Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

AHW25-01 Room:101B Time:May 27 14:15-14:35

Occurrence of health-related water microorganisms in groundwater of the Kathmandu Valley, Nepal

HARAMOTO, Eiji[1*]

[1]University of Yamanashi

Waterborne diseases are one of the most serious public health concerns in the Kathmandu Valley, Nepal; however, the occurrence of waterborne pathogens (viruses, protozoa, and pathogenic bacteria) as well as their indicator microorganisms in aquatic environments of the valley has not yet fully understood.

Through the Global COE program entitled 'Evolution of Research and Education on Integrated River Basin Management in Asian Region' and the Science and Technology Research Partnership for Sustainable Development (SATREPS) program entitled 'Hydro-microbiological Approach for Water Security in Kathmandu Valley, Nepal', we have been trying to determine the occurrence of health-related water microorganisms in water samples of the Kathmandu Valley. Examples of our findings are as follows: (1) Levels of contamination of health-related water microorganisms in groundwater are quite different depending on types of wells; (2) Groundwater is contaminated with animal feces as well as human feces; (3) Waterborne pathogens are frequently detected even in *Escherichia coli*- and/or total coliform-negative samples, indicating that they are unsuitable indicators of pathogen contamination of groundwater.

Some of the results obtained to date in the projects will be presented.

Keywords: Health-related water microorganism, Microbial water quality indicator, Microbial source tracking

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AHW25-02 Room:101B Time:May 27 14:35-14:50

Ammonium sources of groundwater in Kathmandu Valley, Nepal

NAKAMURA, Takashi[1*] ; NISHIDA, Kei[1] ; YAMAMOTO, Yuki[2] ; HIRAGA, Kodai[2] ; KHANAL, Anoj[3] ; SHRESTHA, Suresh das[3] ; KAZAMA, Futaba[1]

[1]ICRE, University of Yamanashi, [2]faculty of eng., University of Yamanashi, [3]CDG, Tribhuvan University

Groundwater quality is a critical problem in the Kathmandu Valley, Nepal. The population of the city increased by 6 times in the last six decades and more than half of water demand depends on groundwater source. Microbial and nitrogen contamination causes loss of water resources, nevertheless, understanding of nitrogen source and dynamics in groundwater system still remains insufficient in the central area of the valley. Objective of this study is to identify source of ammonium contamination on shallow and deep groundwater.

Groundwater samples were collected from 34 shallow wells and 5 deep tube wells in September 2014. Ammonium ion were detected from 12 shallow wells and 2 deep wells. Those ammonium concentrations ranged from 1.3 to 103 ppm. Nitrogen isotope values in ammonium ranged from -0.3 to 9.3 permill; this wide range of the nitrogen isotope values suggested possibility of ammonium contamination from natural and anthropogenic sources.

Acknowledgement

This study are supported by the Science and Technology Research Partnership for Sustainable Development Program (SATREPS, Project Manager: Prof. Narendra Man Shakya and Prof. Futaba Kazama) of Japan Cooperation Agency (JICA)/Japan Science and Technology Agency (JST).

Keywords: Kathmandu, Urban, Groundwater, Nitrogen isotope in ammonium, Nitrogen and oxygen isotope in nitrate

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AHW25-03 Room:101B Time:May 27 14:50-15:05

Effects of reduced leakage from the water main on the spring at Otomeyama Park in Shinjuku ward

TAKANO, Yuki[1*] ; YOSHIMURA, Kei[2] ; MURAKAMI, Michio[3] ; UEMURA, Takeshi[4]

[1]Dept. of Earth and Planetary Phys., Univ. Tokyo, [2]Atmosphere and Ocean Research Institute, Univ. Tokyo, [3]IIS, Univ. Tokyo (Present address: School of Medicine, Fukushima Med. Univ.), [4]Kaijo Junior and Senior High School

Decreacing of spring discharge in Tokyo is a problem since it leads to lost of the place for relaxation and refreshment for the citizens. To date, it has considered that increasing of impervious land cover followed by rain infiltration blocking results in decline of spring discharge. Although declining in a spring discharge in Tokyo was reported by several investigations, the causes of the declining was not quantitatively discussed based on the water budget. In order to estimate the causes, we observed spring discharge at Otomeyama Park in Shinjuku ward for 5-years (2009-2013) and evaluate water budget of the spring by means of tank model analysis. In this evaluation, not only increasing of impervious land cover but also diminish of reduced leakage from the water main are take into consideration.

