

Japan Geoscience Union Meeting 2011

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ACG035-01

Room:201A

Time:May 27 10:45-11:00

Effect of Climate Change on Nutrient Discharge to Coastal area, Western Japan

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This study investigates the effect of climate change on nitrogen and phosphorus discharges from a watershed in western Japan. Numerical simulations for a 30 year period (1977-2007) demonstrate annual precipitation has decreased over the study period as well as loads of nitrogen and phosphorus. Nutrient fluxes were estimated using the SWAT model. The estimated phosphorus flux is more highly correlated with precipitation than nitrogen flux. The results suggest a high correlation between phosphorus and discharge but during high precipitation years phosphorus loads have decreased. A sensitivity analysis of parameters for phosphorus discharge showed the most sensitive parameter is support practice factor. Consequently, phosphorus flux would decrease from the Asahi River watershed in the future, because precipitation has decreased and as such so has the driving force for soil erosion, the primary source of the nutrients.

Keywords: Climate Change, Nutrient, SWAT, Seto Inland Sea, Asahi River

ACG035-02

Room:201A

Time:May 27 11:00-11:15

Difference in suspended transports of the Ishikari and Tokachi Rivers affected by seasonal precipitation variability

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Most of rivers in Japan are rapid rivers characterized by steep riverbed and strong ability for erosion. Rapid rivers can transport a large amount of materials to the ocean in spite of their small size, especially, on the high discharge events. Japanese Islands are situated under the influence of the east Asian summer monsoon which brings a lot of rain by frontal activity and typhoon. Northern part of Japan is also characterized by heavy snow in winter that is brought by very moist cold air mass from the east Asian winter monsoon wind passing on the warm current in the Japan Sea. The snow melt water in spring also promotes another high discharge event there. Thus, the rivers in Hokkaido, a northern island of Japan, are characterized by two seasonal discharge events both of which are controlled by the east Asian monsoon climate. Such condition of rivers in Hokkaido enables us to examine the relationship between discharge events and abilities of material transport under control of monsoon climate.

During high discharge (flooding) event promoted by typhoon rain, the Tokachi river exhibited highly erosive feature where the concentration of suspended materials was proportional to a square of water discharge. A single flooding event could transport more than half of total transport of suspended matter in a year. These case studies suggest the significance of turbulence of flow on suspension transport, which controls the total amount of materials transported to the ocean.

Snow melt discharge event occurs more gently than peaky flooding event promoted by heavy rain, but the duration is long lasting for two months. In the case of Ishikari River, suspended matter is dominantly transported during snow melt season, which is different from the case of the Tokachi River. This is because the concentration of suspended matter of the Ishikari River is approximately linearly proportional to the water discharge. Though the significance of high discharge events for suspension transport is common for small rivers in Japan, it is still difficult to distinguish snow melt event from heavy rain event. We need to be careful to interpret the reconstructed riverine flux as winter signal or summer one.

Keywords: river, suspension transport, precipitation, monsoon, Ishikari River, Tokachi River

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ACG035-03

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Time:May 27 11:15-11:30

The effects of river fluxes on river plume behaviors: Yukon River and Bering Sea

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Satellite images show that the sediment plume is developed off the estuarine delta of the Yukon River, Alaska. In order to explore how the river fluxes affects the plume behaviors off the Yukon delta, time series of discharge, sediment load and chemical flux were obtained at a downstream point of the Yukon River, Alaska, and marine observations were performed off the delta in June 2007 ? September 2009. Meanwhile, the plume area was obtained by using three near-infrared bands of MODIS/Aqua. As a result, there is the significant correlation between the plume area and the Yukon discharge or sediment load in spite of the northern winds opposite to the advance of the plume.

