

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

藤井 智康^{1*}, 藤原建紀², 駒井幸雄³

FUJII, Tomoyasu^{1*}, FUJIWARA Tateki², KOMAI Yukio³

¹ 奈良教育大学 教育学部, ² 京都大学大学院 農学研究科, ³ 大阪工業大学 工学部

¹Nara University of Education, ²Kyoto University, ³Osaka Institute of Technology

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

金 広 哲^{1*}, 小野寺 真一¹, 天野 敦子², 清水 裕太¹, 佐藤 高晴¹, 地下 まゆみ³

JIN, Guangzhe^{1*}, ONODERA, Shin-ichi¹, AMANO, Atsuko², SHIMIZU, Yuta¹, SATO, Takaharu¹, JIGE, Mayumi³

¹ 広島大学総合科学研究科, ² 独立行政法人産業技術総合研究所, ³ 千葉科学大学 危機管理学部

¹Hiroshima University, faculty of Integrated arts and science, ²Geological Survey of Japan, AIST, ³Chiba Institute of Science Faculty of Risk and Crisis Management

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

小松 幸生^{1*}

KOMATSU, Kosei^{1*}

¹ 東京大学大学院新領域創成科学研究科, ² 東京大学大気海洋研究所

¹ Graduate School of Frontier Sciences, University of Tokyo, ² Atmosphere Ocean Research Institute, University of Tokyo

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

知北 和久^{1*}, 岩坂 航², 大森和博³, Mamun Abdullah²

CHIKITA, Kazuhisa^{1*}, IWASAKA, Wataru², Kazuhiro Ohmori³, MAMUN, Abdullah²

¹北海道大学大学院理学研究院, ²北海道大学大学院理学院, ³北海道大学理学部地球科学科

¹Faculty of Science, Hokkaido University, ²Graduate School of Science, Hokkaido University, ³Faculty of Science, Hokkaido University

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1.9m標高以下で $D=1.4\text{ m}$ と求めた。湖水位が2m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

入野 智久^{1*}, 齋藤 京太², 多田 隆治², ルオ・チャオ³, ツェン・ホンボ³
IRINO, Tomohisa^{1*}, SAITO, Keita², TADA, Ryuji², LUO Chao³, ZHENG Hongbo³

¹ 北海道大学, ² 東京大学, ³ 南京大学

¹Hokkaido University, ²University of Tokyo, ³Nanjing University

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

森林流域における土砂流出機構：北海道十勝地方・生花苗川 The mechanism of suspended sediment load from a forested drainage basin

岩坂 航^{1*}, 知北 和久², 大森 和博¹, Mamun Abdullah¹

IWASAKA, Wataru^{1*}, CHIKITA, Kazuhisa², Kazuhiro OMORI¹, MAMUN, Abdullah¹

¹ 北海道大学大学院理学院, ² 北海道大学大学院理学研究院

¹Graduate School of Science, Hokkaido Univ., ²Faculty of Science, Hokkaido Univ.

河川の土砂流出は、流域における栄養塩や有機物の輸送・侵食・堆積と深く関わり、従来より、流送土砂と生態系との関係について多くの研究がなされている。ここでは、北海道十勝地方・生花苗川で得られた流量と浮遊土砂濃度の時系列データについて、両者間の履歴現象に着目した。結果として、生花苗川の降雨流出時には、ピーク浮遊物質濃度がピーク流量より遅れて現れる「遅れ型」、および両者ピークが同時に現れる「同時型」が観測された。つまり、降雨流出の回数が多かった2009年及び2010年では「遅れ型」が観測され、台風イベント以外に大きな降雨がなかった2011年では「同時型」が観測された。前者は、流域斜面を起源とする浸透流による土壌侵食、後者は河川流路に蓄積された土砂が台風時の出水で侵食されたと考えられる。

キーワード: 森林流域, 浮遊土砂流出, 履歴現象, 浸透流, 台風イベント

Keywords: forested drainage basin, suspended sediment load, hysteresis, throughflow, typhoon event