From stable water isotopes measurement, it is suggested that leakage from the water main recharges the spring. From Detailed Digital Information (10m Grid Land Use), it was determined that land cover/land use of the subject area has remained unchanged since the 1980's so that it does not effect spring discharge. We developed a model that represents discharge from the spring based on the observation. The model was calibrated using data from 2012-2013 and validated using data from 2009-2012. We used the model to simulate the discharge for 1998-2013 and specifically investigated the impacts of impervious land cover fraction and water main leakage on long-term trends in the spring discharge. If we take into account reduced leakage from the water main, then discharge is decreasing over time.

Keywords: spring, Tokyo wards area, impervious land cover fraction, water main leakage, tank model

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AHW25-04 Room:101B Time:May 27 15:05-15:20

Three-dimensional mapping of groundwater flow system in Osaka Basin based on the database of water chemistry

SHINTANI, Tsuyoshi[1*] ; MASUDA, Harue[1] ; NEMOTO, Tatsuya[1] ; MASUMOTO, Shinji[1] ; MITAMURA, Muneki[1] ; MORIKAWA, Noritoshi[2] ; YASUHARA, Masaya[2] ; MARUI, Atsunao[2]

[1]Graduate school of science osaka city university, [2]National Institute of Advanced Industrial Science and Technology

Osaka Basin is a large reservoir of groundwater resources, which can be used for various applications as industrial and domestic water resources. However, the uptake of groundwater has been strictly regulated in the center of Osaka Basin since 1960s to avoid geogenic disasters such as land subsidence, which actively occurred in the period of rapid economic growth. The land subsidence has stopped since 1970s because of the regulation, and groundwater has not been extensively used for more than three decades. However, the uptake of groundwater has been a threat again due to increasing consumption of groundwater for private water supplies since 2000s. Depths of private wells for industries, hospitals, etc., are mostly from 100 to 300m from the ground surface, where the shrinking clay layers severely occurred. Because those groundwaters have not been used for long time, present water chemistry is not well documented.

In this study, groundwaters mainly sampled from the wells between 100 and 300m depths were studied for the stable hydrogen and oxygen isotope ratios and major chemical components to estimate the origins of groundwaters. Combining the results of this study and previous studies, three-dimensional mapping of groundwater geochemistry was drawn to discuss the groundwater flow system of the basin and the effect of the land subsidence to the present groundwater geochemistry. Aquifers of groundwater were classified by geological information including marine clay layers. This study was successful to visualize the groundwater chemistry as three-dimensional maps, which clearly show the following features of groundwater chemistry.

Hydrogen and oxygen isotope ratios of the groundwater ≤ 100m depths increased from mountainous areas to the center of plain, and the origin of these groundwaters were local meteoric water. In the western plain of Uemachi plateau, of which altitude is below sea level, the stable isotope ratios of groundwaters (δ^2H: -40 ‰ ∼, δ^{18}O: -5 ‰ ∼) are larger than those of local meteoric water (δ^2H: -45 ‰ ∼-40 ‰, δ^{18}O: -7 ‰ ∼-6 ‰), due to mixing with seawater. Thus, the seawater invaded into the aquifers of these areas, especially those between marine clay layers Ma12 and Ma9.

The stable isotope ratios of the groundwater were low (δ^2H: ∼-55 ‰, δ^{18}O: ∼-8 ‰) in the deeper aquifers than the Ma9. Slightly lower isotope ratios of the groundwaters than those of local meteoric water with diluted Na-HCO_3 type chemistry suggested that the groundwater contained squeezed pore water from the overlying clay layers. It would be the evidence of excessive wage of groundwater when the land subsidence actively occurred.