Keywords: Yukon River, Bering Sea, glacier-melt, MODIS, river plume

ACG035-04

Room:201A

Time:May 27 11:30-11:45

spatial variations and chemical characters of sediment phosphorus in an artificial lake and Kojima bay

Guangzhe Jin^{1*}, Shin-ichi Onodera¹, Atsuko Amano², Takaharu Sato¹, Yuta Shimizu¹

¹Hiroshima University, ²AIST

Eutrophication is an important world wide problem and became a heated debate recent years. In many costal 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 accumulation rates (SAR) and the sedimentation of P in Kojima lake (SAR=4300g m⁻² y⁻¹ , P=140.1mmol m⁻² y⁻¹) are higher than that in Kojima bay (SAR=3500g m⁻² y⁻¹ ,P=82.4mmol m⁻² y⁻¹). The sediment phosphorus content in both surface and core samples are higher in the lake samples than in the bay samples, while the pore water samples and water samples both showed higher in bay samples than in lake, It may indicate that the P supply of Ashahi River is at very high level than Kurashiki and Sasagase River. While the retention of P is lower in Kojima bay because of the high water flow of Ashahi River. After the dike constructed .the Kojima Lake seems to act as a trap for material transported from the open sea. Kojima Lake seems has richer phosphorus content than in the Kojima bay.

In Kojima bay the surface sediment P fractionation and sediment core seems to be more uniform and of same size of P pool rather than P fractionation in Kojima lake .this could also indicate that the early diagenetic process may have enough time to transform the deposited P into the more immobile forms and at last buried forms. The content and the more rivers supply leads more uniform quality and quantity of P resources deposited in the sediment in Kojima bay. The low SAR value in Kojima bay may suggest that it is more vulnerable to be the transportation of sedimentation process. The more uniformed and immobile phosphorus forms in Kojima bay than in Kojima lake leads to a higher burial efficiency of phosphorus at 55% in Kojima bay sediment compare to that of Kojima lake (35%), The efflux of losing P through the time at a prediction value of is lower in Kojima bay at 0.71 mmol m⁻² y⁻¹ is lower than the inner site 0.97mmol m⁻² y⁻¹

In this study, the Kojima bay and part of bay changed to Artifice Lake 50 years ago, the environment changes leads to a very interesting results. The Kojima Lake has higher sedimentation value than the bay samples. But with lower burial of P and higher efflux of P, P fractionation revealed that most part of P sediment in sub layer of sediment is in forms prone to be stable with the depth increasing. While in surface layer is prone to be release under anoxic condition or other digenetic process.

Keywords: sediment, phosphorus, fractionation, artificial lake

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ACG035-05

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Nutrient discharge in a large tidal slope

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To clarify spatial variation of nutrient discharge in one of a largest tidal slope of Seto Inland Sea, we observed subsurface flow and dissolved nitrogen, phosphorus, and silica, using piezometer and tracer method. The study area is located on Saijo city, Ehime prefecture, western Japan. The tidal slope has the width and length of 1km. We installed three piezometers for observing water potentials, collected pore water samples at the about 50 plots, and monitored ²²²Rn of seawater at the edge of the tidal slope.

The ²²²Rn and salinity of pore water indicated that discharges of shallow groundwater at the landside and deep groundwater at the shoreside of the tidal slope, respectively. The discharge volume was larger in shallow groundwater than in deep groundwater. The nutrient included the nitrogen as well as phosphorus and silica. Based on this observations, the large contribution of nutrient was confirmed from groundwater to coastal area.

Keywords: tidal slope, nutrient, groundwater, seawater, Radon

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ACG035-06

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Movement of hypoxia in strongly enclosed waters of ports and harbor

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We conducted field observations in relation to hypoxia which occurs in strongly enclosed waters, such as ports and harbors, and examined generation mechanism and movement of hypoxia. Diurnal variations in hypoxia were driven by tide and wind in the strongly enclosed waters in the head of Osaka Bay. It was found that processes of the organism decomposition, oxygen consumption and carbon dioxide generation were different in and out of the ports. In the spring and summer when the water column is stratified, surface water absorbs CO₂ and bottom water stores CO₂ in strongly enclosed waters. On the other hand, in the end of summer, the stored CO₂ upwells to the surface and causes spontaneous emission because the north wind induces the upwelling.

