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

AHW26-01 Room:201B Time:May 24 09:00-09:15

Development of multi-tracer of water toward Asian geo-isoscape study

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Research Institute for Humanity and Nature (RIHN), an Inter-university Research Institute Corporation, aims to elucidate the linkage of interactions between human activity and natural environment. Most elements have stable isotopes (SI), which are known to be powerful as a tool to promote this linkage study. RIHN has been establishing an analytical system to get multiple SI information, and will assure the proper use of this system and support its accessibility in order to propel cooperative studies through RIHN and related projects. As such an attempt, RIHN starts the geographical mapping of multiple SI and elements for environmental materials in collaboration with local universities and research institutions.

Quality of fresh water is a function of human activities and natural environment such as industry, climate, geology, vegetation, and so on. The concentrations of dissolved elements and the ratios of SI in groundwater and surface water at base-flow periods are temporally stable, while they are spatially variable. This indicates a potential that the water quality can be served as indexes to characterize the local environment and the traceability information of ecosystem and biological body since water is indispensable for the life of biota and the ultimate source of most elements in biota is attributable to water. Accordingly, the geographical map of SI and dissolved components in fresh water is fundamental for environmental studies such as water circulation, pollution, ecological and health risk, source identification of agricultural products and food, which are main problems of global environment to be solved urgently. However, in order to apply the water-quality map for water management and to extend it for exploring a new science, SI researchers should cooperate with local autonomies and citizens and with scientists of other disciplines, respectively. Building the data-base system of SI in different spatial scales is also prerequisite for these purposes. I will introduce an application example of this map into environmental diagnosis and water management in Saijo city of Ehime prefecture and its extension to joint studies in Japan and East Asia through RIHN projects.

Saijo city is known to be rich in groundwater of good quality and uses the water for drinking, agriculture and other industries. By working with municipal organization, we collected more than 1000 samples of groundwater and 400 samples of surface water in the city and determined the compositions of 50 elements and stable isotopes (H, O, S, N, Sr, and Pb). Comparison of both waters have elucidated the impact of atmospheric deposition to the surface water, the recharging area and flow route of the groundwater, and human impacts of the two waters (nitrate pollution by excess use of fertilizer, salt intrusion by over pumping, antimony pollution by abandoned mine, industrial waste disposal etc). For example, map of water isotope ratios and chlorine concentrations have successfully visualized the flow direction of groundwater from its recharging area. Based on this map, we started the biweekly to monthly monitoring of water quality over three years, which have shown the geological structure, flow rate, and salt intrusion process of groundwater.

In order to enhance environmental literacy of citizens, we have been returning obtained results into Saijo citizens through symposium and book. The SI map can contribute to studies of food-web analysis, identification of habitat of plant, trace of animal behavior as well as social problems of the source identification and false description of food. This collaborative map study is conceptually analogous to isoscape project in U.S.A. The water quality map shows a wide geographical variation of multiple tracer components in different scales. RIHN calls for universities and research institutions to join this map study, which aims to explore an academic seed and meet social needs for environmental management.

Keywords: water-quality map, stable isotope, water management, environmental diagnosis, environmental tracer, database

Japan Geoscience Union Meeting 2012
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AHW26-02 Room:201B Time:May 24 09:15-09:30

Spatial distribution and seasonal variation of stable isotopes in precipitation over Japan

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This study revealed spatial-temporal variations of stable isotopes in precipitation over Japan from previous observed data. Also, the d-excess in winter precipitation was used to estimate the origin of water vapor over Japan. Observed stations were divided into 3 regions (Pacific Ocean side, Japan Sea side and Southern Japan) from precipitation patterns. The d18O in precipitation were high in April, October and November, but low in June over Japan. Distribution of annual d18O was recognized latitude effect over Japan, and also altitude effect only in Pacific Ocean side. The d-excess in precipitation were lower than 10 permil from May to August and higher than 15 permil from November to March over Japan. The d-excess in winter precipitation in Pacific Ocean side were about 20permil, however that of Japan Sea side was higher than 25 permil. It cannot estimate the origin of water vapor to be Japan Sea even d-excess in winter precipitation is more than 20permil.