亜寒帯河川流域における水・土砂の流出機構：アラスカ・タナナ川 Discharge and sediment load from a subarctic river basin: the Tanana River, Alaska

和田 知之¹, 知北 和久^{1*}, 金龍元², 工藤 勲³

WADA, Tomoyuki¹, CHIKITA, Kazuhisa^{1*}, KIM, Yongwon², KUDO, Isao³

¹北海道大学大学院理学研究院, ²アラスカ大学国際北極圏研究センター, ³北海道大学大学院水産科学研究科

¹Faculty of Science, Hokkaido University, ²International Arctic Research Center, University of Alaska Fairbanks, ³Faculty of Fisheries Sciences, Hokkaido University

貯留型流出モデルの一つ、タンクモデルを用いて、亜寒帯河川であるアラスカ・タナナ川での流量・土砂流出量時系列に対する再現を試み、水・土砂の流出に対する氷河融解流出と降雨流出の寄与を定量化している。結果として、その再現性は高く、タナナ川の流量に対する氷河融解流出の寄与は 26-57%、土砂流出量に対する氷河土砂流出の寄与は 76-94%と極めて高いことがわかった。

キーワード: 氷河融解流出, 土砂流出, POC, PON, 永久凍土, 融雪出水

Keywords: Glacier-melt runoff, sediment load, POC, PON, Permafrost, Snowmelt runoff

石英の ESR・結晶化度分析に基づく、ユーコン川からベーリング海陸棚域へと運ばれる陸源碎屑物の評価

Contribution of detrital materials from the Yukon River to the continental shelf sediments of the Bering Sea

長島 佳菜^{1*}, 浅原 良浩², 豊田 新³, 和田 知之⁴, 知北 和久⁴, 原田 尚美¹

NAGASHIMA, Kana^{1*}, ASAHARA, YOSHIHIRO², TOYODA, Shin³, WADA, Tomoyuki⁴, CHIKITA, Kazuhisa⁴, HARADA, Naomi¹

¹ 海洋研究開発機構 地球環境変動領域, ² 名古屋大学大学院環境学研究科, ³ 岡山理科大学理学部応用物理学科, ⁴ 北海道大学大学院理学院自然史科学専攻

¹JAMSTEC, RIGC, ²Graduate School of Environmental Studies, Nagoya University, ³Faculty of Science, Okayama University of Science, ⁴Graduate School of Science, Hokkaido University

Bering Sea sediments contain detrital materials from the Yukon River. These materials may contain records of past climate changes in the Arctic area, such as the melting of glaciers around the drainage basin of the Yukon River, which help to understand hydrological cycle in this area. In the Bering Sea, however, the spatial extent and pattern of the detrital materials supplied from the Yukon River is not yet fully understood due to the lack of proxy. For better discrimination of the detrital materials from the Yukon Rivers, we focused on quartz, because it is the major component of both the silt- and sand-sized populations of detrital materials from the Yukon River (Eberl, 2004) and because it is resistant to chemical alteration and physical ablation by weathering, transport, and diagenesis. We adopted two parameters of quartz, the electron spin resonance signal intensity of its E1' center (Toyoda and Hattori, 2000) and its crystallinity index (Murata and Norman, 1976), and characterized the quartz in different sizes derived from the Yukon River. We then estimated the spatial pattern of quartz contributed by the Yukon River on the Bering Sea shelf by applying the method to core-top samples from the continental shelf and slope of the eastern Bering Sea.

The results showed a large contribution of sand-sized quartz from the Yukon River to wide areas of the continental shelf and slope, whereas contributions of clay- to silt-sized quartz from the Yukon River were small, except on the northeastern shelf. These spatial distribution patterns suggest that sand-sized quartz was repeatedly reworked and transported by processes such as storm surges to the outer continental shelf, whereas the clay- to silt-sized quartz on the northeastern shelf was supplied, as suspended materials, directly from the Yukon River. Therefore, the clay- to silt-sized quartz on the northeastern continental shelf probably records past climate changes related to the amount and intensity of the Yukon River discharge, whereas the sand-sized quartz in the eastern Bering Sea probably records variations of stormy weather.