Keywords: strongly enclosed waters, hypoxic water mass, carbon dioxide, wind drift, upwelling

ACG035-07

Room:201A

Time:May 27 12:15-12:30

Groundwater under the seabed

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A rapid increase of population in the world causes growth of water demands, and this may result worldwide water shortage in future. Especially, in the coastal area, water resource development becomes important because the half of the world population is concentrated in this area. Recently, countermeasures to mitigate climate change are discussed. Coastal area is one of the promising places for disposal of high-level nuclear waste or carbon dioxide capture and storage. Lots of development will be conducted in the coastal areas, however there are a lot of uncertainties remaining to understand the hydrogeological environment in there.

It has been said that salt water / fresh water interface is formed in the place where meteoric fresh groundwater and salt groundwater from the ocean meet, and there is a large amount of groundwater discharge on the seafloor of the end of this interface so far. Recently, there is a lot of research about this submarine groundwater discharge because of the protection of the coastal ecosystem. In addition, there is a report that fresh water under the seabed was discovered on the continental shelf away from a present coastline by tens of kilometers in many parts of the world, because recently offshore drilling technology has been improving. Classical theory about formulation of salt water / fresh water interface could not explain completely, and consideration of long-term geochemical process (e.g., sea level fluctuations) is needed to understand this mechanism.

Fresh (or brackish) groundwater under the seabed have been found on the investigation related to a seabed resources exploration in the field of coal mining, oceanic engineering works such as submarine tunnels, the atomic research, and the collection investigations of the basic data in the earth science field. A lot of fresh water under the seabed is confirmed on the offshore side from a present coastline as for these cases, and it is suggested that the end position of the salt water / fresh water interface (position of the submarine groundwater discharge) may appear on the seafloor. Moreover, neither the salinity concentration nor the groundwater age depends on depth. It is thought that it is because that the groundwater forms the complex flow situation through the change in a long-term groundwater flow system.

The technology to understand the coastal groundwater flow consists of remote sensing, geographical features analysis, surface of the earth investigation, geophysical exploration, drilling survey, and indoor examination and the measurement. Integration of each technology is needed to interpret groundwater flow system because the one is to catch the local groundwater flow in the time series and another one is to catch the long-term and regional groundwater flow in the general situation.

The purpose of this study is to review the previous research of coastal groundwater flow, and to integrate an applicable evaluation approach to understand this mechanism. In this presentation, the review of the research and case study using numerical simulation are introduced.

Keywords: Continental shelf, Water resource, Groundwater flow, Salt water / fresh water interface, Sea level fluctuations

ACG035-08

Room:201A

Time:May 27 12:30-12:45

Spatial distribution and seasonal variation of submarine groundwater discharge in the coastal area of Seto Inland Sea

Mitsuyo Saito^{1*}, Shin-ichi Onodera², Xinyu Guo¹, Yuta Shimizu², Koki Onishi², Minoru Tokumasu³

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Recent studies have revealed that submarine groundwater discharge (SGD) is one of the important pathways for nutrients and the other dissolved materials such as carbon and trace metals from terrestrial area to the marine environment. Seto Inland Sea is the largest semi-enclosed coastal sea in Japan. Recently, some researchers tried to estimate SGD at the specific area of the Seto Inland Sea by field research and numerical model approach. Nevertheless, deep (confined) groundwater discharge was not evaluated in these studies. The objective of the study is to confirm the spatial distribution and seasonal variation of SGD including both of shallow and deep groundwater in the coastal area of Seto Inland Sea. The study area is southwestern part of the Hiuchi-Nada located in central part of the Seto Inland Sea, and has a size of approximately 30 km * 13 km. We conducted the measurement of vertical profiles in salinity and water temperature at 13-15 sampling stations in July and November 2011. Radon-222 (²²²Rn) concentration was measured at surface and bottom layers using electronic radon detector (RAD7, Durrige Co.). Radon-222 (²²²Rn) is one of the useful tracers of SGD because groundwater has extremely high concentration in ²²²Rn compared with river water and seawater.