Keywords: stable isotopes in precipitation, origin of water vapor, d-excess, Japan Sea

Japan Geoscience Union Meeting 2012
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AHW26-03 Room:201B Time:May 24 09:30-09:45

Chemical weathering in Himalaya: Insights from trace element geochemistry of the Ganges-Brahmaputra River sediments

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The Ganges-Brahmaputra River drains a greater part of the Himalaya, including the western and eastern Himalayan syntaxis, a tectonically active region in the world. Rivers play a vital role in earth surface processes and are regarded as the key carrier of terrestrial materials into the ocean. Major and trace element analyses of the river sediments have been used to investigate their provenance, physical and chemical processes of silicate weathering.

The chemical index of alteration (CIA), chemical index of weathering (CIW), and elemental ratios (Ca/Ti, Na/Ti, Al/Ti, Al/Na, and Al/K) are sensitive to terrestrial chemical weathering intensities in sediment source area. SiO_2 in both rivers show a linear trends and marked negative correlation with grain size, suggesting quartz dilution, mineral sorting as well as compositional maturity during transportation of sediments in fluvial system. The distribution of Fe, Ti, Zr and Th is controlled by their association with heavy or coarse minerals, but Al is independent of hydrodynamic processes. Low CIA (˜62) and CIW (˜64) values in the river bed sediments are due to fresh detritus within the active channel or most likely favored physical over chemical weathering. High CIA, CIW with high Al/Ti and Al/Na ratio values in the river suspended sediments, suggesting a significant chemical weathering in its source rocks. Discriminant diagrams and trace element ratio plots show the influx of sediments were derived from felsic continental crust sources. Geochemical similarity between the Ganges-Brahmaputra River sediments and various lithologies of the High Himalayan Crystalline Series, Lesser Himalaya, Tibetan Himalayan batholiths and Siwalik sedimentary rocks in Nepal indicates homogenization of material derived from the Himalayan source region.

Keywords: Geochemistry, fluvial sediments, chemical weathering, Ganges-Brahmaputra River, Bangladesh

Japan Geoscience Union Meeting 2012
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AHW26-04 Room:201B Time:May 24 09:45-10:00

The carbon cycle, nutrients cycle, heavy metal flux changes in Kushiro mire

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We investigate riverine acidification effects on carbon cycle, nutrients cycle, and heavy metal flux changes in Kushiro mire and Bekanbeushi marshland. Peatlands occupy approximately 5% of the Earth's land area, and the northern peatlands play the important role in global carbon cycle. The surface water in peatlands are highly colored and acid due to humic substances originated from peats. This locally acidification process influences material transportation in adjacent river. In this research, we discuss dissolved iron concentration, the chemistry form of dissolved iron, humic substance concentration and nutrient concentration in Kushiro and Akkeshi, and finally discuss the influence on marine organism production.

Keywords: Kushiro mire, pH, biogeochemical cycle

Japan Geoscience Union Meeting 2012
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AHW26-05 Room:201B Time:May 24 10:00-10:15

Studies on defining the effect of chemical weathering on river water PCO2 rates

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Previous studies show that total carbon rates are mainly controlled by only weathering and respiration, and because of this, it is highly possible that river water generally acts as a source of CO_2 . This fact is confirmed by data in a local scale, but when standing on a more nationwide perspective, there is still no compiled data to suggest it.

Based on the works of Kobayashi (1960) and the further datasets of Kobayashi (Harashima et al., 2006) and the data data published by the Japan Meteorological Agency, the PCO_2 of the Japanese river water was mapped. Using this, this study worked on determining whether Japanese rivers generally act as a CO_2 taker or not. It will then discuss why, looking at the effects of each presumable parameter, especially focusing on the effects of weathering and respiration.