キーワード: ユーコン川, ベーリング海, 石英, 電子スピン共鳴, 結晶化度

Keywords: Yukon River, Bering Sea, Quartz, Electron Spin Resonance, Crystallinity

Treatment Facilities for Hygienic Fish Market Wastewater Treatment Facilities for Hygienic Fish Market Wastewater

Yustiani Yonik Meilawati^{1*}, Anni Rochaeni¹

Yustiani Yonik Meilawati^{1*}, Anni Rochaeni¹

¹Dept. of Environmental Engineering Pasundan University

¹Dept. of Environmental Engineering Pasundan University

Hygienic fish market in Indonesia is now being developed to have better products and healthy condition in the fishermen and vendors community. Inefficiency and inappropriate of wastewater treatment facilities can cause the water quality of the coastal nearby becomes deteriorated. In this research, we investigate the fish market activities condition in related to the wastewater generated. Samples were taken from wastewater generated by washing activities in Cituis Fish Market; thus the dominant parameters need to be treated can be determined. Data of wastewater quality was collected also from previous researches. The results show that BOD, COD, TSS, E.Coli, oil, and grease concentration have to be reduced to meet the government standard. Determination on treatment unit was conducted by considering the availability of land, user-friendly technology, treatment capacity, low-cost maintenance, and side-product potency. The recommended wastewater treatment unit is called up-flow modified septic tank. Trickling filter is installed to modify the conventional septic tank in order to increase the biological processes inside the tank. Sedimented waste in septic tank chamber can be used for other purposes such as manure and pellet.

キーワード: wastewater treatment facility, fish market wastewater, modified septic tank

Keywords: wastewater treatment facility, fish market wastewater, modified septic tank

大阪湾における地下水流出由来のリン供給の推定

Estimating phosphate supply via submarine groundwater discharge in Osaka bay, Japan.

小野寺 真一^{1*}, 清水 裕太², 齋藤 光代³, 福岡 正人²

ONODERA, Shin-ichi^{1*}, SHIMIZU, Yuta², SAITO, Mitsuyo³, Masato Fukuoka²

¹ 広島大学総合科学研究科, ² 広島大学, ³ 愛媛大学沿岸環境科学センター

¹Graduate school of Integrated Arts and Sciences, University of Hiroshima, ²Hiroshima University, ³Center for marine environmental studies, Ehime University

流域スケールでの物質循環の解明は、酸性雨や富栄養化といった大気-陸域及び陸域-海域相互作用環境の予測という点や、さらには資源管理、河川・地下水などの物質輸送場の保全という点でも重要である。

本研究では、栄養物質でもあり、かつ農業肥料資源としても重要なリンを対象として、流域スケールでの物質輸送に関してレビューを行いその問題点を整理するとともに、特に本課題講演のテーマでもある人間活動の影響についても整理することを目的とする。

流域におけるリン循環は人間活動の影響が強まった 20 世紀以降一変してきた。Timlin et al.(2002)によれば、近年化学肥料の使用量の増大にともない大量にリンが供給されてきたが、その利用効率は下がってきていることが指摘されている。すなわち、これは、作物に吸収されずに系外に流出する割合が増大していることを意味する。Cordiel et al.(2009)は、その割合が 50 %に及ぶことを指摘している。

北川ら(2009)は花崗岩中でのリンの含有量も無視できない量であると評価し、自然由来のリンも無視はできない。しかし、清水ら(投稿中)による都市近郊流域での解析によれば、発生源として溶存態は家庭排水、懸濁態は農地で主であると指摘され、その多くは人為的な起源に由来する例も少なくない。リンの陸域から海洋への輸送経路は、主に河川であり、特に洪水時の流出によって多くが輸送される。

また、地下水でも、特に沿岸域で高濃度のリンが検出されており(例えば、Onodera et al.2007;小野寺ら 2010)、地下水による海洋へのリン流出も重要な場合がある。特に、感潮域における海水の再循環も重要な過程となっている。

キーワード: 海底地下水流出, リン, 閉鎖性海域

Keywords: submarine groundwater discharge, phosphate, semi-enclosed bay