

AHW026-01

Room:201A

Time:May 27 14:15-14:30

Distribution properties of phosphorus concentration in coastal groundwater: hydrogeological background

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Nutrient condition in water environment controls the ecosystem. Groundwater discharge to the oceans is significant as nutrient supply (Slomp et al, 2004 etc). Especially, phosphorus and silica concentration generally are relatively high in coastal area. However, it has not been enough to confirm the source of phosphorus in coastal groundwater in previous studies. This study aims to confirm hydrogeological properties in coastal groundwaters, and estimate the possible phosphorus sources of groundwater.

The study areas are Osaka, Marugame, Okayama, and Fukuyama alluvial plains and small island groundwaters in Hiroshima prefecture. We arranged hydrogeological and groundwater quality data sets in previous studies of Hiroshima University. The phosphorus concentrations were high in anoxic condition. In addition, shallow aquifers around alluvial clay had high concentrations. The phosphorus contents in alluvial sediments of Okayama plain were relatively high around alluvial clay. These results suggest the contribution of phosphorus from alluvial sediment to groundwater.

Keywords: phosphorus, coastal groundwater, hydrogeology, sediment

AHW026-02

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Residence Time estimation for the Highly Arsenic Contaminated Groundwater in Sonargaon, Bangladesh

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Large-scale natural arsenic contamination of groundwater has been a serious problem in a number of areas around the world, especially in Asian countries, in many cases having a major impact on potable water.

Throughout a series of our studies in Sonargaon, Nayakaganj, Bangladesh (Mitamura et al., 2008; Itai et al., 2008; Seddique et al., 2008), vertical infiltration of surface water into the shallow aquifer would promote the As contaminated groundwater. In those studies, Mitamura et al. (2008) reported that the highly As contaminated wells are occasionally installed into the finer and micaceous sediment, and that the geological structure of the aquifers is an important control on the formation of As-contaminated groundwater in Bangladesh. Seddique et al. (2008) pointed out that the detrital biotite is a primary source of As, and chemical weathering of this mineral is an essential mechanism forming chemical composition of groundwater including As concentration. Heterogeneous distribution of major chemical component and oxygen and hydrogen isotopic ratios of the groundwaters indicated vertical infiltration of surface groundwater into the shallow sediments (Itai et al., 2008). The three-dimensional groundwater flow model numerically predicted that water recharged from the ground surface beneath the flood plain moves approximately 10 m to 20 m vertically downward, with a gradually increasing horizontal flow, toward the underlying Pleistocene middle mud layer (aquitard) (Nakaya et al., 2010). Groundwater pumped up from tube wells in the Holocene aquifer for daily use is recharged in several areas in the flood plain. The model also predicted that hotspots with the highest As concentrations (> 700 ppb) are formed on the vertical groundwater flow paths during surface water recharge and not on the horizontal flow paths. Therefore, the model supported the view that chemical weathering of detrital minerals in Holocene sediment (shallow aquifer) is an essential mechanism forming chemical composition of groundwater including As concentration.

In this study, to estimate the residence time of As highly contaminated groundwater in Holocene aquifer, we measured the concentrations of CFCs, ³He/⁴He and As in groundwater samples, including DO, sampled carefully at 20-25 m depth private tube wells in a recharge zone, As hot-spot in September and December, 2010. The apparent residence time is estimated to be from about 30 to 10 years from ³He/⁴He and from about 43 to 27 years from CFC-113. The As in groundwater ranges from 100 to 1250 ppb. The apparent residence time for high As groundwater (>500 ppb) ranges from about 40 to 27 years from CFC-113 in September samples, while it ranges from about 43 to 27 years from CFC-113 and from 28 to 10 years from ³He/⁴He in December samples. For December samples, higher As indicates shorter residence time. Moreover, As increases in concentration with depth from 100 ppb at 5 m depth to 700 ppb at 10 m depth for groundwater samples from survey wells. Since shorter residence time means shorter path length of groundwater flow from three-dimensional groundwater flow model (Nakaya et al., 2010), at our study site, the results lead to the As mobilization model that As is strongly released during vertical infiltration from surface to about 20 m depth for 10-20 years in As rich Holocene aquifer and As is transported by horizontal flow path without As release.

Keywords: groundwater, arsenic pollution, Bangladesh, residence time

AHW026-03

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Study on characteristics of NO₃-N concentrations in groundwater of 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. We studied the behaviour and characteristics of NO₃-N in groundwater in this region by using observation data at 13 springs through long term monitoring

It was found that the NO₃-N concentrations at in springs ranged from 6.2 mg/L to 16.6mg/L during 17years in this area. The No₃-N concentrations had decreased from the mid-1990s to early 2000s.And The No₃-N concentrations not have been decreased or increased since early 2000s. Distribution of NO₃-N concentrations show various form according to location and differences of various form are approximately classified into two types (stable type and unstable type). It was considered that NO₃-N concentrations were influenced by the rainfall, geological structure and land use of upland fields. The equation between T-N concentrations and NO₃-N concentrations could be obtained from observed data. The predicted values of NO₃-N concentrations were approximately in agreement with the observed values.

Keywords: NO₃-N, groundwater, spring water, Ryukyu limestone

AHW026-04

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Quantitative analysis for nitrogen contamination of tea plantation area caused by excess fertilizer

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In this study, it is proposed that nitrate nitrogen concentration of spring and river water is estimated from land use, amount of fertilizer, absorption for plants, and precipitation and then it can be applied for another area. In order to establish an estimation method, spring and river water chemistry, land use for each catchment, amount of fertilizer, precipitation, and flow rate of river were studied at the hilly terrain with tea plantations in Shimizu, Shizuoka city. The nitrate nitrogen concentration estimation method for river and spring water was proposed based on the results.