As a general result, it can be said that (1) Japanese rivers act as a source of CO_2 . (2) Especially, Hokkaido, Kinki area, and the Kyushu area have a high contribution. (3) Urban areas show artificial increase in PCO_2 . (4) In the Japanese river system, soil respiration has a critical effect on PCO_2 , and weathering does not. (5) Therefore, defining the effects of weathering on PCO_2 is still challenging. (6) Areas with steep slopes have a tendency to have lower PCO_2 rates than that of the flat lands. This can be related to the amount soil, which is possibly controlled by the currency of the carrying river.

Keywords: PCO2, chemical weathering, land water

Japan Geoscience Union Meeting 2012
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AHW26-06 Room:201B Time:May 24 10:45-11:00

Aquifer structures and flow systems of groundwater in the Osaka sedimentary basin

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Withdrawal of groundwater in urban areas of Japan has been strictly controlled for the mitigation of disasters caused by groundwater such as subsidence and salinitization, which were serious social problems until 1970s. However, the withdrawal of groundwater increases as a cheap water resource recently and the groundwater attracts the attention as an emergent water resource when the natural disaster occurs and water supply lines are damaged. We should evaluate accurately the potential of groundwater, including scale and structure of the aquifers and the flow rates of each aquifer, as a water resource to use effectively without the groundwater disasters. We have studied to visualize groundwater flow beneath the Osaka Plain, where is one of the largest urbanized area. The Osaka sedimentary basin, which is one of the largest groundwater aquifers of this country, has rather simple structure than the other sedimentary basins of this country, and it is easy to trace the groundwater flows. In this report, the groundwater aquifers and those structure and flow systems are documented, and the recharging paths will be discussed mainly based on the data of oxygen and hydrogen stable isotopes of the groundwaters.

Groundwater aquifers beneath the center of the Osaka Plain can be roughly divided into three categories; the unconfined and uppermost confined aquifers <50 m depth, confined aquifers in Tanaka Formation of Osaka Group, and confined groundwater in Miyakojima Formation of Osaka Group and basement rocks. The Tanaka formation comprises freshwater sandy sediments as groundwater aquifers and intercalated less permeable marine clay layers. The Miyakojima Formation is composed of freshwater sediments and the aquifer is not separated by less permeable layer. The depths of boundary between Tanaka and Miyakojima Formations are commonly 600 to 700 m depth and the basement rock underlies at 800 m depth beneath the Uemachi Daichi at the center of the plain and 1000 to 1500 m beneath the lowland of the plain.

Uppermost groundwaters are recharged by the local precipitation. The groundwater has high quality, and is used as the washing water for temples and shrines at the Uemachi Daichi and gardening for the residences in the suburban area. While, the groundwaters of lowland contain present seawater in the western part and are stagnant in the eastern part from Uemachi Daichi. Thus, the groundwaters of this area are not used and give high hydropressure to be a potential cause of liquification.

The confined groundwaters in the Tanaka Formation are recharged at the Uemachi Daichi and surrounding hills of lowland of Osaka Plain. This formation contains unconsolidated marine clay layers, which was subsided due to excess uptake of groundwater, thus, the groundwaters have not been used after 1970s. Recently, the groundwaters at 100 to 300 m depths are used for supplied water for each buildings and prepare for emergency. Since the groundwaters of this level at the location apart from recharging area occasionally gives the light oxygen isotope shift, squeeze of porewater from the clay layers may occur. The groundwater at 300 to 500 m depths are not used, and probably at the stagnant condition.

Deep groundwaters from Miyakojima Formation and basement rocks are used for bathing purpose. Those from upper part of Miyakojima Formation are diluted Na-HCO3 type chemistry, and highly saline waters are occasionally found in the deeper portion. Temperature of the groundwaters are 50 degreeC at the highest. Active faults works as recharging paths for the groundwater in Tanaka Formation, however, the groundwaters in the Miyakojima Formation and the deeper are fossil water. Some of the saline waters, probably originated from seawater judged by Br/Cl ratio, give the heavy oxygen shift for those oxygen isotope ratios, suggesting that those are formed at low water/rock ratio.

