{mmolNm}^{-2}\text{s}^{-1}$ at the 25.0-25.5sigma-theta just above the core of the epipycnal flux, indicating that the high nutrient transported epipycnally along the jet is supplied efficiently upward by the strong diapycnal mixing and that it contributes significantly to the spring new production around the Kuroshio.

Importantly, on the northern side of the Kuroshio Extension the water mass of 25.0-25.5sigma-theta is distributed at the upper part of the euphotic layer in spring, as a result the nutrient flux via the Kuroshio jet contributes the high productivity around the region, where enhanced concentration of chlorophyll can be seen from the ocean-color map and favorable habitats are formed for various pelagic fishes.

キーワード: 黒潮, 栄養塩輸送, 密度面横断フラックス, 等密度面に沿ったフラックス

Keywords: Kuroshio, Nutrient Stream, diapycnal flux, epipycnal flux

間欠開口型汽水湖の海陸への応答特性

Dynamic response of a sporadically opened lagoon to land and sea

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北海道の十勝海岸には、湖水の溢流によって砂州が切れ、太平洋に開口する4つの汽水湖が存在する。このうちの生花苗沼（おいかまないぬま）は、年に3~4回開口する。開口すると数日間、潮汐の影響を受けつつ海水が進入する。湖口が漂砂で再び閉塞される閉塞期間は、流入河川の融雪出水・降雨出水により湖水位が上昇し、それに対応して、湖水の海と内陸湿原への地下水流出が生じる。閉塞期間における湖水位の安定期での湖の水収支評価から、湿原と外海への正味地下水流出量は、湖水位の高さに線形的に依存することがわかった。これより、この比例関係は、外海への被圧地下水流出が卓越していることを示唆し、被圧帯水層の厚さDを未知数として、水収支を再計算すると、湖水位1.9 m標高以下でD=1.4 mと求めた。湖水位が2 m標高を超えると、地下水流出の一部は湿原への不圧地下水として流出することがわかった。

キーワード: 沿岸汽水湖, 間欠開口, 水収支, 湿原, 太平洋

Keywords: coastal lagoon, sporadical opening, water budget, marsh, Pacific Ocean

揚子江河川水の同位体比および濁度の時空変化とその東シナ海への影響 Variabilities of isotope ratios and turbidity of the Yangtze River water and their impacts on the East China Sea

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Water discharge and suspension load of a river are potentially recorded in sediments in the drainage and / or the river mouth. Isotope composition of fossil calcareous skeletons and detrital provenance and flux reconstructed from the sediment samples could provide us useful proxies for paleoclimatic study. Sediment load from the Yangtze River to the East China Sea (ECS) from the delta to the Okinawa Trough have been widely used to reconstruct the East Asian summer monsoon (EASM) in the past since the water discharge from the Yangtze would be highly affected by monsoon rain, which could deliver much fresh water and sediment to the ECS. The past impact of fresh water from the Yangtze could be reconstructed from stable oxygen isotope signal recorded in the fossil calcareous skeletons found in the ECS sediments, which has also been used as proxy for EASM.

Theoretically, sediment provenance and its yield could be changed from time to time depending on the distribution of precipitation which would control the balance of water discharges from the tributaries. Change in the precipitation distribution also affects the water isotopic composition of each tributary and then the main stream of the Yangtze. Although such variability could change the end-member composition and concentration of the fresh water and sediment load provided to the ECS, paleoceanographic studies in this region have not considered well about the potential change in the basic condition. Therefore, we need to know the water isotope and sediment budget along the Yangtze main stream with regards to the inputs from its major tributaries in order to understand the potential effects from the change in the distribution of the EASM precipitation.

For this purpose, we have started a systematic sampling of the Yangtze River water to determine the stable oxygen and hydrogen isotope ratios and suspension loads as well as the ECS surface water since summer in 2011. We will report the seasonal variations of isotope and turbidity of the River water in comparison with the distribution of surface water mass in the ECS.

キーワード: 揚子江, 酸素同位体比, 水素同位体比, 懸濁物, 東シナ海, 東アジアモンスーン

Keywords: Yangtze, Oxygen isotope, Hydrogen isotope, Suspended matter, East China Sea, East Asian monsoon