Estimation method 1

There are three kinds of land use in this area, tea plantation, orange grove and coniferous forest. The measured nitrate nitrogen concentration for spring water at the catchment increased when annual total amount of nitrogen fertilizer was over 20 kg/10a and when the value was less than 20 kg/10a the measured concentration was low. Then the 20 kg/10a was thought to be permissible range for plant absorption. Plant absorption was added for the estimation. Therefore, groundwater nitrate nitrogen concentration for each land use was estimated from each land use area, amount of fertilizer for each land use, absorption for plants and the measured nitrogen concentration for spring water in the catchment. The annual amount of nitrogen fertilizer for tea plantation and orange grove were 54 and 24 kg/10a. The annual absorption for tea and orange were 21.6 and 16 kg/10a. The estimated nitrate nitrogen concentration for tea plantation, orange grove and coniferous forest were 19, 2.8 and 0 mg/l. Nitrate nitrogen concentration at each catchment can be estimated from land use and the estimated nitrogen concentration of groundwater at each land use and in this area, the estimation and concentrations was in good agreement with the measured concentration.

Estimation method 2 : Estimation method 1 + precipitation

Precipitation was not accounted in the estimation 1. When the precipitation was different, the estimation 1 can not be applied for another field. As most of nitrogen fertilizer was ammonium sulfate and it was directly sowed on the ground, then, it was proposed that fertilizing nitrogen was diluted by precipitation on the ground and some water directly flowed on the slope and others infiltrated. The infiltrated nitrogen was absorbed by plants in the ground. Then, estimation 2 was as follows.

$$\text{Nitrate nitrogen concentration} = (\text{amount of nitrogen fertilizer} \times \text{infiltration rate of precipitation} - \text{absorption by plants}) / [(\text{precipitation} - \text{evapotranspiration}) \times \text{infiltration rate of precipitation}]$$

The nitrate nitrogen concentration estimated by estimation method 2 was in good agreement with the measured concentration. In this area, 13 % nitrogen of the amount of nitrogen fertilizer sowed on the ground directly flowed on the ground and 87 % nitrogen of the amount of nitrogen fertilizer sowed on the ground infiltrated into ground and some nitrogen was absorbed. 11 % of water for infiltrated water was deep groundwater.

Keywords: tea planation, fertilizer, nitrogen contamination

AHW026-05

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Characteristics of contamination and attenuation of nitrate in groundwater with different scale of flow system

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For the sustainable use of groundwater resources for the future, it is important to clarify the characteristics of nitrate contamination and natural attenuation (e.g. denitrification) in an aquifer. In recent years, several researchers have suggested that landscape hydrogeology can provide an important framework for understanding nitrate removal capacity at the riparian zones. However, few studies discussed about the relation between groundwater flow condition and nitrate attenuation process on the catchment scales. The objective this study is to confirm the characteristics of nitrate contamination and attenuation in the groundwater with the different scale of flow system. We compared the data on the groundwater flow, nitrate concentration and nitrogen stable isotope ratio (d15N) in groundwater in the three study sites (IK, YD and JK). All these study areas are characterized by the large nitrogen load from agricultural, domestic and industrial activities. The IK (Ikuchijima) aquifer is located in southern Japan with the catchment area of 44ha and topographic gradient of 1/50. The YD (Yellow River Delta) aquifer is located on the lower reaches of the Yellow River, which covers approximately 5200km² and topographic gradient is approximately 1/1000. The JK (Jakarta) aquifer is located on the metropolitan area of Jakarta that is lower reaches of the Ciliwung River catchment and the topographic gradient is approximately 1/400.

In the all study sites, groundwater in the recharge area is characterized by relatively high concentrations of NO₃-N and relatively low d15N. Especially in the IK and YD, NO₃-N concentration exceeds 20mgL⁻¹. However, NO₃-N concentration decreased and d15N increased along with groundwater flow in all study area. These results suggest that NO₃-N attenuation by the processes of dilution and denitrification occurs. Especially in the YD, isotope enrichment ratio is higher than the other two sites (IK & JK). NO₃-N attenuation potential is estimated to be YR > JK > IK based on the geological condition, groundwater velocity and isotope enrichment ratio.

Keywords: groundwater, nitrate, contamination, attenuation, different scale of flow system

AHW026-06

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Simultaneous use of natural attenuation and permeable reactive barrier in nitrate contaminated groundwater

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Since the implementation of the Law on Promoting Proper Management and Use of Livestock Excreta in 1999, the number of the farmers that do not meet the management criteria is on the decline. However, there is a possibility that many of the animal waste disposal pits that have been either abandoned or refilled according to the law have been the potential contamination source.

In this study, we discussed the possibility of simultaneous use natural attenuation and permeable reactive barrier in nitrate contaminated groundwater. As a result, after 55 days from the startup of the experiment, the nitrate concentration decreased from 151 mg/L (upstream observation wall) to 0 mg/L inside the permeable reactive barrier.

Keywords: groundwater, NO₃⁻, permeable reactive barrier, natural attenuation, denitrification, animal waste

AHW026-07

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Evaluation of artificial effect to the regional groundwater flow system in the southern Fossa Magna area

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In order to evaluate the artificial effect to the regional groundwater, the concentration and source of minor and major elements in the groundwater, spring as well as river water were investigated based on the geological and geochemical features in the southern Fossa Magna area. Most elements except vanadium, phosphorus and uranium, which do not give sensitive characteristics in igneous rocks also showed obscure characteristics in groundwater, spring and river water. However, the geological source classification of some major elements in groundwater which reflects the geology was successfully achieved using differences in the distribution area in Fossa Magna area. Thus, it is possible to estimate the excess concentration of some major elements in the groundwater in this study.

Keywords: groundwater, major elements, minor elements, Fossa Magna

AHW026-08

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Study on management of groundwater reservoir with example from Ryukyu limestone aquifer in southern part of Okinawa

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The Komesu and Giiza underground dams are first full scale underground dam facilities constructed for irrigation in Japan. A groundwater flow analysis was conducted with three dimensional numerical model (MODFLOW2000) apply for these dam reservoir areas. Through the comparison with calculation and observed data, the cut off wall of dams effectively storage the groundwater in the reservoir areas. This also found the Komesu underground dam can reduce the movement of salt-water into the reservoir areas, salt-water masses remained behind the dam at the time of it is completion.

The observed groundwater level at the reservoir areas were almost reproduced by this model, but there were a few differences between the calculation and observation, response analysis could be carried out to improved the model by inputting various data of geological-structure of Ryukyu limestone and introducing non-darcy flow.

The results of examination make it possible to improve the management of groundwater reservoir in the limestone aquifer area behind the underground dam.