Vertical profiles of salinity and water temperature indicate the presence of stratification with a pycnocline at depth of about 5 m in July, whereas it was completely mixed in November. ²²²Rn concentration in the surface layer was relatively high in the several sites near the coast line. Meanwhile, in the bottom layer, high ²²²Rn concentration was detected in the offshore area at southern part of the study area in both July and November. Therefore, the result indicates that deep (confined) groundwater discharge from seafloor throughout the year.

*This research was supported by the research grant of Saijyo city and Nissay financial group in 2010.

Keywords: submarine groundwater discharge, spatial distribution, seasonal variation, coastal area of Seto Inland Sea

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ACG035-P01

Room:Convention Hall

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Monitoring method for eelgrass bed mapping using ASTER data

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¹IGG, AIST

In recent years, the seaweed bed with biological productivity and habitat function is brought to international attention. From such a background the long-term monitor to aim at environmental preservation is necessary. An easy and inexpensive monitoring method including the citizenry participation is requested. However, monitoring in the seaweed bed is needed diving operation in general. Therefore, this monitoring method is that an economical load is large and it is a limit within the range of the search. The problem includes cannot help the large area evaluation using limited results in narrow region.

Meantime, some approaches of change and formation in coastal line are executed by using satellite image of high resolution that became possible to buy comparatively at a low price in recent years. And these monitoring methodologies are paid to attention, because a large area, economical, long-term continuance possibility is high.

In this study, for Mitsukuchi bay, Hiroshima prefecture, the possibility of seaweed bed distribution monitor by the satellite image was examined by existing classification technique methods of maximum likelihood etc, compared with seaweed place distribution measurement data that has been obtained up to now with the supersonic wave measurement device. In this meeting, it reports on the analytical result and detailed contents.

Keywords: ASTER, Eelgrass bed, Remote sensing, Monitoring method

ACG035-P02

Room:Convention Hall

Time:May 27 09:00-10:45

Effect of groundwater discharge and seawater on nutrient component of tidal river

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Nutrient condition in water environment controls the ecosystem. Ground water discharge to the oceans is significant as nutrient supply (Slomp et al, 2004 etc). This situation is similar to the nutrient condition in rivers. In coastal urban area, land fill has generally been conducted in offshore and tidal flat. Groundwater gradient is generally declined by these constructions of new lands, and submarine groundwater discharge tends to stop in coastal areas. On the other hand, groundwater would discharge to rivers in a terrestrial area. In this research, we aimed to confirm effects of groundwater on nutrient supply to tidal river. The study area is located on the river mouth area of Asahi River in Seto Inland Sea watershed, western Japan. We collected water samples at one station of the river mouth area for the analysis of ²²²Rn and nutrient elements at five times on each tide level. In addition, groundwater near the river sampling station, bottom sea water in Seto Inland Sea, upstream river water and tidal river water at 5 points from the station to the 4km upstream area were collected.

The result of the hourly changes in ²²²Rn and nutrient concentrations at the river mouth station in each times shown, the ²²²Rn concentration was highest at the low tide level, and it was twice of that at the low concentration of ²²²Rn. On the other hand, the relationship between ²²²Rn and nutrient suggests the P, Si and NO₃-N discharge by groundwater to the tidal river. Especially, the phosphorus concentration was high in the tidal river. This would be supplied by the diffusion from river bed sediment as well as by groundwater discharge. Based on these results, we estimated the TP discharge by groundwater to be about 30%-60% of the tidal river nitrogen input to the study area.

