Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AHW30-P01 Room:Convention Hall Time:May 22 17:15-18:45

Topographical variation of soil respiration in a warm-temperate evergreen forest in Kumamoto Prefecture, western Japan.

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The soil respiration rate was measured in four plots in different topological locations at the top, upper, middle, and base of a south-facing slope in the Kahoku Experimental Watershed, located in Yamaga, Kumamoto Prefecture. The soil moisture content ratio and soil temperature were also monitored. No large difference in soil temperatures was recognized among the four plots. By contrast, very large differences in soil moisture were found in the four plots. The soil was wetter in the plots located lower on the slope. The estimated annual soil respiration rate was much lower (around 60%) in the base plot, compared with the middle plot. This was thought to occur because the decelerating effect of soil characteristics on soil respiration exceeded the accelerating effect of wetter soil.

Keywords: Slope Scale, Forest Soil

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Major and trace elements behavior in two forest watersheds in the Kanto region

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Atmospheric deposition supplies some nutrients to forest ecosystem, serving as a source of reactive nitrogen, sulfur and the toxic metals. Although nitrogen and sulfur have been deposited in Japan as well as in Europe and North America, the impacts of the deposition of reactive N and S such as acidification of surface water and forest decline have not been reported yet. Itoh et al. (2004) reported high nitrate concentrations in stream waters mostly on the periphery of metropolitan Tokyo in Japan. In these forest watersheds, a high level of reactive nitrogen deposition may enhance the nitrification process and thereby acidify the forest soils. In turn, soil acidification can cause increased solubility of metals in the forest soil. In the surface forest soil layer, heavy metals derived from the atmosphere and mainly anthropogenic sources have been accumulating for long time in Japan (Itoh et al., 2007). The increasing mobility of the metals could pollute stream water or ground water, and thus damage the forest ecosystems in the future.

The objective of this study was to compare the behavior of potentially toxic metals in forest soil profiles in two forest sites: the Tsukuba experimental forest watershed and the Katsura experimental forest watershed. Two soil profiles were studied at Tsukuba and one soil profile at Katsura. Soil solution was collected from suction cups (PTFE) installed at each plot at depths form 10 cm to 100 cm. Concentrations of metals were determined using an inductively coupled plasma mass spectrometer (Agilent 7500).The soil solutions were acidic at Tsukuba. The pH values of soil solution did not increase from the surface soil layer to deeper layers ($<$ pH 4.5). Elevated nitrate leaching from the rooting zone was also observed. At Tsukuba, the concentrations of metals (Al, Pb, Cd, Cu, and Zn) were significantly higher than those at Katsura. Higher N deposition loads from the atmosphere and higher nitrification rate in the soils were also observed at Tsukuba. Therefore, the acidification of soil resulting from nitrate leaching may increase the mobility of metals in the soils. However, surface water acidification and high losses of metals from forest ecosystems have not been detected yet.

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AHW30-P03 Room:Convention Hall Time:May 22 17:15-18:45

Evaluation of the process of determining sediment yield in forested slopes with different forest floor cover percentage

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Recently, forest management, especially thinning, has not been conducted fitly in Japanese forest area. In unmanaged Japanese cypress plantations, where the weak penetration of sunlight into forest plantations results in poor growth of understory vegetation, soil erosion has been a serious problem. Many studies have reported the protective effects of forest floor cover on soil erosion. However, mechanism of preventing soil erosion by floor cover is not fully understood. To evaluate the effects of forest floor cover on the process of determining sediment yield in forested slopes, we measured rainfall, surface runoff, soil splash detachment and sediment yield which are considered to closely link with sediment yield in two kinds of forest stands consisting of Japanese cypress (CY:Chamaecyparis obtusa) with poor floor cover and Konara oak (KO:Quercus serrata Thunb.) with dense floor cover, which is located in Gunma Prefecture, Japan. The intensive observation was conducted from June 2010 to August 2011. The forest floor cover percentage (FCP) in CY were between 73 and 87%, on the contrary, that in KO was were about 100% during observation periods. Soil splash detachment was by about six times higher in CY than in KO, although the kinetic energy of raindrops measured below the canopies was almost equal in both sites. This indicates that the higher FCP in KO caused reducing raindrops impact to soil surface and contributed to preventing of soil splash detachment. Sediment yield was by about one order higher in CY than KO, and positively correlated with soil splash detachment in both sites. Maximum intensity of surface runoff was higher in CY than KO, and positively correlated with sediment yield in CY. These results suggest that higher sediment yield in CY was responsive for higher intensity of surface runoff, which contributes to transporting of soil detached by raindrop impact, as well as for higher splash detachment in CY.

Keywords: Soil erosion, Forest floor cover, Surface runoff, Cypress plantation, Soil splash detachment, Sediment yield

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

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Classification of soil erosion patterns on grazing pastures

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Keywords: grazing pasture, soil erosion

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AHW30-P05 Room:Convention Hall Time:May 22 17:15-18:45

The effects of typhoon on nitrate concentration in stream water during storm and post-storm

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The nitrogen is an important resource in the forest ecosystem, and the nitrogen constituent that flows out outside from a forested catchment through stream water becomes a loss for the forest ecosystem. It is undesirable that the nitrogen flows out from a forest voluminously from the viewpoint of the water quality control of the river. In general, the nitrogen runoff from a forested catchment tends to increase as the rainfall increases. Therefore, it is expected that a large amount of nitrogen flows out when there is a large amount of rainfall by the typhoon. A long term influence, the nitrate concentration in stream water rises for several years after the typhoon, was reported. According to the climatic change, the increase of frequency of a more powerful typhoon is pointed out. In this study, the short-term (during storm and post-storm) influence of the typhoon on the nitrate concentration in stream water was investigated based on the observation in two or more domestic forested catchments.