Keywords: underground dam, Ryukyu limestone, numerical simulation, menegement of groundwater

AHW026-09

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Nutrient exchange between surface water and subsurface water in ponded shallow reservoir of a suburban river catchment

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This research aims to clarify the nutrient exchange processes within the reservoir in a suburban river with considering of interaction between subsurface water and river water. The vertical distribution of nutrient concentration in the water column and sediment pore water indicates there was large concentration gradient of dissolved nitrogen and phosphorus across the water-sediment interface. $\text{NO}_3\text{-N}$ was dominated in the water column although $\text{NH}_4\text{-N}$ and $\text{PO}_4\text{-P}$ were dominated in the sediment pore water. The hydraulic gradient between the surface water and pore water in the sediment indicates that this reservoir has advection from the water column to the sediment throughout of a year. As a result, it was confirmed the surface water infiltration in this reservoir. Based on the estimation of nutrient flux by diffusion and advection, diffusive fluxes of $\text{NH}_4\text{-N}$ and $\text{PO}_4\text{-P}$ was larger than advective fluxes. Totally, it was confirmed that this reservoir worked as a source of on the material transport in the river system. However, diffusive fluxes of $\text{NO}_3\text{-N}$ and $\text{NO}_2\text{-N}$ indicated downward (water column to sediment) as same as advective fluxes, because $\text{NO}_3\text{-N}$ and $\text{NO}_2\text{-N}$ would be attenuated by denitrification near the surface sediment. This result suggests the reservoir works as attenuation zone for nitrogen.

Keywords: Lentic water, Nutrient, Sediment, Diffusion, Advection, Takaya River

AHW026-10

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Subsurface flow processes of the soil and bedrock in a small headwater catchment

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The hydrometric and tracer approaches were applied to investigate subsurface water flow processes of the soil and bedrock in a small headwater catchment underlain by sandstone, Karasawasan University Forest, Tokyo University of Agriculture and Technology, Tochigi prefecture, eastern Japan.

During the observation period (June 19, 2010 - December 29, 2010), 862 mm precipitation were observed and the runoff ratio of the monitored spring discharge was 32%, that suggesting a large amount of groundwater infiltrate into the bedrock.

Groundwater level changed in the boreholes drilled into the bedrock with a similar trend of hydrograph at spring. The lag time from rainfall peak to the runoff peak shows a good correlation with that of groundwater level. This suggests that the groundwater flow hydraulically connects with the spring discharge.

End-member mixing analysis was applied to evaluate the runoff components using SiO_2 and HCO_3^- concentrations as tracers. Contribution ratio of the bedrock groundwater to the runoff was estimated to be more than 60% during a secondary runoff peak.

The CFCs concentrations show an average residence time of the spring water to be approximately 20 years.

Keywords: headwater catchment, sandstone, rainfall-runoff process, bedrock groundwater, end-member mixing analysis, CFCs

AHW026-11

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Do ion dynamics represent the hydrochemical characteristics in headwater catchments?

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To understand the effect of complexation in transporting major metals, the concentrations of Na, Mg, Ca, Si, and fulvic acid like materials (FAM) were measured in two headwater streams of coniferous and deciduous catchments. The differences of concentration between total elements (T-Na, -Mg, -Ca) and ionic materials (Na⁺, Mg²⁺, and Ca²⁺) were equated with the concentration of non-ionic materials (NIM). The rates of NIM to the total elements in the coniferous and deciduous catchments respectively ranged 0% to 40% and 0% to 70% in stream baseflows and 5% to 60% and 20% to 60% in stormflows. In the stream baseflows, the relationships between NIM and total Si (T-Si) showed the high correlation ($r > 0.9$) in both catchments. In contrast, in the stormflows, the relationships between T-Si and FAM showed good correlations ($r > 0.8$) in both catchments, implying the organic-inorganic complexation was promoted. However, in the coniferous catchment, the good correlations ($r > 0.8$) between NIM and T-Si or FAM were provided mainly at the rising limbs of the hydrograph, contrastive to the good correlations ($r > 0.8$) both at the rising and falling limbs of the hydrograph in the deciduous catchment. These things exhibited that #1) in the low flow conditions, the complexation of the major metals with clay minerals could be the main process in transporting NIM in both catchments, #2) throughout the storm events, the complexation of clay minerals and humic substances (organic-inorganic complex) could be promoted in both catchments, #3) only at the rising limb of the storm hydrograph in the coniferous catchment, the complexation of the NIM with the organic-inorganic complex may have been the main process in transporting NIM, however, at the falling limb of the hydrograph, the NIM transport may have resulted from the effect of other materials such as organic acids, likely due to the more active production of organic acids in the soils of the coniferous than in the deciduous catchments, and #4) in the deciduous catchment, the NIM transport in the stormflows could be mainly controlled by the organic-inorganic complex throughout the storm events, on account of the small effect of the organic acids that may have resulted from low production in the soils. These findings emphasize that not only the ion dynamics but also the active complexation of Na, Mg, and Ca in freshwater environments, as well as the effect of differing vegetation on their complexation, should be carefully examined in the headwater hydrology.

Keywords: fulvic acid, organic acid, major metal, fresh water environmt, organic-inorganic interaction

AHW026-12

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Nitrogen leaching from two forested watershed in Ibaraki, Japan

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Increased atmospheric nitrogen deposition to forested watersheds will increase the nitrate concentration in stream water. In Japan, high nitrate concentrations in stream water have been observed at some forested areas around the Kanto region, suggesting the occurrence of "nitrogen saturation". We observed the concentration and flux of inorganic nitrogen of bulk precipitation, throughfall, soil water, and stream water at two forested catchments with different N input, Katura experimental forest (KEF) with low N deposition and Tsukuba experimental forest (TEF) with high N deposition. The amounts of nitrogen deposition by throughfall at KEF and TEF were $7.8 \text{ kg ha}^{-1} \text{ y}^{-1}$ and $22.4 \text{ kg ha}^{-1} \text{ y}^{-1}$. The inorganic nitrogen flux at 100 cm depth were lower than $0.5 \text{ kg ha}^{-1} \text{ y}^{-1}$ at KEF and higher than $50 \text{ kg ha}^{-1} \text{ y}^{-1}$ at TEF. The nitrogen runoff as stream water were $1.9 \text{ kg ha}^{-1} \text{ y}^{-1}$ at KEF and $11.1 \text{ kg ha}^{-1} \text{ y}^{-1}$ at TEF. In TEF, the nitrogen input is thought to exceed the ecological demand.