Keywords: Osaka Plain, groundwater, oxygen hydrogen stable isotopes, saline water

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

AHW26-07 Room:201B Time:May 24 11:00-11:15

Groundwater quality in the Ndop Plain, a CVL depression, N.W. Cameroon, Central Africa

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The Ndop Plain is a depression along a chain of volcanoes that cuts diagonally across Cameroon known as The Cameroon Volcanic Line. With population increase, there is a high water demand for domestic and irrigation uses. 70 % of the population depends on ground water sources of little known chemical quality. The Rocks in the area are of igneous (granitic and volcanic) and metamorphic origin and constitute a natural source for the enrichment of water chemistry. The convergence of numerous rivers in the centre of the plain poses a potential pollution from the varied geology and human activities. Wirmvem (2010) revealed water of poor microbial quality hence, prevalence of water borne diseases in the area. The spatial and temporal components of groundwater have not been evaluated for possible pollution pathways and duration. The on-going study seeks to a. Assess in detail, the physic-chemical properties of the groundwater; b. Characterize the resource (flow regime, evolution, recharge mechanism and age) by using stable isotopes (D and O18) and environmental isotopes (CFCs, SF6 and 3H); and c. Asses the geological control on water composition. The following outcomes are expected: suitability of water sources for human and animal consumption and irrigation, a baseline hydrogeochemical data and source rock chemistry, a water management tool for the government hence, a great input to the lacking knowledge on numerous groundwater resources in Cameroon highly used.

Keywords: Cameroon, Ndop Plain, Geology, Groundwater, Drinking quality

Japan Geoscience Union Meeting 2012
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AHW26-08 Room:201B Time:May 24 11:15-11:30

Characteristics of groundwater age tracers' concentration (CFCs, SF_6 and Tritium) in Kumamoto area

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In Japan, groundwater residence time is relatively young (within 50 years) because of its steep gradient and high rainfall. So, young age tracers are useful to estimate residence time of groundwater in this country. However, each tracer has disadvantages when groundwater age dating due to anthropogenic sources, microbial degradation, sorption, terrigenic source, and so on. It is required to know the characteristics of each tracer's behavior during groundwater flow in the aquifer.

Groundwater samples were collected from various hydrological aquifers (pyroclastic flow deposit, volcanic rock, alluvium and marine deposit) in Kumamoto area. And samples were analyzed for young age tracers (CFCs, SF_6 and Tritium) to evaluate its characteristics of concentration in each aquifer.

Water samples were collected from Kumamoto area in April and October 2011. Almost all samples were analyzed for CFCs, SF_6, major dissolved components and stable isotopes ($d18O_{-H2O}$, dD_{-H2O}). Tritium results were quoted from previous studies.

On our presentation, "the characteristics of age tracer concentrations in each aquifer" and "factors for over- and/or under-estimation of groundwater age" will be presented.

Keywords: Young age tracers, Groundwater, CFCs, SF_6, Kumamoto area

Japan Geoscience Union Meeting 2012
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AHW26-09 Room:201B Time:May 24 11:30-11:45

The water quality of underground dam in Miyakojima and Izena Island.

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It is well studied that the surface dam constructions have a significant impact on nutrient and carbon cycles via photosynthesis in dam lakes. Underground dams are recently emerging, new type of dams developed for an effective use of groundwater, which shut groundwater flow and raise ground water level. However, detailed researches on impact of subsurface dams on water quality are quite limited to date. In this research, I analyzed water quality of storage water and compared with unperturbed spring water nearby, to evaluate their impact on water quality in groundwater. The results show that alteration of water quality in underground dams was quite little, whereas surface dam water was highly altered from unperturbed river water by photosynthesis.