Our study carried out in four experimental basins. YS and HT catchments are located in Kochi Prefecture and KFC and KHC catchments are Ibaraki Prefecture. At each catchment, the amount of the runoff water was measured and the stream water during the typhoon was collected with the automatic water sampler at chiefly 1-2 hours intervals. After it had filtered it, nitrate concentration was analyzed by the ion chromatography methods. The sampling at the runoff according to the typhoon of the total rainfall 133 mm July, 2011 in KFC and the KHC catchment of the total rainfall 212 mm May, 2011 in the HT catchment of the total rainfall 247 mm June, 2004 in the YS catchment and total rainfall 289 mm August of the same year, total rainfall 742 mm August of the same year, and total rainfall 133 mm September of the same year and total rainfall 206 mm September of the same year was done.

The nitrate concentration in stream water at KFC and the KHC catchment rose as the amount of the runoff water increased the concentration, and became the maximum concentration around the discharge peak. Afterwards, the concentration has decreased gradually decreasing in the amount of the runoff water. This variability pattern looked like nitrate concentration variability pattern that had been observed at the runoff of the total rainfall 189 mm of Ohrui et al., (1992) and of the total rainfall 291 mm by Muraoka and Hirata(1988). On the other hand, although the nitrate concentration in stream water increased during the former half of the deluge, it decreased remarkably at mid to the latter half of that in YS and HT catchments. An extremely low concentration continued for at least one week or more. A remarkable decrease in nitrate concentration of the runoff water by the typhoon was similar to the case with Zhang et al.(2007) with the total rainfall 182 mm. As mentioned above, it was shown that the influence of the typhoon on nitrate concentration in stream water during typhoon and post-typhoon was different domestically. In YS and HT catchments, the runoff of the nitrate is not generated during several days at least after the typhoon. The difference of the response of such a catchment may influence the annual nitrogen exports. It is expected that the influence of the typhoon on the concentration of nitrate in stream water is different because of not the original characteristic of each catchment but the regional characteristic of such as a geology, terrains, and soils, judgement from that same variation patterns are observed in the same region.

Keywords: typhoon, streamwater, nitrate

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AHW30-P06 Room:Convention Hall Time:May 22 17:15-18:45

Application of SWAT using the Japanese soil taxonomy of agricultural fields and SolphyJ to the Sakura River watershed

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To apply SWAT to agricultural watersheds in Japan, the soil taxonomy polygon data for agricultural fields and the SolphyJ (Agricultural soil profile physical properties database, Japan) were utilized as input data. The procedure was applied to the Sakura River watershed in Ibaraki to simulate water and N and P movements. As a first approximation, river flow by SWAT reasonably agreed with the measured one by changing physical parameters relating river water flow, although irrigation and drainage to paddy fields, occupying 30% of all the area, were not taken into account. The N and P movements were difficult to be simulated by the current version of SWAT that does not consider the physical and chemical processes occurred in ponded water in paddy fields.

Keywords: SolphyJ, SWAT, soil taxonomy of agricultural fields, paddy field

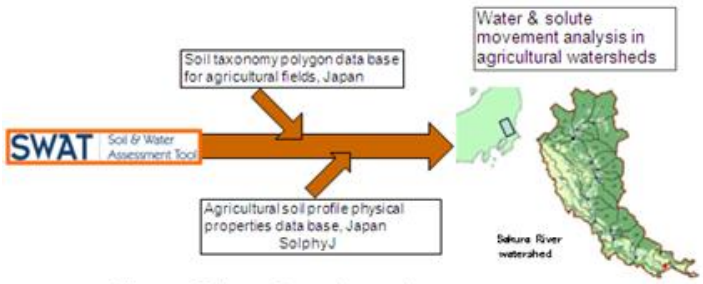

Figure Scheme of research procedure

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AHW30-P07 Room:Convention Hall Time:May 22 17:15-18:45

Spatial distribution characteristic and seasonal change of N_2O in the groundwater of an agricultural catchment

ONISHI, Koki[1*], ONODERA, Shin-ichi[1], SAITO, Mitsuyo[2], SHIMIZU, Yuta[1], YOSHIKAWA, Masashi[1]

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The distribution characteristics of nitrous oxide (N_2O) in an unconfined aquifer was examined based on the change of concentrations in N_2O, nitrate-nitrogen (NO_3^--N), and other chemical components with the groundwater flow in an agricultural catchment affected by the significant fertilizer application. N_2O concentrations were about 10ug L^{-1} in the upstream area, and they were positively correlated with NO_3^--N concentrations. These results suggest that the nitrification process influences N2O concentrations in the upstream area. On the other hand, in the downstream area, N_2O concentrations in the deeper groundwater ($>$15m) were significantly high (40ug L^{-1}), while they were very low in the shallower groundwater ($<$15m) (below the detection limit). The spatial distributions of DO and DOC suggest that the shallower groundwater is characterized by the strong reducing condition and high organic carbon content compared with the deeper groundwater. These results suggest that the complete denitrification process (NO_3^--N_2) occurred in the shallower groundwater, while the incomplete denitrification process causes the increase of N_2O concentrations in the deeper groundwater. This investigation was conducted in April. Furthermore, the second investigation was conducted in December. The result in wet season was compared with the result in dry season.

Keywords: groundwater, N_2O, denitrification, nitrification, agricultural catchment

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AHW30-P08 Room:Convention Hall Time:May 22 17:15-18:45

Estimation of nutrient flux in the Yamato watershed using SWAT model

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The long-term variation of nutrient flux in the Yamato watershed was estimated using the SWAT model. The results indicate that estimated nutrient flux during flood event is much higher than it was estimated by previous method. Furthermore, nutrient source has been traced by the SWAT and the results indicate that there are different sources between flood events and ordinary flow.

Keywords: water pollution, river, nutrient, SWAT, dissolved nitrogen

Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AHW30-P09 Room:Convention Hall Time:May 22 17:15-18:45

Nutrient transport with the river water-groundwater interaction in the tidal reach of the Yamato river basin

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In tidal reaches of river basins, river water levels fluctuate significantly with the seawater intrusion. It may enhance the river water-groundwater interaction and the associated change in dynamics of nutrients. However, effects of the nutrient transformation in tidal reaches on the nutrient load from river to the sea have not been fully evaluated in previous studies. Therefore, we tried to clarify the characteristics of the nutrient transport with the river water-groundwater interaction in the tidal reach of the Yamato river basin flowing into the Osaka bay.