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Relationship between gully erosion and soil-layer hardness on grazing pastures

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At present, large-scale grasslands such as public pastures are about 900 spots in Japan. Most of these are located on sloping lands. Therefore, gully erosion has occurred in some grasslands.

In this study, distributions and cross-sections of gully erosion were surveyed in the public pasture in Tochigi prefecture, Japan. Soil hardness of shallow and deep layer were also investigated using the SH type handy dynamic cone penetrometer etc. along gully channels. The cross-sectional profile of the gully channel was compared with the depth of a hard layer that appeared in the soil layer. The results indicated that the maximum depth of the gully cross-section was governed by the hardness characteristic of the soil layer (Fig.1).

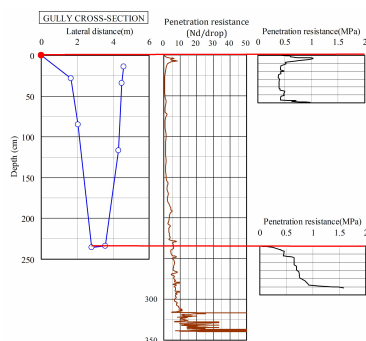


Fig.1 Relationship between gully channel profile and characteristics of penetration resistance

Keywords: Grazing pasture, Soil erosion, Gully erosion, Soil hardness

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Transport of sediment with phosphorus

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Eutrophication is caused under the rich nutrient condition. Nutrient transport by terrestrial water to marine has been reported by so many researchers. Not only artificial water pollution but also the leaching from natural rocks and/or soils affects the eutrophication in the coastal area in various time scales, respectively. However, the source and transport of phosphorus (P) in various watersheds has not been clarified enough. Transporting sediment with high P concentrations has been identified as a major hydrological pathway for sediment associated P delivery to surface waters, and is considered a major threat to water quality. Especially, some researches have not been considered the mineralogical sources and carriers of phosphorus, and hydrological dynamics of phosphorus transport, respectively. So, it is important to determine kinds of minerals including P, and concentrations of P in each mineral. By the study about the characterization of P in the granite distributed area, it is known that P is included in mica minerals and/or iron hydroxide minerals.

This study is aimed at clarifying the relations of P contents and minerals weathering of rocks and sediments from drilling core at four points around Asahi River, Okayama Prefecture. Collected samples were examined the identification of mineral in sediment by the X-rays diffractometry and chemical composition of sediments by the X-ray fluorescence analysis. Furthermore, carbon and nitrogen contents in each collected samples were analyzed.

The constituted particle of the drilling core is comparatively big in particle size rather an upper basin than the lower basin. Quartz, feldspars, hornblende and clay minerals were recognized in all points. Mica minerals, kaolin minerals, chlorite, vermiculite and smectite were confirmed as clay minerals. XRD analyses show a decrease in mica minerals contents and a increase in vermiculite formed in altered sediment. Vermiculite has been formed as altered mineral from mica minerals such as biotite. The phosphorus concentration has negative relation to the potassium content. On the other hand, it was shown that it had equilateral relation to iron and magnesium content. The phosphorus content tends to increase in a part with much vermiculite. It is thought that phosphorus is adsorbed in vermiculite; however we must consider adsorption of phosphorus of the amorphous iron hydroxide. Sediment transport with a high phosphorus concentration has been identified as a major role to total phosphorus supply to the marine. Therefore, it is necessary to determine kinds of minerals including P, and concentrations of P in each mineral in stream sediments.

Keywords: phosphorus, mica mineral, vermiculite

AHW026-15

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100 years variation in nutrient discharge reconstructed, using the sediment profile of an artificial lake in west Japan

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Coastal sediments are an important sink for terrestrial derived nutrients. Sediment cores extracted from these environments can provide vertical phosphorus distribution which correlate with historical patterns of phosphorus sedimentation. Coastal lake sediment therefore provides information on phosphorus which can be used to reconstruct the paleoecological and pollution history of the lakes and their catchment basins. And also some climatic changes could also reflect on its recorded.

One 124-cm long core sample was taken by piston core sampler in Kojima Lake during September 2009. Sediment total phosphorus (TP) and total inorganic phosphorus (TIP) were determined by Asplund method. Local precipitation data, population data and paddy field data were also considered in the research.

The reconstruction of phosphorus discharge for last 100 years was conducted. We use the ²¹⁰Pb activity and ¹³⁷Cs activity to determine the dating data of the core sample. Sediment TP in sediment showed a slightly decreasing trend with the depth and through obvious peak in the core suggests the eutrophication in Kojima Lake for last century and the peak of nutrient load in around 1970s. As In Sasagase Basin and Kurashiki Basin, there is significant amount of farmland and residences area. And the construction of dike enhances the Nutrient retention in lake sediment. So the impact of intensive human activity and diversity of heavy nutrient discharge from the Rivers leads to abrupt changes of phosphorus in sediment both in organic and inorganic forms. The high P content of sediments in the eutrophic Kojima Lake is hypothesized to result from high P content of sediment in the inflow.

In addition, sediment TP and TIP contents in sediment indicated yearly variation. Relationship between TP content and factors were determined through linear correlation ship analysis. The variations of TP content were not clearly affected by the annual precipitation(1900-2000),population change(1920-2000)and paddy field area change(1949-2006) whereas it was related to the annual number of the event with daily rainfall over 100mm. Intensive extreme precipitation events results most of the points which sediment TP content is over 1.000mg/g . In 1976, there was 3 times of over 100mm daily precipitation leads to a high TP content recorded in sediment core at 1.161mg/g. The 2 times big precipitation year in 2005 also leads to a high TP record (1.155mg/g).The two big precipitation in year 1971 and 1972 related to a TP content of 1.023mg/g . Same trend also show on sediment TIP result which consist of most part of sediment TP content. This may because of the regional high rainfall carries more nutrients of the two basins farmland into the lake and the storm may have a direct effect of erosion. And high rainfall also brought more suspending sediment property and storm water runoff. An increase in the number of torrential rainfall events are hypothesized to increased phosphorus transported to ocean.