Keywords: groundwater, isotope

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AHW25-05 Room:101B Time:May 27 15:20-15:35

Removal of very fine oil particles from produced water by microbubble flotation in conjunction with coagulation technic

KOJIMA, Keisuke[1*] ; TASAKI, Masaharu[1] ; OKAMURA, Kazuo[2] ; MARK N., Sueyoshi[1] ;
RASHID S., Al-maamari[3]

[1]SHIMIZU CORPORATION, [2]TECNET Co. Ltd, [3]Sultan Qaboos University

During the oil production process, oily waste water is coproduced at a rate several times that of oil. This water is known as produced water. Most produced water requires treatment to prevent groundwater contamination because it contains very fine oil particles as dispersed and dissolved oil, which are very difficult to separate by gravity separation. It also contains heavy metals, boron, corrosive fluids such as H_2S, and other chemicals. The treatment and disposal of produced water is a significant operating expense for oil and gas companies. Therefore, treatment levels and technologies are selected based on disposal method or reutilization objectives, environmental impacts, economics, and other such factors.

A 50 m^3/day capacity pilot plant was designed, fabricated, and utilized to conduct produced water treatment trials in Oman. Pilot treatment trials of produced water from three different oilfields in Oman were carried out by nitrogen microbubble flotation in conjunction with coagulation/flocculation. Filtration and adsorption treatment processes were tested as advanced process for reutilization objectives.

Oil concentration in one of the produced waters was reduced to below the Omani standard for re-use, through microbubble flotation combined with coagulation/flocculation treatment. Oil concentrations in the other two produced waters, which had higher-initial concentrations, were reduced to below the Omani standard for marine discharge. With additional adsorption treatment, these concentrations were further reduced of the level of the re-use standard as well.

Additionally, aeration treatment was effective for removal of sulfur compounds such as sulfide from produced water.

Keywords: produced water, microbubble flotation, coagulation/flocculation, oil removal

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AHW25-06 Room:101B Time:May 27 15:35-15:55

Utilization and environmental suitability of excavated and recovered soils

KATSUMI, Takeshi[1*]

[1]Graduate School of Global Environmental Studies

Soil excavation and reclamation are fundamental steps of infrastructure development. For the re-development of urbanized areas, where the use of underground space is unavoidable since finding new land space is usually difficult, few construction works for infrastructure can be possible without excavation. As a result, excavated surplus soils are generated in large quantities. Management of such excavated soils discharged through construction works is therefore an important consideration in geotechnical and geoenvironmental engineering. Reuse of excavated soils either at the generating sites or at different places has been promoted, because disposal of unusable soils at landfill sites should be minimized due to the limited capacity of landfills. Limitation of available natural resources, as well as land spaces for landfills, has strongly promoted reuse of materials in Japan. Reuse of materials in construction works has particularly attracted a great attention because of the large capacity of application as well as the large generation of by-products including excavated soils. Since the establishment of Soil Contamination Countermeasures Law in 2002, natural contamination which may be contained in such excavated soils has been a concern, while proper method to evaluate the environmental suitability assessment is still under discussion. The 2011 East Japan earthquake and tsunami which occurred on March 11 generated a large quantity of disaster wastes and tsunami deposits which requires proper treatment and utilization. Use of the recovered soils obtained from disaster debris has been an issue in the affected area. In this presentation, these issues are presented.

Keywords: Excavated soil, Heavy metal, Geoenvironment

Japan Geoscience Union Meeting 2015
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AHW25-P01 Room:Convention Hall Time:May 27 18:15-19:30

Water balance analysis for assessing groundwater resources in Kofu basin

ICHIKAWA, Yutaka[1*] ; TAKABE, Yuya[2] ; NAKAMURA, Takashi[3] ; MAGOME, Jun[3] ; ISHIDAIRA, Hiroshi[3]

[1]Graduate School of Engineering, Kyoto University, [2]Graduate School of Medicine and Engineering, University of Yamanashi, [3]International Centre for River Basin Environment, University of Yamanashi