We conducted the field survey from the river mouth to the 6~7km upstream area. Spatial variations in radon (222Rn) concentrations and the difference of hydraulic potential between river waters and the pore waters suggest that the groundwater discharges to the river channel in the upstream area. In contrast, the river water recharged the groundwater near the river mouth area. It may be caused by the lowering of groundwater level associated with the excess abstraction of groundwater in the urban area. The result also implies the seawater intrusion would accelerate the salinization of groundwater. The spatial and temporal variations in nutrient concentrations indicate that nitrate-nitrogen (NO3-N) concentrations changed temporally and it negative correlated with dissolved organic nitrogen (DON) concentrations. Inorganic phosphorous (PO4-P) concentrations showed the increasing trend with the increase of the river water level.

∗This research was supported by the research grant for the recovery and creation of Osaka bay in 2011.

Keywords: tidal reach, river water-groundwater interaction, nutrient transport

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Nutrient regeneration at seawater-groundwater interface zone in Gulf of Etajima and Gulf of Jakarta.

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Tidal pumping is one of the most important factors for nutrient load in local tidal zone. Although most of Submarine Groundwater Discharge (SGD) is recirculated seawater (RSGD), nutrient supply via RSGD is much higher by nutrient regeneration such as remineralization than river discharge or Fresh SGD (Santos et al.2009). Before now, SGD is remarked as important source of nutrients for marine environment. However there are few researches of comparing with different hydrological condition in standing the sight of nutrient production via seawater recirculation due to tidal pumping. So in this research, we focused on the range of tidal fluctuation, and estimate the nutrient supply via SGD by comparing with Gulf of Etajima that has a large tidal fluctuation and Gulf of Jakarta that has a small one.

This study is operated during 9 July 2011 to 10 July 2011 at tidal coast in the north side of Etajima, Hiroshima pref. and during 23 Aug 2011 at tidal coast in Gulf of Jakarta, Indonesia. This area is a granite island located Seto inland sea which is a semi-enclosed sea. Annual precipitation is about 1100mm. Although river discharge is about 10% of rainfall, groundwater discharge is about 20-40% of rainfall (Onodera, 2008). And this area has a large tidal fluctuation. Observed maximum tidal fluctuation is about over 2m. On the other hand, Gulf of Jakarta has small tide fluctuation. In this area, annual precipitation is about 1800mm but, most of rainfall is just only rainy season. This observation is operated at dry season. Therefore in our expectation, almost no FSGD exist.

222Rn was measured at 80m offshore from land in Etajima. On the other hand, it was measured at 40m offshore from high tide mark in Jakarta. The flow rate of seawater was measured by laser Doppler anemometer (WH-ADCP: Teledyne RD instruments). Water samples were filtered with syringe filter. After sampling, water samples were preserved in cooler box. After observation, samples were taken back to laboratory, and frozen immediately. And we analyzed the nutrients by flow injection type spectral photometer (SwAAt, made by BLTEC), dissolved anion by ion chromatography. In this study, we estimated the nutrients flux via mixed SGD with FSGD and RSGD, and their flow rate by calculated mass balance of 222Rn, Cl-, SiO2-Si. Nutrient supply and productions via each SGD were estimated from the endmember of salinity for seawater and groundwater.

Keywords: tidal zone, tidal fluctuation, nutrient production, submarine groundwater discharge

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(May 20-25 2012 at Makuhari, Chiba, Japan)

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Changes of the mitorogen pollution problem accompanying human work from the field survey example by LHG of Hosei Univ.

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1 Introduction

In Hosei University, the field survey has been continued from the viewpoint of ”water [accompanying human work] environmental” change in various areas in and outside the country.

From signs that water pollution progresses at the high-growth era of the 1950-1960s, The observation result obtained by just busying oneself with human-wave tactics by the development of laws centering on Water Pollution Control Law after the 1970s to the present condition complicated from the relation between the time improved quickly and various public works after that, etc. is left behind.

2 Water Pollution of City Region, and Nitrate Nitrogen Contamination

Taking advantage of what Dr. Mitsui succeeded for underground water survey record of Musashino Plateau where Dr. Shinkichi Yoshimura was investigated energetically in the 1930s, after that, investigation of the groundwater, springwater, and river water of this area was continued repeatedly, and many students summarized the result as a graduation thesis and master’s thesis, and have announced also at the society.

These days, as a part of Ministry of Education, Culture, Sports, Science and Technology scientific frontier promotion enterprise ”research on reproduction of the waterside space in a city”, over 2004- 2007, the field survey for the wide range area of the metropolitan area is performed, and it is collecting into ”the water environment of the city zone” (2005), etc.

Although Moriki etc(2009). who were especially summarized about the Shingashi river based on continuous results of an investigation are the main results, it is the mere part which is dedicated by the paper and it is a subject how huge search record will be utilized from now on.It is clear that the nitrate nitrogen accumulated into groundwater over many years has had big influence on the water quality of river water.The nitrogen problem has changed from remarkable concentrated contamination to field contamination and concentrated contamination in the different form has also been tackled.

Changes of the nitrogen pollution problem are summarized based on those examples.

3 Big River Basin

About the big river basin, it is divided roughly into the research on what was advanced as part of the database research by the workgroup in two or more societies (especially the association of Japanese Geographers), and the small basin standard physical unit GIS material-recycling model construction for basin management from classic and comprehensive investigation.

1) water environmental database

2) The joint research about Nogawa with the Oka laboratory of civil engineering and Onodera laboratory of Hiroshima Univ.

I think that it is utilizable for nitrogen problem analysis.

4 Peninsula, Island, and Agricultural Area

In an agricultural area, research which arrives at the present condition and the measure against the nitrogen contamination according to the land use and fixture situation has been advanced to the Lords, such as a peninsula and an island. As an area, they are Boso Peninsula, Miura Peninsula, the Shimabara peninsula, Ishigaki Island, Miyako Island, etc. If there continues to be an opportunity, I would like to continue, since a concrete and dense result is obtained although the periodical observation for grasping seasonal change and the burden of fixture investigation are heavy.