The climate change by global warming may expected to appear in the alternation in rainfall patterns and an increase in the occurrence of extreme climate change events, which may lead to a change in the frequency and intensity of storms. This influence has already been confirmed in Japan from daily precipitation including typhoon .Accordingly; it would be further enhanced over Japan due to the increase in atmospheric moisture availability. If precipitation changes more intensive and more sever, it may lead to a result that high soil erosion and high phosphorus river discharge. The phosphorus resources in sediment may also increase due to increase of extreme precipitation event. It would be a potential release pool of phosphorus to the environment again because the most part of TP in sediment is consists of inorganic forms. Consequently, climate change may enhance phosphorus discharge to open-sea.

Keywords: sediment, phosphorus, precipitation, extreme rainfall event

AHW026-P01

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Development of three dimensional hydrogeological model in Japanese islands and its applications

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The groundwater resource is a sustainable water resource. Recently, social demands against the groundwater resource become more multifaceted. And almost people need an optimum groundwater management achieved a good balance between conservation and utilization. Recent core technique of groundwater management is quantification of groundwater balance by numerical simulation. It is well known that the behavior of groundwater is restricted by distribution and hydraulic characteristics of a stratum. This argument points to a need for grasping the whole picture on groundwater basins and groundwater storage. And the current situation of groundwater resource development exceeds 1,000m in depth. It is necessary to improvement of advanced information on groundwater including the revaluation of co-existing information. However, basic information on the groundwater has not maintained still enough. Therefore, previous study has not been clarified the whole picture of groundwater basin and groundwater storage throughout Japan. The present work is intended to evaluate the whole picture of groundwater basin throughout Japan, and develop the three dimensional hydrogeological model in Japanese islands using the related database. We developed the three dimensional hydrogeological model based on the geological age as a key to divide from a same viewpoint, and became possible to specify the wide-range continuousness and distribution shape of a stratum which would become an aquifer. This report presents the developed three dimensional hydrogeological model and the estimation results of groundwater storage, unused groundwater resources, hot spring development potential in Japanese islands as its applications.

Keywords: Three dimensional model, Hydrogeology, Database, Japanese islands, Social demands

AHW026-P02

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Hydrologic cycle of upland-lowland system in Shimosa Upland, Chiba Prefecture and spatio-temporal distribution NO₃-N in

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1. INTRODUCTION

NO₃-N in the environmental water has been increasing in many places in the world because of human activity, especially by agriculture. Upland regions in Chiba prefecture is extensive crop area and much amount of NO₃-N is expected to add in hydrologic cycle.

This paper deals with the NO₃-N contamination in the upland-lowland hydrologic cycle. Surface waters and groundwaters are sampled and analyzed for NO₃-N. With the concept of groundwater flow system, holistic understandings of NO₃-N distribution are attempted.

2. Study area and the methodology

Takasaki-gawa is the tributary of Kashima-gawa which flows into Inbanuma Lake, one of the source of domestic water in urban area of Chiba Prefecture. Takasaki-gawa dissects the flat upland called Shimosa Upland, prominent crop land in Japan. Valley bottom is mostly used for paddy field. Along the dissected valleys, there are two types of land use chains, crop land to paddy field and urban area to paddy field.

Waters are sampled routinely after 2008 to measure inorganic nitrogen, and seasonal variation and spatial distribution of inorganic nitrogen are made clear. Groundwater are also sampled and analyzed for NO₃-N. The flow of rivers are measured seasonally and nitrogen load is calculated.

3. Results

There are many points that shows high NO₃-N concentration in upper reach of Takasaki-gawa watershed. There is seasonal change in NO₃-N. Low concentration is observed in May or June. Most observation points except urban area on the upland show the same seasonal change. There may be some signal concerning hydrologic cycle and material cycle in the upland-lowland system.

The paddy fields on May and June are in flooding condition. The source of irrigation water is deep groundwater and its NO₃-N concentration is revealed to be low. Low NO₃-N water is added to paddy field during irrigation period. At the same time, denitrification under the paddy is possible in deoxidization condition.

There are characteristic changes in NO₃-N concentration along the tributaries of the Takasakigawa-river.

Channels A (Takasaki-gawa main course) and C starts from shallow dissected valley on the upland, gradually deepening the valley and transit to boat-shaped dissected valley. There is a knick point between shallow valley and boat-shaped valley. Uppermost area is urban area, or cropland in shallow valley, and paddy fields in the bottom of boat-shaped dissected valley. NO₃-N concentration increased downstream and reach its maximum. After the maximum, NO₃-N concentration gradually decreased downward.

Channel B starts from valley head with clear valley walls, so-called horse's hoof shape. NO₃-N concentration is high from the beginning, and gradually decrease downward or keeps high level. There is extensive flat cropland behind the valley head. NO₃-N concentration at the spring in valley head is high, and exceed environmental standard. Manuring on the upland should be the source of NO₃-N.

The chain of land use and topography have primary influence of NO₃-N concentration in river water. In channels A and C, there is a chain like upland (residential)– upland (cropland)– lowland (paddy). In channel B, the chain is upland (cropland) – valley head – lowland (paddy)

Along Takasaki-gawa main channel, the flow steadily increases downward. NO₃-N concentration has its maximum and decrease downward, however, nitrogen load gradually increase downward. Total nitrogen load in the middle reach of Takasaki-gawa watershed is estimated to be 100 to 200 t/year.

Preliminary survey on groundwater reveals that the "NO₃-N pool" in the upland reaches to the depth of about 50m. Below this depth the concentration of NO₃-N is still low. The evaluation of local groundwater system correspond to uppermost dissected valley is important as drainage system of high NO₃-N groundwater.

Keywords: nitrate-nitrogen, Shimosa upland, Chiba Prefecture, The chain of land use and topography, groundwater flow system, public water area

AHW026-P03

Room:Convention Hall

Time:May 27 09:00-10:45

Concentration of nitrate nitrogen in a urban and mountainous area - Case study of Kyoto Basin and Mt. Tsukuba -

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The concentration of nitrate nitrogen ($\text{NO}_3\text{-N}$) in groundwater rose in recent years after the 1970's, and it began to pay attention as a serious social problem. As the main source of the nitrate nitrogen in groundwater, the following are the conceivable causes; i.e. excessive fertilizer for the farmland, the excrement of domestic animals and domestic waste water. It is difficult to specify the source of nitrate nitrogen when the multi sources exist. In the mountainous area where the anthropogenic impact is comparatively little, the concentration of nitrate nitrogen is high in some cases. The reason of this is exhaust fumes from cars which are contained the nitrogen oxides. The exhaust fumes diffuse to the atmosphere and nitrogen oxides fall to the mountainous area. The problem of nitrate nitrogen is widely caused from the urban area to the mountainous area, and thus, the groundwater quality investigation is executed.