Keywords: undergrounddam, water quality, nutrient carbon cycle, photosynthesis

Japan Geoscience Union Meeting 2012
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AHW26-10 Room:201B Time:May 24 11:45-12:00

Interaction between surface water areas and groundwater in Hanoi area, Viet Nam

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Hanoi is the capital of Viet Nam and the second largest city in this country (population: 6.45 million in 2009). Urbanization of this city has reduced number of natural water areas such as ponds and lakes by reclamation not only in the central area but the suburban area. Rivers also have been reclaimed or cut into pieces. Contrary, number of artificial water areas such as fish cultivation pond has increased. On the other hand, various kind of waste water flow into these natural and artificial water areas and induce pollution and eutrophication. These waste waters also have possibility of pollution of groundwater that is one of major water resources in this city. Therefore, we focus on the interaction between the surface water areas and groundwater. Water samples of ponds and groundwater were collected from four communities in suburban areas and stable isotopes of oxygen and hydrogen were measured.

Correlations between delta-18O and delta-D of precipitation in Hanoi that were compiled by GNIP was shown as delta-D=8.2delta-18O+14.1 (LMWL). Weighted mean values of precipitation in rainy season were delta-18O: -9.1 permil and delta-D: -60.5 permil, respectively. According to Berg (2007), Red river waters were distributed along GMWL. On the other hand, groundwater samples were mainly distributed along other lines. These lines crossed the LMWL around the weighted mean value of precipitation in rainy season and slope of these lines were from 5.3 to 6.5. Thus, groundwater in these communities is mainly recharged by mixing of precipitation and evaporated water bodies. In addition, Red river water also recharges groundwater near the river. This result suggested that the evaporated water were recharged through the natural/artificial water areas, and surface water and groundwater were widely connected in the suburban area.

Keywords: Hanoi city, surface and ground water interaction, water cycle, environmental isotopes

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AHW26-11 Room:201B Time:May 24 13:45-14:00

Behavior of iodine in sedimentary rocks based on iodine speciation and ^{129}I /^{127}I ratios

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[Introduction]

Japan is the second largest country for iodine production in the world, and iodine is mostly produced from brine. Iodine ages, determined by ^{129}I /^{127}I ratio, in brine are often older than host rocks (Muramatsu et al., 2001). However, formation process of iodine-rich brine is still unclear. On the other hand, radioactive iodine (^{129}I) is one of the most problematic radionuclides contained in nuclear waste, because of its long half-life (15.7 million years) and high mobility. To investigate behavior of iodine in sedimentary rocks is important to evaluate the effectiveness of the natural barrier for nuclear waste repositories. In order to predict behavior of iodine in the environment, speciation of iodine is essential because of different mobility among their species (ex. IO_3^-, I^-, I_2, and organic iodine). In this study, we determined iodine distribution, speciation, and isotope ratios (^{129}I /^{127}I), to investigate long-term migration of iodine in Horonobe area.

[Experimental]

All rock and groundwater samples were collected at JAEA Horonobe underground research center. The region is underlain mainly by Neogene to Quaternary marine sedimentary rocks, the Wakkanai Formation (Wk Fm), and the overlying Koetoi Formation (Kt Fm): siliceous and diatomaceous mudstones. Iodine species in rock samples were determined by iodine K-edge XANES (SPring-8 BL01B1). Thin sections of rock samples were prepared, and iodine mapping were obtained by micro-XRF analysis (SPring-8 BL37XU). Iodine species (IO_3^-, I^-, and organic iodine) in groundwater were separately detected by high performance liquid chromatography (HPLC)-ICP-MS. The ^{129}I /^{127}I ratios in groundwater and rock samples were measured by accelerator mass spectrometry (MALT, Univ. of Tokyo). Iodine in rock samples were separated by pyrohydrolysis and water extraction.