5 Conclusion

Although the Ministry of Environment added nitrate nitrogen and nitrous acid nitrogen to the environmental standards item concerning water pollution in 1999 and regulation was begun, the excess rate of environmental standards is projected and industrial, administrative and academic sectors people’s cooperation and collaboration are called for. I would like to also examine the problem of the countermeasures-against-groundwater-contamination promotion plan by national nitrate and nitrous acid nitrogen, and to continue the continued argument.

Keywords: nitrogen pollution problem, high-growth era, water pollution, environmental standards, public works, geographical infomation system

Japan Geoscience Union Meeting 2012
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Characteristics of groundwater chemical composition on Ryukyu limestone region in southern part of Okinawa

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The study area is located in the southern part of Okinawa Main Island, Japan, where Ryukyu limestone is extensively distributed. In this study field surveys were conducted to examine the characteristics of groundwater quality over a wide coastal area with agricultural land use We studied the characteristics of groundwater chemical composition (the four major cations (Na+, K+, Mg2+, Ca2+) and four major anions (Cl-, HCO3-, SO42-, NO3-)) in this region by using observation data at springs and observation wells. It was found that the chemical composition showed CaHCO3- type of groundwater from limestone aquifer where CaCO3 dissolution was predominant process yielding atypical bird-like shape in the Stiff diagram. The other components of groundwater also were indicated high concentrations so that the compositions waere dominated by Na+ and Cl- reflecting salt water and NO3-N and SO42- related agricultural land use in this area.

Keywords: Groundwater, Chemical composition, Ryukyu limestone

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The origin of sulfate ion in groundwater at the Higashi-Hachimantai area, Investigation using sulfur isotopic ratio

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Although the water pollution is not caused by human activities, dissolved ion content of most water samples in Higashi-Hachamantai area is larger than that in surrounding area. The sulfate ion (SO_4^{2-}) concentration of water samples in the study area is especially larger than normal natural water samples. The purpose of this study is to investigate the origin and formation process of SO_4^{2-} in groundwater using sulfur isotopic ratio ($d^{34}S$).

Major chemical compositions of water samples were divided into two types on the boundary of the Matsu River through the central part of study area. One is a Ca-HCO_3 (Iwate) type water in Kanazawa area at the southern part of the river and another is a Ca-SO_4 (Hachimantai) type water in Kashiwadai area at the northern part.

The $d^{34}S$ of dissolved sulfate in Iwate type groundwater was different from that in Hachimantai type one as well as major chemical composition and d-excess. The $d^{34}S$ values of two water samples in Iwate type were higher values of +10.0 and +12.3 per-mil, while those of two water samples in Hachimantai type were lower values of -2.6 and -1.6 per-mil. From the result of carbon isotopic ratio ($d^{13}C$) in dissolved inorganic carbon, Iwate type groundwater is obviously affected by volcanic CO_2 gas. Therefore, SO_4^{2-} in Iwate type groundwater seems to be originated from volcanic sulfur species, such as SO_2. On the other hand, Hachimantai type groundwater with lower $d^{34}S$ value seems to be produced by the oxidation of sulfide minerals such as Fe_2S, since the Aka River which is an acid river containing acid mine drainage from Matsuo mine located on about 4km northwestern part of study area, has the lowest $d^{34}S$ value of -6.2 per-mil. It is, however, estimated that Hachimantai type groundwater in the Kashiwadai area, which have intermediate $d^{34}S$ value between Iwate type groundwater ($>$10 per-mil) and the Aka River (-6.2 per-mil), is mixed with Iwate type groundwater which flows from the Mt. Iwate into Kashiwadai area, passing through under the Matsu River through the central part of study area. According to the measurement of flow rate in the Aka River, the infiltration water from the river would not contaminate the groundwater.

Keywords: Mt. Iwate, Hachimantai, groundwater, mixing, sulfate ion, sulfur isotopic ratio

Japan Geoscience Union Meeting 2012
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Hydrogeology and groundwater flow system in the Mitaki river basin, Mie prefecture

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Groundwater is mainly used as a water resource in Yokkaichi city. Mitaki river basin is one of the most significant area to collect a good groundwater for water supply. But, recently, land use condition changes agricultural field to residential or commercial area. So, it is concerned the groundwater quality will change worse and the amount of groundwater reserves will decrease. It is necessary to make clear the actual condition of effect of land surface conditions to the shallow groundwater, to preserve a good aquifer for sustainable shallow groundwater resource supply.

The purposes of this study are to analyze the physical and chemical characteristics of shallow groundwater quality related to geomorphology, geology and land use. Water samples are collected at 85 measurement points of river and groundwater in the irrigation season (August, 2010) and the not irrigation season (December, 2010), and analyzed dissolved major ions and oxygen and hydro-stable isotope compositions.

There are some groundwater flow systems and these water qualities are different in each area. Water quality composition of groundwater flow system in the upstream area is similar to Mitaki river water. But, isotopic composition showed two types. There are different groundwater flow systems, one is local groundwater flow system which the recharge area is the foot of Suzuka mountains, another has relatively long residence time. In the downstream area, recharge area is on the hills which are distributed at northern and southern hills. In this area, Shallow groundwater is mixed with river water and hills water. These showed that Mitaki river water is recharge to the portion of sallow groundwater in the downstream area, but chemical characteristics is not affected to the shallow groundwater. So, chemical characteristics of shallow groundwater are closely related to geomorphogical, geological and land use conditions. Land use is crops, paddy field and residential area in the basin, so it is possible that this water quality type is effect by any human activities. Seasonal change of groundwater qualities is different in each area. It was summarized that shallow groundwater quality is affected by land surface conditions which is different in each area.

Keywords: Mitaki river, groundwater flow system, hydrogeology, recharge area, drinking water source well

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Chemical forms of arsenic in the arsenic polluted groundwater aquifer sediment in Sonargaon, Bangladesh

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Health desease caused by the arsenic contaminated groundwater reported in the 1990s, is still serious all over the world, mainly in Asian countries. It is important to reveal the formation mechanism of the arsenic contaminated groundwater to establish the mitigation plan. Chemical weathering of detrital minerals such as pyrite, biotite and chlorite are also suggested as the arsenic host materials in the aquifers.