In Japan, the environmental standard values of nitrate nitrogen have established for 10mg/L since 1999. However, the concentration of nitrate nitrogen in groundwater exceeds 10mgN/L in various places, and it is necessary to elucidate the source of the pollutant and checked the improvement plan.

In this presentation, it introduces the previous study of various places, and it reports on the problem about the nitrate nitrogen using the example of observing in the tea plantation, mountainous area and urban area.

Keywords: nitrate nitrogen, groundwater, Mt. Tsukuba, Kyoto Basin

AHW026-P04

Room:Convention Hall

Time:May 27 09:00-10:45

An estimation of nitrate concentration of soil water in a valley bottom of pasture-dominated drainage basin

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In order to estimate a spacial distribution of nitrate concentration, we applied an equation derived from the reaction kinetics to a pasture-dominated drainage basin. Parameter values relating to the spatial concentration change of ammonia and nitrate nitrogen along the valley bottom was used in the equation.

Keywords: Nitrate, Transport model, Soil water, Pasture, Forest, Drainage basin

AHW026-P05

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Time:May 27 09:00-10:45

Urbanization and water quality properties in South Asian Megacities

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¹Hiroshima University

Increased population not only converts our environment it also change the landscape. Increasing population results urbanization that includes conversion of cities to megacities. These increased pressures of expansion affects the condition of the environment in many ways, it increase the amount of impervious surfaces and the quantity and types of products that human produce, use, and discard, thereby affecting water quality. Water quality deterioration is one of the major consequences of urbanization. These occur very often in megacities of developing countries, where untreated industrial sewerage and unplanned water use affects both surface and ground water quality. Among the Asian megacities, Dhaka and Delhi expanded remarkably and degraded their water quality over the years. These two cities are partially depending on the river with ground water extraction. Over the decades water quality deterioration trend is an inconvenient truth. Within these scenarios, trend analysis is necessary for efficient water resource management. Parameter specific trend analysis can give a right way to the policy makers to formulate need based water policy. This study tries to grasp the trend of the important water quality parameters of both surface and ground water with population growth. The general approach for the current study is to highlight the results available in literature on water quality with some firsthand data. Study includes observation for uneven years since 1980 and analysis is developed within a longitudinal data. Yamuna of Delhi and Buriganga of Dhaka are checked with historical data for surface water quality. Result shows that most of the water qualities deteriorate with increase population in varying degrees. pH, DO, BOD and Fecal Coliform (FC) are strongly correlated with population for surface water and Conductivity, Cl, Mn and Fe with ground water. Most of the ground water qualities parameters have deteriorating trend. Among surface water parameters some shows opposite trend between Dhaka and Delhi scenarios. This study concludes by discussing policy implications and avenue for further research.

Keywords: urbanization, water quality, megacity, pollution, south Asia

AHW026-P06

Room:Convention Hall

Time:May 27 09:00-10:45

Water pollution characteristics of mega-cities: seasonal variation, BOD sources and recovery process

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¹Hiroshima University, ²Ehime University

Water samples were collected in the Ciliwung River, sewage and ponds on 25 - 26 April in 2010 under a low flow condition and 12 - 13 June in 2010 under a high flow condition after a storm flood. The spatial distribution of EC, DO, BOD and DOC in the Ciliwung River from mid-stream to downstream on 12 - 13 June, 2010 was shown in the figures (see the report). The EC and DO were measured by portable meters, BOD analyzed by PD PAL JAYA, and DOC analyzed in Hiroshima University. In the case of water with less suspended materials, such as the sewage or river water in downstream, the EC and BOD relationship was similar to the best-fit curve shown. On the other hand, BOD values were high and EC were low in water with suspended solid.

The relationship between BOD and DOC in river in Jakarta in June 2010 indicated that BOD values were mostly higher than DOC in June. This suggests that these water samples included the suspended solids of organic substances. The EC and DOC relationship in April was better than that in June. The water samples with suspended solids tended to have high DOC concentration. EC is normally related to total ion, and DOC is one of the main ions in case of organic polluted area. The good correlation between EC and DOC supports these properties. But in case of high suspended concentration, part of DOC includes unionized compounds.

Based on the preliminary results of this survey, the Survey team finally proposed a real time monitoring system which included a suspended solid sensor to the system. Good correlation between EC and DOC, and EC and BOD were confirmed in many cases including that from Japan. Based on these relationships, The Survey team could estimate BOD in sewage without suspended material. However, it is required to use the relationship between SS and BOD in case of high suspended concentration.

In the proposed system, the cost is one fifth of that of BOD and the sensor has high durability. The Survey team is confident that the proposed monitoring system for Indonesia would be effective.

Keywords: water pollution, river, mega-cities, BOD, dissolved nitrogen

AHW026-P07

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Time:May 27 09:00-10:45

Stream water quality in snow melting period and snow water quality in the Uono river basin.

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1.Introduction

The stream water quantity increase with the snow melting water is seen putting it in the snow region in early summer at the early spring, and the snow melting water also influences the river quality strongly. Moreover, the snow melting is frequently generated for the snowfall period in a clement snow region compared with the cold snow region. Also snow melting mechanism are greatly different from that of the cold snowfall ground. In the Niigata Prefecture Shinano river basin Uono river, the amount is a lot of absolutely heavy snowfall areas of the snow in the point where a lot of snowfalls in winter exist that are exceeding 3m. It considered it by using the snow condition of the influence that the snow melting water generated in the same valley along with the snow and the snowfall gave to the watershed environment, the aquatic environment, and the river quality by the field observation in the present study.