[Results and discussion]

Concentration of iodine in groundwater varied widely and was much higher than that of seawater showing a high correlation with that of chlorine (R^2 = 0.90). Species of iodine in groundwater was mainly I^-. Iodine in rock samples decreased near the boundary between Wk and Kt Fm. Based on iodine K-edge XANES, iodine in rock was a mixture of organic and inorganic I. Iodine mapping showed that iodine accumulated to micro region. Carbon content was also high in iodine rich region, suggesting that iodine existed as organic I. Iodine isotope ratios (^{129}I /^{127}I) were higher in rocks compared with those in groundwater. According to these results, migation of iodine in this area can be expected as follows. During sedimentation of Wk and Kt Fm, iodine accumulated as organic iodine in siliceous sediment. Iodine was released as I^- from the layers deeper than Wk Fm during diagenetic processes. Subsequently, iodine-rich groundwater was distributed to Wk and Kt Fm due to the compaction of the layers. During uplift and denudation processes, both iodine and chlorine were diluted by meteoric water from the surface.

It was suggested that I^- is released to the ground water during the maturation of organic matter. However, the mechanism of dissociation of iodine from organic matter is still unclear. Speciation of carbon in rock at various depths should be investigated in future study.

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[2] Shimamoto, Y.S., Takahashi, Y., Terada, Y. Environ. Sci. Technol. (2011) 45, 2086-2092.

Keywords: Iodine, XANES, HPLC-ICP-MS, ^{129}I /^{127}I ratio

Japan Geoscience Union Meeting 2012
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AHW26-12 Room:201B Time:May 24 14:00-14:15

Estimating groundwater residence times in southern part of Mt. Yatsugatake from environmental tritium, CFCs and SF6

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To estimate residence times of groundwater in southern part of Mt. Yatsugatake, groundwater samples were collected from 27 springs, and tritium, CFCs and sulfur hexafluoride were analyzed for all samples. Most of the springs have detectable 3H concentrations ranging from 2.4 to 6.9 TU, indicating that these springs were mainly recharged during the post-bomb period. Apparent CFCs and SF6 ages for springs were ranged from 4 to 32 years and from 1 to 26 years, respectively. Results of tracer plots between CFCs and SF6 suggests that the springs are discharged after well-mixing in volcano body. Based on the exponential mixing model, residence times of the groundwater are estimated to be 1 to 32 years, and relatively longer residence time over 20 years are appeared in springs in 1000 m zone.

Keywords: Groudwater age, Mt. Yatsugatake, spring, tritium, CFCs, Sulfur hexafluoride

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

AHW26-13 Room:201B Time:May 24 14:15-14:30

Water quality and stable isotope for springs in the Kirishima volcanic area

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Kirishima is located at north part of Kyushu and extended from the northeast at Kagoshima prefecture to the southwest at Miyazaki prefecture. Kirishima is a one of most active volcanoes in Japan. Kirishima consists of more than 15 volcanic mountains, for example, Karakuni mountain, Shinmoe mountain, Kurino mountain and Takachiho mountain. The annual precipitation amount around Kirishima is very large (more than 2,000 mm), and precipitation amount is especially large from June to August. It is estimated that the amount of groundwater recharge in Kirishima is large. The purpose of this study is to make clear the characteristics of water quality and stable isotopes in groundwater and spring water, and estimated the groundwater flow in Kirishima volcano.The observation was carried out at July 19 to 21 in 2011 and December 3 to 5 in 2011. The water samples were sampled at 24 points in July and at 30 points in December.

As a result of field survey, EC (electric conductivity) and pH values of spring water are almost same between July and December. In many points, however, the groundwater discharge in December is relatively smaller than that in July. It is consider that the groundwater discharge is influenced by the precipitation amount which is large in summer period. The water temperature is slightly high in July. Water temperature may be influenced by air temperature. The EC value of hot spring is very high (1,255uS/cm), and relatively high at southeast in Kirishima. The water quality type is mainly Ca- HCO_3 and Na- HCO_3 in spring water. For the hot spring, the water quality type is (Na+Mg)- HCO_3. Thus the spring water which is located at southeast in Kirishima also show the (Na+Mg)- HCO_3 type, it is estimated that the hot spring is mixed in the spring water at southeast in Kirishima. The NO_3^- concentration is contained in several sites.