The study area, Sonargaon, Bangladesh is located in the Ganges delta, which is known to the largest affected area in the world. The study area including in the old Brahmaputra basin is located at the boundary between the Pleistocene terrace and the Holocene flood plain. Arsenic contaminated groundwater occurs in the Holocene sandy aquifer. The underlying Pleistocene sandy aquifer, separated by the Pleistocene impermeable clay layer, is free from the arsenic. The studied samples are the 38m long drilled core sediments taken from the highest arsenic contaminated groundwater appearing area, where active recharge of ground water occurs.

The major mineralogy and the major and the trace elements were analyzed using powder X-ray diffractmetry (XRD) and X-ray fluorescence photometry (XRF).

After the sediments were decomposed by alkali fusion and dissolved into HCl solution, total arsenic concentration was determined using hydride generation atomic absorption spectrophotometry (HG-AAS). According to the BCR method, four different chemical forms of the arsenic was extracted; acid soluble form comprising carbonate mineral impurity and weakly adsorbed on the mineral surface, reducible form fixed in and strongly adsorbed on iron oxides/oxyhydroxides, oxydisable form mainly comprising organic matter and insoluble form comprising silicate and sulfide minerals. The extracted arsenic was determined with arsenic ?related metal ions using inductively coupled plasma mass spectrometer (ICP-MS).

The cored sediments consisted with medium to fine sand except uppermost 4m, which was land-fill. Major mineralogy was quatz and feldspar, and biotite, amphibole, chlorite, goethite and calcite were included as minor or trace minerals. Major chemistry, SiO2, Al2O3, Fe2O3, Na2O, K2O and CaO were 60-80wt%, 10wt%, 2-5wt%, 2-5wt%, 2-4wt% and 1-3wt% respectively. The mineralogy and chemistry are homogeneous throughout the sediment column, except the sediments from 10-15m depths, in which Fe2O3, MgO, Co and Ni were higher. Although the arsenic concentration was about 10mg/kg throughout the column, the slightly higher concentration was observed in the sediments at 6m, 14m, 24m and 35m depths.

Arsenic concentration of sequentially extracted solutions was 0.1-1.0mg/kg, 0.2-1.1mg/kg, 0.5-0.9mg/kg, a few-20mg/kg for each steps respectively. The chemical extraction analysis documented that the most of arsenic is fixed in the insoluble phases such as silicate and sulfide minerals. The arsenic concentration of reducible phases of the sediments at 3.8m and 35m depths are slightly higher, i.e., 4.3mg/kg and 6.9mg/kg respectively. The former is at the depth where groundwater level changes seasonally, and the latter is at where the underlying oxic Pleistcene sediment directly contacts to the Holocene contaminated aquifer sediment. The oxidisable phases are categorized as organic conpounds, however, small amount of chlorite contribute to the extracted elements of this study.

u-XRF and XAFS analyses performed at Spring-8 in 2010 from the other sediment column in the studied area revealed that the chlorite was a source mineral of arsenic. Biotite was not the source mineral of arsenic.

As a conclusion, Fe-oxyhydroxides/oxides are not the host of As. Thus, the chemical weathering of chlorite occurring at around the groundwater level would be the mechanism to release As into the Holocene groundwater aquifer of this area.

Keywords: arsenic, chlorite, speciation

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Formation process of Arsenic contaminated groundwater at recharge area in Sonargaon, Bangladesh

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Ganges delta plain is the largest affected area of As contaminated groundwater in the world. Since the As contaminated groundwater occurs mostly in the reducing aquifer condition in this area, the formation mechanism has been believed that the As adsorbed onto Fe-oxyhydroxides/oxides was released in association with reduction-dissolution of the host phase via microbial activity. However, in Sonargaon, located east from Dhaka in Bangladesh, the As contaminated groundwater occurs in the actively recharging and oxic zone, and the conventional mechanism cannot explain the case. In this area, a host phase of As is chlorite. Based on the chemistry of groundwaters taken from -5, -10 and -15 m test tube wells (total 12 wells) and about 50 household tube wells drilled in the actively recharging zone, we documented that the As was released between -5 and -10 m depth via chemical weathering of chlorite. In this area, the groundwater at -5 m contained ˜0.4 mg/L As and 0.8 mg/L at -10 to -15 m, and >1.1 mg/L at -24 m (Maeda et al., 2011). In order to quantitatively argue the contribution of chemical weathering of detrital mineral(s) to the As and related chemical composition of As contaminated groundwater, REE elements of groundwaters and detrital plagioclase and chlorite picked from the contaminated aquifer sediments were analyzed using ICP-MS. Plagioclase is one of the most soluble mineral during chemical weathering and cholorite was the most plausible candidate of As source of the contaminated groundwater of this study. The obtained REE data was normalized using the data set of shale.

All REE paterns of the studied groundwater give the positive Eu anomaly, and most of those the negative Ce anomaly, which becomes larger with increasing depth. Groundwaters taken from test tube wells give the increasing As concentration with increasing concentrations of heavy REEs. REE concentrations of the chlorite are higher than those of the plagioclase, and the normalized concentrations are almost the same among the REEs. While, the plagioclase enriches in Eu, and the light REEs are enriched compared with the heavy REEs. As contaminated groundwaters of this area has Ca-(Mg)-HCO3 type major composition. Calcium and Mg are the major elements of plagioclase and chlorite. REE analysis confirmed that the chemical weathering of those minerals control even the major water chemistry.

Positive Eu and negative Ce anomalies do not have good correlation to the As concentration of the groundwaters. The positive Eu anomaly indicates active dissolution of plagioclase in the aquifer, while the dissolution of this mineral does not cause As contamination. Ce is easily oxidized in oxic aqueous condition from III to IV valance to be removed from the solution due to precipitation as oxide. Thus, the negative Ce anomaly indicates the reduction of groundwater with increasing depth of the aquifer. No relationship between As concentration and degree of negative Ce anomaly suggest that the As release into this groundwater aquifer does not occur in association with the reduction. In conclusion, the REE patterns of groundwaters and detrital minerals support our hypothesis that the As is released from congruent dissolution of detrital chlorite via chemical weathering.