2.Method

It went in hydrological measurement (AT,WT,pH-RpH,EC,TDS,DO) once a month.Not only winter but also summer in April, 2009. Winter and the snow melting period did a similar observation once a week. One observation a month was done on the first weekend. Moreover, the depth of snow cover observation and the snow scale gathered the snowfall sample at the same time. In the laboratory,the sample that did the obtaining water and measured EC measurement,needed main dissolved constituent analysis,total carbon,it was total inorganic carbon,and it was total organic carbon. About the snow sample,the amount was measured,it was assumed 1ml=1g,measured the density,and snow conditions were requested at the same time.

3.Result

The stream water at the snow was plotted at the position where which Cl^- , SO_4^{2-} , NO_3^- , Na^+ and K^+ density were high and the Ca^{2+} , Mg^{2+} density was low. It is suggested that it is shape that the stream water quality element is pulled to the density of Cl^- , SO_4^{2-} , NO_3^- in A layer on Asamadaira bridge, the Onohara bridge, Yokkamachi bridge, and the snow form the water quality of the stream water. It is thought that it is a water quality that underground water mixes with the snow and the snowfall water because the element of the geological features origin named Ca^{2+} , Mg^{2+} has increased, too. Therefore, the tendency has lowered in there is a lot of underground water and the valley. As for the dilution of the river quality, a plain relation to the snowfall element was not seen by neither April nor May it though it was thought that February 27 was the snow melting initial and the snowmelt runoff started. However, the Cl^- , SO_4^{2-} , NO_3^- density has decreased obviously though January and the water quality composition on February 27 greatly see the difference key diagram in the Ono field bridge in the style part in the main stream. It is thought that the Ca^{2+} , Mg^{2+} element flows out directly from no increase to the river the snow melting water and caused the concentration reduction. It seems that the antifreezing agent element is not so included in the snow melting water because the melting amount is thought to be an outflow of the element in the throwing away snow to the river already because of the progress of a lot of snow meltings than the amount thrown away as for the snow throwing away place in the expressway of not only that but also this time.

4.Conclusion

I want to clarify the water budget and the mass balance of the aquatic environment in the entire clarifying Uono river basin of the valley of each small watershed based on the Hydrological data that has been observed since April 2009 and the snow data in winter.

Reference

Yoichi Morimoto Koji Kodera(2011): Relation of water quality composition of snow and stream water in the Uono River basin,Year 2011 Committee Association of Japanese geographers

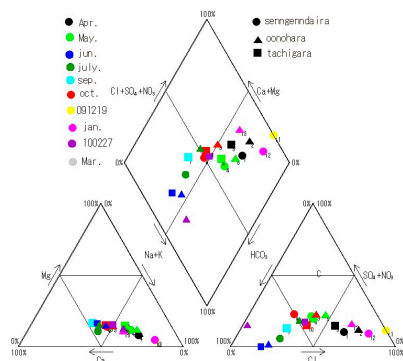


Figure 1 Trilinear diagram in the main stream upstream (0904~1003)

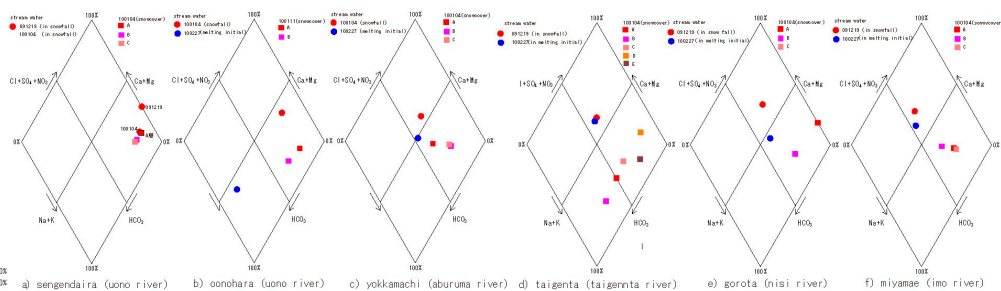


Figure 2 Keydiagram(snowcover • streamwater)

Keywords: Uono river basin, snow melting period, stream water quality, snow, dissolved constituent

AHW026-P08

Room:Convention Hall

Time:May 27 09:00-10:45

Characteristics of outflow variations of rivers in Ishigaki Island

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1 Preface

In Islands around the sea, surface water immediately flows out to the ocean, and various materials flow out to the ocean at the same time. Land waters that flows in the island and flows out to the ocean influence the littoral region because the coral reef etc. especially develop to surroundings on the island, and a valuable environment is formed in Yaeyama islands that belong to the subtropics climate. The red soil runoff has been put in question since before in Ishigaki Island and R.Nagura, R.Todoroki the present study aims not only the unit of the valley but also to catch inland waters in the large area, and to clarify the change by the seasonal variation and the rainfall event.

2 An area for summary

it exists as a center island in Yaeyama islands. The normal temperature is 23.7 degree, the average precipitation is 2127.2mm, and the rainfall at the rainy season and the typhoon accounts for 60 percent of the annual rainfall. there are Mt Omoto that is the most high mountain in Okinawa. Main river are R. Miyara, R. Todoroki, R.Nagura.

3 A study method

I performed water sentence observation in about 90 spots in Ishigaki Island. The observation item was AT, WT, pH-RpH, EC, TURB, DO, TDS, and the sample performed measurement of the alkalinity and major dissolved components measurement with the ion chromatograph, all dissolved carbon quantity analysis with the TOC analyzer.

4 A result and consideration

The standard deviation of EC under 20 concentrates around Mt.Omoto. It is characteristic that value and average of EC are large. The water in Ishigaki island quality are grouped Ca-HCO₃ type. Especially the trend are conspicuous at R.Todoroki by limestone area. Na-Cl type is shown in some area but volume of Ca²⁺, HCO₃⁻ are small while Na⁺, Cl⁻ are same degree.at Ca-HCO₃ type area. After rainfall EC decrease suddenly and the minimum value of EC250uS/cm or less was observed around noon increase Sep.4. Recovery speed is early at headwaters and slow at downstream. Ca²⁺, Mg²⁺, Cl⁻ vary together with variation of EC. It has been understood to exist without making it to the place where the soil component flows out because the difference is in the size because of the point though the outflow of the dissolved matter according to the rainfall causes EC to change by the rainfall event.

5 Conclusion

If the relation of the soil erosion to rainfall strength can be found, it becomes possible to calculate the rainfall according to the value of EC at the rainfall. It is necessary to lead outflow strength of the soil component from various factors like the inclination and geological features, etc. , and to clarify the relation between EC and the rainfall of the river.