Keywords: nutrient, groundwater discharge, ²²²Rn, tidal river

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ACG035-P03

Room:Convention Hall

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The water budget of a closed lagoon sporadically open to the sea: Lake Oikamanai, Hokkaido

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A closed lagoon, Lake Oikamanai, on the coast of southeastern Hokkaido tends to open sporadically to the Pacific Ocean. The sporadic opening is due to the overflow of the lake water breaking the gravelly sand bar. For several days after the opening, the lake level fluctuates daily in response to the ocean tide. Meanwhile, the drift sand and gravel close the lake again by constructing the bar. Many kinds of birds and water plants are seen in the marsh around the lake, and extraordinarily large corbiculae (*Corbicula japonica*) live in the lake. In this study, the water budget of lake was estimated before and after the opening. The temporal change of water volume was calculated by using the accurate bathymetry. As a result, more than 96 % of the lake water was drained by the opening, and during the closed periods, the river inflow dominated the water budget of the lake. Our future's works are to estimate groundwater input from around the lake and groundwater output to the sea.

Keywords: closed lagoon, water budget, snowmelt runoff, rainfall runoff, open frequency

ACG035-P04

Room:Convention Hall

Time:May 27 09:00-10:45

Seafloor environmental changes effected by the construction of artificial lake in Kojima Bay, Okayama

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Kojima Bay is an estuary located at the southern coastal area in Okayama Prefecture. Its topographic has been varied by the effect of deposition processes in natural and reclamations. In addition, artificial lake called Kojima Lake was formed by dikes construction at the eastern part of the bay in 1959 AD. In order to examine the impacts of the formation of Kojima Lake to the seafloor environment, we collected 4 core samples in the bay and lake and analyzed sedimentary structures by soft-X ray radiographs, grain size and ²¹⁰Pb dating.

Three cores were mainly composed of mud sediments and one core in Kojima Lake divided three sections by sedimentary structures; bioturbated section in the lower of core, sharply-defined laminated section in the middle and bioturbated section in the surface. Results of ²¹⁰Pb dating showed that the ages of boundary between these sections were 1960 and 1980 AD, respectively. On the other hand, core collected in the mouth bay showed two sections which were a sand section in the lower of core and a mud section in the surface. These core results imply the seafloor environmental variations accompanied with the construction of Kojima Lake in 1959 AD as the following. Before the construction of the lake, benthic activities were very active in the interior of the bay. However, hydrodynamic condition became a stagnant and benthic activities were very little after 1960s. And it was probably that improvements of water quality slightly restored benthic activities after 1980s.

Keywords: sediment, grain size, Pb210 dating, artificial lake, Kojima Bay

ACG035-P05

Room:Convention Hall

Time:May 27 09:00-10:45

The nutrient load from a drainage basin of different land cover

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The nutrient load from a drainage basin by rainfall or snowmelt is a key factor to affect the ecosystem in rivers, lakes and on the coast. In this study, we investigated the nutrient loading processes in the Saromabetsu river basin, facing a brackish lake, Lake Saroma. We separated river water into new and old waters for the runoff event of the 2009 typhoon by using three chemical tracers, O18, D and SiO₂. As a result, it was found that the peak discharge in the typhoon runoff event is occupied by the same amount of new and old waters. By calculating the nutrient concentration of new and old waters, we considered how the farmland affects the river water quality. In order to examine the farmland effect, during non rainfalls, we sampled river water and measured discharge at 10 points along the main and tributaries' channels. The simultaneous soil moisture measurement on the basin slope suggests that the new water is transported by the unsaturated throughflow in the surface soil layer. The old water was supplied probably by the piston groundwater flow, because the O18 and D values did not then change. The separation of new and old waters suggested that the throughflow has the NO₃-N concentration of 1.3mg/L. Meanwhile, the NO₃-N concentration of the soil water was nearly 0 mg/L in forest and 2 ? 8 mg/L in grassland. So the river water pollution could occur mainly by the throughflow generated at farmland. The NO₃-N concentration of the river water during non rainfalls was correlated with the rate of the farmland area in the drainage basin upstream of the sampling points.