Beneath the studied area, Holocene As contaminated aquifer and Pleistocene uncontaminated aquifer separated by the intercalated impermeable clay layer are present. However, the clay layer lacks just beneath the highest As contaminated well studied here, and the two aquifers directly contact to each other. Excess use of deeper groundwater for irrigation would promote accelerated vertical infiltration of oxic surface water into the shallow aquifer, and the appearance of oxic condition in the groundwater must cause As release from the chlorite via chemical weathering.

Keywords: arsenic contamination, groundwater, Bangladesh, Chlorite, weathering, rare earth element

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Fate and source of nitrate contamination in the groundwater along its flow in Kumamoto region, using nitrate isotopes

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Kumamoto city has a population of about 0.7 million people. This region is unique in the world because 100% of the drinking water is dependent on groundwater. Huge amount of groundwater is stored in high permeable Quaternary volcanic deposits and andesitic lavas mainly composed of four volcanic layers associated with 4 times Aso volcanic eruptions.

Nitrate-nitrogen contamination of groundwater has previously been observed in the aquifer system in Kumamoto area. Nitrate-N concentration in groundwater has been increasing and exceeding 10 mg/l in some places. However, the source and fate of nitrogen in groundwater in this region has not yet been clarified. For sustainable utilization of groundwater in this region, this issue needs to be addressed. Therefore, the purpose of our study was to confirm the source of nitrogen in groundwater and to understand the fate of contaminant in groundwater system in this region using nitrogen isotope and oxygen isotope.

The main land-use is consisting of farm land and livestock farm in upland areas and rice paddies in the lowland area. It would therefore be possible that nitrate in groundwater is originated from fertilizers and livestock wastes. The other notable features of this area is that large amount of irrigation water using Shira River infiltrates into deep groundwater around mid-watershed area.

In the year 2011, water samples were collected from 68 production wells (shallow groundwater 15 samples, deep groundwater 53 samples) in January to March, from 50 private wells (shallow groundwater 31 samples, deep groundwater 19 samples) in July, and from 78 production wells (shallow groundwater 21 samples, deep groundwater 57 samples) in October to November, respectively.

Average nitrate concentration in shallow groundwater was 10.4 mg/l (Max 44.0mg/l) while that in deep groundwater was 11.8mg/l (Max 72.0mg/l). Nitrate concentrations in the groundwater were high in highland areas where groundwater recharges. Nitrogen isotope ratios of most of groundwater samples ranged from +2 to +7 permillage. With comparison of all possible source materials, the source of nitrate in groundwater in this area was estimated to be mineral fertilizers applied in the agricultural fields. This conclusion differs from earlier study that concludes the nitrate source as livestock waste.

On nitrogen isotope vs oxygen isotope diagram, the shallow and deep groundwater samples having nitrogen isotope of above 7 permillage plot along the evolutional line for denitrification. In spatial point of view, most of the denitrification phenomenon was found in coastal area. Denitrification rates of these groundwater samples are calculated above 90% in most of case. Nitrate concentration tends to be lower towards the end of flow path because significant denitrification is occurred at coastal area.

In addition, in mid-watershed area, reduction of nitrate concentration was also found due to the dilution effect with mixing of Shira River with much lower nitrate concentrations. Using hydrogen and oxygen isotope ratios and sulfate concentration, mixing rates of both end-members (Shira River water and groundwater in recharge area) were calculated. Mixing rates of Shira River into deep groundwater were estimated to be from 40% to 70%. All of these results are important information to be used in the program of groundwater resource management of the Kumamoto City.

Keywords: Groundwater contamination, NO3-N, Nitrate isotopes, Denitrification, Source of nitrate

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Subsurface vertical temperature profile and estimated deep groundwater flow in the coastal zone at Horonobe area

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Groundwater flow in coastal regions is greatly affected by changes in the shapes of saltwater/freshwater interfaces. Saltwater/freshwater interfaces can be broadly classified into two types (Marui and Yasuhara, 1999). The interface is frequently located in the offshore region owing to the influence of the hydraulic potential. Fresh groundwater discharges along this interface have been identified locally and globally as submarine groundwater discharges (eg., Church, 1996). In addition, fresh groundwater is expected to be present under the seabed; this store of fresh groundwater is attributed to the evolution of the groundwater flow system with long-term sea-level changes (e.g., Groen et al., 2000). Formation process in these cases is considered to be as follows. During the glacial state, e.g., Last Glacial Maximum, the seabed surface was exposed, and fresh groundwater flow systems were widely developed. Subsequently, with the rapid rise in sea level, low-permeability mud was deposited, and resulted in the suppression of seawater intrusion; thus, fresh groundwater was retained under the seabed.

In the study area located in the coastal zone at Horonobe, northern Hokkaido, deep drilling and geophysical exploration surveys have been carried out. The results revealed the continuous distribution of fresh groundwater from land to the offshore region (Marui et al., 2011). Distribution of this fresh groundwater extends up to 5 km offshore to a maximum depth of 200?300m. However, site data on groundwater flow were unavailable, and the formation processes of the groundwater environment were unclear. Hence, we investigated the subsurface temperature at the borehole DD-1 (depth: 1,004 m). Further, the deep groundwater flow scenario was evaluated on the basis of the subsurface vertical temperature profile.

Deep groundwater flow was divided into an upper active and a lower slow sections by a boundary at a depth of 275 m. The groundwater flow rate in the lower section was very low, to the extent that it could not be determined on the subsurface temperature. Pore-water chemistry varies greatly at the boundary at a depth of 500 m; fresh groundwater with different residence times are estimated to exist above the depth of 500 m (Machida et al., 2011). It is possible that the fresh groundwater below the depth of 275 m had accumulated in the past and stagnated because the groundwater flow estimated on the subsurface temperature reflects the present groundwater flow situation. Therefore, it is suggested that the groundwater environment at the study site strongly reflects not only the present groundwater flow situation but also the hydrogeological history concurrent with the long-term sea level changes. In addition, since sea-level change is a global geographical phenomenon, regions with similar hydrogeological features commonly have possibilities of similar groundwater environments.