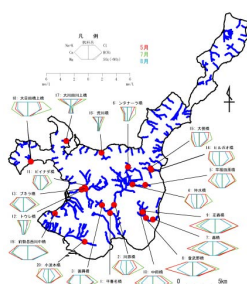


fig.1 stiff diagram

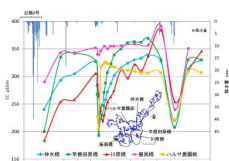


fig.2 valiation of E0 after rainfall

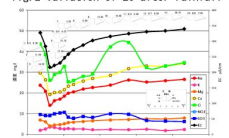


fig.3 valiation of main dissolved elements after rainfall (R.Nakamizu)

Keywords: electrical conductivity, main dissolved elements, rainfall, typhoon, Ishigaki Island

AHW026-P09

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Time:May 27 09:00-10:45

Estimation of Groundwater Recharge from Low-Discharge and Gravelly River by Synoptic Survey using Handheld ADV

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Synoptic survey, performing stream gauging at a number of stream cross sections over a short period, is often applied to estimate how and where the groundwater recharge in an alluvial fan occurs. But the complex and variable distribution of depth and velocity due to gravelly riverbeds cause the unacceptable uncertainty of river discharge.

In the Toyohira River, which flows through the center of Sapporo city, Japan, the rate of water loss is estimated to be about 1 to 2 m³/s. If so, it is afraid to influence the well pumping and the river environment by the losing. Although many synoptic surveys were performed in past times, they were inconsistent and incoherent because of the uncertainty of the measurement.

In this study, the improved synoptic survey are applied, which uses Handheld ADV(Acoustic Doppler Velocimeters), "Flow-Tracker" designed by Sontek/YSI. And vertical measurement points of velocity were arranged densely so that the river discharge in each subsection is less than 5 to 10% of the total. In result, the distribution of discharge and the rate of water loss are able to be estimated more correctly. In addition, the measurements by the propeller velocimeter and by ADCP are compared to assess the adequacy of each method.

The synoptic surveys were performed at some of 10 gauging sites and 2 tributaries several times in which the variation in water level are small, from September, 2010 to December 2010. It was revealed that the discharge losing section located between 16 to 17 km from where the Toyohira River and the Ishikari River join together. In the measurements, the rate of water loss between the two gauging stations, the Moiwa st. and the Kariki st., was constant at about 0.2 m³/d and was independent on both the river discharge, ranged between 3 to 15 m³/d, and the temperature of surfacewater, ranged between 1 to 21 degrees Celsius.

The rating curves of the Moiwa st. and the Kariki st. are estimated for considering the losing statistically. The groundwater recharge from the Toyohira River is probable to be decreasing in decades. The factor is thought to be the long term decline in water table around the river owing to the increased well pumping and the urban developments such as the subway construction, drainage and so on.

Keywords: alluvial fan, groundwater recharge, synoptic survey, ADV, ADCP, rating curve

AHW026-P10

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Time:May 27 09:00-10:45

Contribution of the Otaki dam and water environment in the surrounding area

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Otaki dam itself was built 84 million tons of storage capacity in 2002, a landslide dam occurred at the bottom of the gate is open, they failed to present the reservoir. Once completed, the water level to rise more than 60m, an internal dam, the downstream effects of concern. Therefore, in this study was to investigate the environment for a long time before hanging up the reservoir, to gather information to determine whether the symptoms occur after water from the reservoir. The survey of the river water of dissolved constituents from upstream to downstream of the dam, the species composition of phytoplankton. The effect of dissolved chemical components, phytoplankton, are investigated to assess the impact of temperature and other physical and chemical effects along with the flow.

As a result, For first quality, in the Otaki dam dam size is small, temperature stratification was formed in the summer. The upper 26.5 degrees Celsius, in the lower 22.7 degrees Celsius, while the concentration of dissolved ions upper dam, found that differences seen in the lower. For turbidity, the turbidity point average near the headwaters of most monitoring sites was 0.3. This point was also very good in the sense transparent look. In contrast, the turbidity of the phenomenon can be seen wearing mud sites in the downstream region Otaki dam, and there was no difference between the prediction about the difference between 0.4 and turbidity of the near and Ryuu Hazime. However, it looks completely different look in the lower reaches of the river water has a creamy color. This is a very small particle size is considered that the idea of getting close to the colloidal state. It was found that likely precipitated the very state that it is difficult.

Keywords: The Otaki dam, Kino river, Tubidty, Plankton, Diatom

AHW026-P11

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Phosphorus dynamics in ponded shallow reservoir

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Phosphorus rock which is material of fertilizer faces to depletion in this century due to food demand behind human population increasing. Prevention of loss of phosphorus from farmland and reuse the material which includes phosphorus are strongly desired in agriculture because Japan obtains all of phosphate rock from import. Therefore it is important to look for the location of accumulation of phosphorus and to evaluate amount of loosed phosphorus.

The objective of this study is to clarify the mechanism of long-term variation for nutrient discharge in the Seto Inland Sea. Especially, we evaluate nutrient retention efficiency by small weirs on the stream using hydrodynamic ecological model.

The result of simulation for nutrient dynamics in the small reservoir using an eco-hydrodynamics model indicates that phosphorus overflows from water column to downstream in flood event while phosphorus circulates with sedimentation-resuspension inside the reservoir in ordinary condition. The net flux of phosphorus was estimated that 23% of total inflow is trapped in the reservoir and the residue is overflowed toward downstream. On the other hands, the net flux of nitrogen was estimated that 15% of total inflow is trapped as sedimentation, 26% is attenuated by denitrification and the residue is overflowed. These results suggest that the small reservoir has a capability of nutrient retention. The total sediment in the reservoir was estimated 62352 ton include with 42.4 ton of phosphorus. The result was equal to an accumulation of 15 years of estimated sediment. The result suggests that there is a possibility to be resource of phosphorus because the pore water was actually higher concentration than that in the water column. For fertilizer usage, it is an easy way to recycle of phosphorus from extraction of sediment than other material such as steel slag and sewage sludge.

Keywords: Phosphorus, Retention, Agricultural reservoir, Hydro-eco reservoir model, Takaya River