Stable isotopes of oxygen (d^{18}O) and hydrogen (dD) in spring water which is located at high elevation are relatively light. The altitude effect thus exists in Kirishima volcano site. The local meteoric water line at Kirishima is dD = 5.59 d^{18}O - 5.92 (r^2=0.769) in July and dD = 4.13 d^{18}O -16.81 (r^2=0.548) in December. These local meteoric water line are different to the Craig's meteoric water line. As a result of d^{13}C and water quality, the volcanic CO_2 gas is mixed the groundwater or spring water for the area which is extended from northeast to southeast at Kirishima. In future, the detailed groundwater flow can be clarified by using the result of groundwater residence time.

Keywords: Kirishima volcanic area, spring water, water quality, stable isotope, groundwater flow

Japan Geoscience Union Meeting 2012
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AHW26-14 Room:201B Time:May 24 14:30-14:45

Nitrogen and oxygen isotope composition of nitrate in river and spring waters of the Shirakami Mountains

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Introduction

In recent years, volume of nitrogen load has been increasing in mountainous area because of acid rain. The concentration of NO3- keeps increasing in the water of Subari Lake in Shirakami Mountains at Akita Prefecture. To elucidate of nitrogen cycle in forest is importance problem in view of effects of ecosystem in Shirakami Mountains. Then, in this study, to verify the loaded nitrate source in investigation basin and spatial distribution of nitrogen isotope values originated from forest, thirty river and spring water samples from Shirakami Mountains southern region were analyzed for nitrate concentration and nitrate-nitrogen (d15N-NO3-) and oxygen (d18O- NO3-) isotope values.

Method

So far the investigation and water sampling has been carried out on November 2011 in the Shirakami Mountain southern region at Akita Prefecture. The main water sampling points were in the river, stream, spring, lake and wetlands. Physicochemical parameters (pH, ORP, DO, Temperature) were measured in the field investigation. Water samples were determined NO3- concentration and major water chemistry.

Results

The results showed that NO3- concentration was in the range of 0.5mg/L to 3.1mg/L. In each basin of the western study area (Tokiwa River Basin, Hanawa River Basin, Mizusawa River Basin), there was a more than 2.5mg/L concentration of NO3-. By contrast, at each point in the inland area (The upper stream of Subari Lake, Fujikoto River Basin), NO3- concentration was less than 1mg/L.

Keywords: shirakami mountains, nitrate, nitrate-nitrogen and oxygen isotope ratio, acid rain

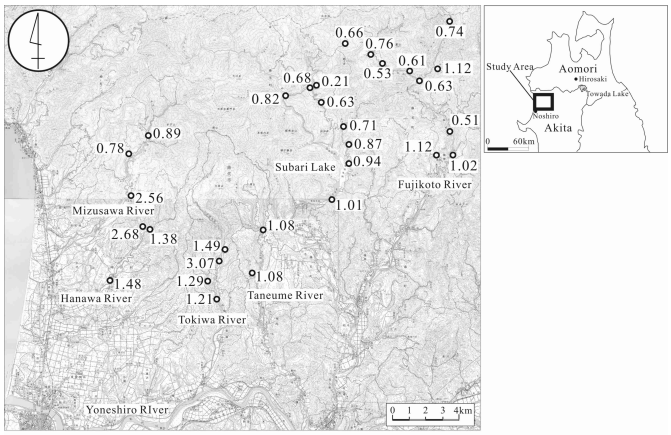

Fig. Distribution of NO_3^- concentration in the water sampling point. Figure shows NO_3^- concentration(mg/L)