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Keywords: Deep groundwater, Coastal area, Groundwater flow, Subsurface temperature, Sedimentary rocks, Horonobe area

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Water quality synthesis analysis at period of winter in Niigata Prefecture Uono river basin

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1 Introduction

Uono river located in the Chuetsu area in Niigata Prefecture is a class A river where with MT,Tanigawa who is the prefectural boundary in Niigata Prefecture and Gunma Prefecture and it joins the Shinano river. The entire river basin is known as a heavy snowfall area. Therefore, it is a factor to cause the snow melting flood putting it in early summer at the early spring, and to change the river quality. Authors investigate the water quality in the Uono river basin in 2009, clarify the water quality variation that passes summer, winter, and year, gather the sample of the water quality observation, the depth of snow cover, and the snow in the entire river basin in addition in winter of 2009-2010,2010-2011 years, and have been considering the relation between the snow and the snowfall and the river quality in winter. It aimed to consider the water quality variation, the depth of snow cover change, and the snow conditions change in the same valley overall in this text based on the observational result every every day that had been done up to now in going winter of the result and one observation a week 2011-12 years and time, and to clarify the water quality variation at the period and the mechanism of the formation in winter.

2 Result and consideration

The day change is large, and in EC change of the snowfall period of the main stream downstream part, the maximum value is 153microS/cm, and is minimum and 94microS/cm. The decrease of EC value is not seen for the 14th though EC ground has decreased when the water level rises, and EC change does periodic movement every day.(Figure1)EC value decreased gradually, and it decreased rapidly until 2nd - 6th in April for the pH at the snow melting period. Moreover, an abrupt increase was seen from the night to early morning of the 19th - EC value the 20th. (figure2)When the relation between EC value and the dissolved constituent in the snowfall was seen, the correlation of Na and Cl was comparatively good, and the result of looking like was obtained in the stream water at the snow melting. Because these densities are higher than the density of Mg and Ca, the factor of a rapid rise of river EC value seems Na and Cl element that originates in the snow. (Figure 4 and Figure 5)

Keywords: Uono river basin, water quality synthesis analysis, water quality variation, diurnal variation, secular variation

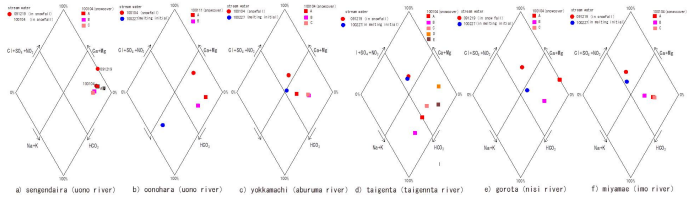

Figure 1 Keydiagram(snowcover・streamwater)

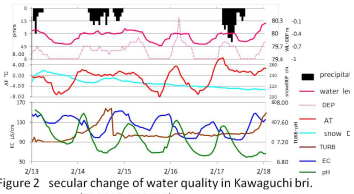
Figure 2 secular change of water quality in Kawaguchi bri. (110213-110218)

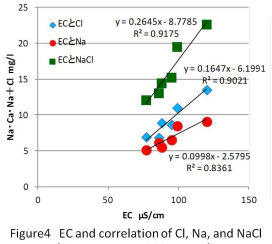

Figure4 EC and correlation of Cl, Na, and NaCl

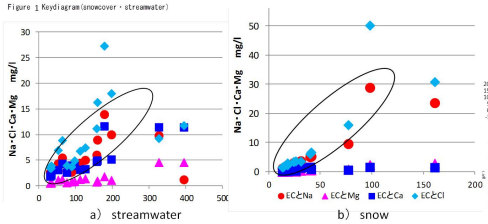

Figure5 Correlation of EC and dissolved constituent

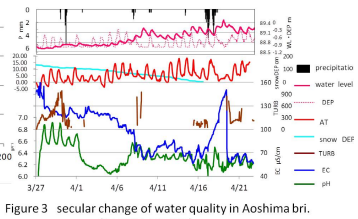
Figure 3 secular change of water quality in Aoshima bri.

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(May 20-25 2012 at Makuhari, Chiba, Japan)

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Evaluation of effect of human activities on groundwater recharge and nitrogen load, using distributed hydrological model

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Recently, groundwater resource has been more important because of surface water resource is getting more unstable due to changing amount and intensity of precipitation by climate change. At the same time, groundwater has many problems by human activities such as contamination by nitrate from agricultural area and decreasing recharge area due to urbanization. For these problems, we could assess and evaluate the effect using distributed hydrological model. This study aims to evaluate the effect of human activities on groundwater recharge and nitrogen loading, using SWAT which is one of major distributed hydrological model. The study area is the Takaya watershed (141km^2) which is one of tributaries in Ashida River system, western Japan. The model was run on two periods (1976 and 2006) for evaluation of the effect. The results indicate that no signal was detected in the upper portion (mountainous area) because there are not any land-use changes. In contrast, decline of groundwater recharge was confirmed in the lower portion because there are high activities with land-use change from paddy fields to residential area. Nitrogen loading from agricultural area into groundwater has decreased due to decline of the area, although the loading from residential area has increased due to population increasing.

Keywords: Human Activities, Groundwater Resharge, Nitrogen Load, Distributed Hydrological Model

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Separating Submarine Groundwater Discharge by using multi tracers in tidal zone.

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Nutrient through Submarine Groundwater Discharge (SGD) is regarded to play important role rivals river discharge in coastal area. And there are many reports of variety of SGD base on local conditions such as geological compositions and land use(e.g. Slomp and Van Cappelen, 2004). And before now, some methods of estimation for SGD have been developed (e.g. Taniguchi and Fukuo, 1993; Burnett and Dulaiova, 2003). Recently, SGD could be separated as Fresh SGD and recirculated sea water (RSGD). In some case, nutrients production via recirculation is much higher than river discharge or FSGD (e.g. Santos et al., 2009). However, there are few sufficient researches to estimating nutrients supply via each SGD with separating them rigorously. Therefore, objective of this study is estimating nutrients supply via each SGD and flow rate of each SGD with separating them by using multi tracer.