Keywords: nutrient load, ecosystem, typhoon runoff event, unsaturated throughflow, piston groundwater flow

ACG035-P06

Room:Convention Hall

Time:May 27 09:00-10:45

Vertical and spatial variations of sediment phosphorus in an artificial lake and bay of Seto Inland Sea

Guangzhe Jin^{1*}, Shin-ichi Onodera¹, Atsuko Amano², Yuta Shimizu¹, Takaharu Sato¹

¹Hiroshima University, ²AIST

The Kojima bay is located in Okayama prefecture and is an important water flow to the Seto inland sea. The Phosphorus (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. Our studies are mainly focused on the vertical distribution of P forms and the relation to physical and chemical properties of estuary sediment material so as to better understand the potential release and burial of P.

The field observations of this study were taken in 2009. Surface and core sediment samples were taken in both in Kojima bay and Kojima lake. The nutrients in surface water samples, near bottom water samples and pore water samples were determined by auto analyzer. ¹³⁷CS and ²¹⁰Pb activity were determined to calculate the dating data of different depth and also the sedimentation accumulation rate (SAR rate). The P reserves were characterized by a sequential extraction procedure. In addition several environmental variables were determined.

The reactive P form takes dominated part in the sites with higher SAR value and also in the Kojima lake surface sediment (40%-71% in Kojima lake compared to the 15%-53% in Kojima bay). It decreased generally with the sediment depth, indicating that the release form Fe compounds and degradation of Organic P with the depth increasing. The immobile P forms dominated (Kojima bay surface sediment 34%-72% Kojima bay core sample 59%-76%) at the sites with the lower SAR value. While in the high SAR value area this value is lower (Kojima lake core samples 23%-80% Kojima lake surface sediment 28%-53%) in the Kojima bay. Its concentration did not change appreciably with the sediment depth. But it changes to be dominating P forms in the deeper layers where the reactive P forms decreases.

Both in lake and bay sediment the loosely sorbed P content is at low level. The bay has lower HCl-iP content and higher content of NaOH-iP compare to the lake cores. This may be because the high discharge flow in bay takes out the fine materials which contain the authigenic apatite P forms and it is easier for lake environment to sink for P at this form. And the large water discharge prevent the transform of the NaBD-iP to NaOH-iP as while as it is more oxic conditions than Lake. The Res-P forms which means the refractory organic P represents the P incorporated in the refractory humic material. This form of P did not show marked vertical variation in the whole profile and also no obvious different in all surface sediment samples.

The content of reactive P and TP in the Kojima lake water sample and pore water samples appears to be lower than that in Kojima bay, this may indicate that the release of sediment P to pore water and overlying water is lower than that of P in Kojima bay, and it appears adverse with the higher value of the efflux of P in sediment cores in Kojima lake. One possible explanation for this may be that the P resources of Kojima lake and Kojima bay is different, and the Kojima bay receives much more resources from other rivers with large water flows such as Ashahi river. So the exchange of nutrients through surface sediment and pore water and overlying water are more strong than that of Kojima lake samples. With the strong water flow the nutrient is moving to the Seto inland sea while the transfer of Nutrient in Kojima lake is not so easy compare to the Bay, So bigger part of the P content is trapped and the vertical and location diversion is obvious in core samples in Kojima lake. In Kojima bay, the higher river discharge shows some choose function to the sedimentation process and some part of the sediment resources especially active exchange part of P is removed by water flow and left with more stable forms. So the sediment in Kojima bay is more uniform and low diversion changes with depth and location.

Keywords: sediment, phosphorus, fractionation, artificial lake, sedimentation rate