This study is operated in the north side coast of Etajima city, Hiroshima. This area is a granite island located Seto inland sea which is a semi-enclosed sea. Annual rainfall is about 1100mm. Although river discharge is about 10% of rainfall, groundwater discharge is about 20-40% of rainfall (Onodera, 2008). And this area has a large tidal fluctuation. Observed maximum tidal fluctuation is about over 2m.

We use the method of estimation for SGD by using 222-Rn continuous measurement suggested by Burnett and Dulaiova (2003). And surface sea water samples were collected at same point of continuous radon measurement by 1 hour intervals. The flow rate of seawater was measured by laser Doppler anemometer (WH-ADCP: Teledyne RD instruments). Water samples were filtered with syringe filter. After sampling, water samples were preserved in cooler box. After observation, samples were taken back to laboratory, and frozen immediately. And we analyzed the nutrients by flow injection type spectral photometer (SwAAt, made by BLTEC), dissolved anion by ion chromatography.Analysis was operated with multi tracer. Before now, several this type of analysis are operated (e.g. Kim et al., 2005), but most of them analyzed only FSGD, and more widely scale. In this study, we estimated the nutrients flux via mixed SGD with FSGD and RSGD, and their flow rate by calculated mass balance of 222Rn, Cl-, SiO2-Si.

At result of the separation, FSGD was marked at -2.1∗105(m s-) to 1.5∗105(m s-). It was stable relatively. In contrast, RSGD had large fluctuation at -8.1∗105(m s-) to 12.3∗105(m s-). At a result of sum, most of positive values were occupied by RSGD. However, in some case, when RSGD flux was below zero, FSGD occupied 100% of all SGD. SGD was coordinated with tidal pumping in the basically trend. SGD recirculated in short time scale was intruded into the ground by tidal pumping up, and FSGD was increased. And in the ebb tide, much RSGD were confirmed. Over ten times larger RSGD flux was computed by comparison with FSGD flux. Next, the result of computing was compared with the flux calculated by the Radon mass balance method suggested in Burnett and Dulaiova(2003). Most of the flux in the radon mass balance was affected by FSGD flux. So, the possibility that we can get more sensitive result in the tidal zone in which RSGD is causable was replied.

Keywords: 222-Rn, tidal zone, recirculated seawater, submarine groundwater discharge

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Signals of sediment nutrients affected by submarine groundwater discharge in Seto Inland Sea Japan

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Submarine groundwater discharge (SGD) is an important source of new nutrients, trace elements, and contaminants transfer to the coastal ocean in many parts of the world. Several studies showing that SGD makes a significant contribution to the nutrient budget of coastal waters. As the importance of SGD, it has led to growing research interest in this phenomenon. The nutrient interaction process and the signals of sediment in this discharge process as well as the long term effect of nutrient discharge through SGD are unknown.

The Seto Inland Sea is the largest semi-enclosed coastal sea area in Japan. The eutrophication incidents occurred in this area with most serious scale from the 1960s to 1970s. The contribution of nutrient discharge through SGD in some part of Seto Inland Sea area is focused by other researchers. In order to determine the sediment nutrient characteristics in this area, we compared the vertical variance of Nutrient in the sediment and sediment pore water between a costal bay area (Kojima Bay) which the nutrient discharge pattern is dominant by surface water is charge and a semi-enclosed bay (Hiuchi-Nada) which the nutrient discharge pattern is dominant by submarine ground water discharge in Seto-Inland Sea, Japan.

Sediment Core samples were taken by piston sampler and by diving in the field trip in 2009 and 2010. The sediment samples were analysed for the pore water nutrient and sediment phosphorus nitrogen, carbon content. The dating data of the sediment core was also determined by ^{137}Cs and ^{210}Pb analysis. The sediment pore water was extracted by centrifugation for 30 min at 3500 rpm .The sediment phosphorus content in the sediment was determined using the methods of Aspila. Sediment carbon and sediment nitrogen content were analysed by CHN analyzer. The nutrient content in pore water samples were measured by spectrophotometry.

Kojima Lake (an artificial lake by enclosed inner part of the Kojima bay) has captured higher phosphorus in sediment (0.37-1.19 mg/kg) than nearby Bay area (0.42-0.62 mg/kg) and Hiuchi-Nada area (0.45-0.63 mg/kg)in Seto Inland Sea. On the other hand it did not show the significant variations with depth in the sediments in Kojima bay and Hiuchi-Nada area. Different from the affection by river discharge, SGD did not result in big variations in sediment N and P properties, Nutrient discharge through SGD may more obviously affect the pore water nutrient content which is considered an important pathway of SGD nutrient discharge. The results shows that both the PO_4-P and total phosphorus concentrations in sediment pore water are comparable higher in Hiuchi-Nada sediment samples than the pore water samples in Kojima Bay area. As the SGD is an important way of discharge the nutrient into the coastal area. Also in Seto-Inland sea area, Onodera et al. (2007) reported that the coastal groundwater around the Seto Inland Sea is characterized by high phosphorus concentration. The pore water TN shows that the Hiuchi-Nada area has lower TN concentrations compare to the Kojima bay core samples. The relationship between N and Pin the pore water shows significant difference trend between the two locations. Kojima bay area has high N:P ratios (average 322:1) and the values has been in increasing trend down core while Hiuchi-Nada area has a decreasing trend down core with relatively lower value (average 26:1). This may indicate nutrient of the pore water affected by different terrestrial resources between two locations rather than the different sediment accumulation process. The semi-enclosed bay sediment nutrient structure may have connection with submarine ground water discharge process reported by Saito et al. (2011) that provides a nutrient supply and water discharge affection.

Keywords: Sediment, Pore water, Submarine Groundwater Discharge, Phosphorus, Seto Inland Sea