Water use in Yamanashi Prefecture is highly dependent on groundwater resources, and a number of groundwater investigations have been carried out. However, groundwater recharge, which is the most crucial factor for its proper management, remains uncertain. This study conducted a water balance analysis of Kofu basin aiming at assessment of its groundwater resources. The water balance of Kofu basin consists of temporal change of groundwater and surface water amount, precipitation, river and groundwater discharge coming from the surrounding mountain regions, evapotranspiration and river discharge going out from the outlet of the basin. The observation datasets were utilized to estimate precipitation and river discharge. An advection-aridity approach was used to estimate actual evapotranspiration. The temporal change of groundwater amount was found to be small enough to be ignored compared other components based on groundwater level observations and the temporal change of surface water was assumed to be negligible. Groundwater inflow from the surrounding areas was estimated as difference of other inflow and outflow components. The annual amounts of each components per unit area of Kofu basin were estimated as follows; precipitation: 1090mm, river inflow: 5090mm, evapotranspiration: 340mm, river outflow: 6500mm, groundwater inflow: 650mm.

Keywords: water balance, groundwater resources, Kofu basin

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AHW25-P02 Room:Convention Hall Time:May 27 18:15-19:30

Distribution of ground water quality in South gobi area

NAKAZAWA, Koyomi[1*] ; NAGAFUCHI, Osamu[1] ; OKANO, Kanji[1] ; OSAKA, Ken'ichi[1] ; HAMABATA, Etsuji[1] ; IKEDA, Keisuke[1] ; YOSHIDA, Akifumi[1] ; CHOIJIL, Javzan[2] ; TSUGTBAATAR, Jamstram[2]

[1]University of Shiga prefecture, [2]Institute of Geography Mongolian academy of sciences

39 ground water samples were collected from wells in August to September 2013 in South gobi, Mongolia. Sampling sites were located in Oyu tolgoi (Cu mine and Au mine), Tavan tolgoi (coal mine) which were large-mining activity has been conducted. In addition, samples are collected in northern area of Mongolia for comparison. PH, EC, the concentration of fluoride ($F^?$), chloride ($Cl^?$), sulfate ($SO_4{}^{2?}$), nitrate ($NO_3{}^?$), sodium (Na^+), potassium (K^+), calcium (Ca2+), magnesium (Mg2+), mercury (Hg), manganese (Mn), nickel (Ni), zinc (Zn), cadmium (Cd), lead (Pb), chromium (Cr), arsenic (As), selenium (Se), lithium (Li), aluminium (Al), vanadium (V), cobalt (Co), molybdenum (Mo), indium (In), antimony (Sb) and tellurium (Te) were measured. We charactrize the water quality and human helath risk. In Tavan tolgoi and Oyu tolgoi, HQ (Hazard Qoutient) showed >1, which is considered at risk. In Oyu tolgoi, HQ of NO3- (29.6+-20.1 mg/l) and As (6.63+-5.69ug/l) showed >1. In Tavan tolgoi, HQ of NO3- (47.1+-36.2 mg/l) showed >1 and it contribute the most (44 %) to the average HI, followed by As (17 %, 2.57+-3.72ug/l) and Mo (17 %, 17.8 +-11.1ug/l). On the other hand neither HQ nor HI not showed >1 in Northern area. Result from the nitrogen and oxygen stable isotope ratio, NO3- contamination in Oyu tolgoi and Tavan tolgoi was caused from livestock waste.

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AHW25-P03 Room:Convention Hall Time:May 27 18:15-19:30

Evaluation of subsurface warming in the Tokyo metropolitan area, Japan

MIYAKOSHI, Akinobu[1*] ; HAYASHI, Takeshi[2] ; KAWAI, Masafumi[3] ; KAWASHIMA, Shinichi[3] ; KOKUBUN, Kuniki[3] ; HAMAMOTO, Hideki[4] ; HACHINOHE, Shoichi[4]

[1]Geological Survey of Japan, AIST, [2]Faculty of Education and Human Studies, Akita University, [3]Civil Engineering Support and Training Center, Tokyo Metropolitan Government, [4]Center for Environmental Science in Saitama

Three-dimensional subsurface temperature distribution and its long-term change were examined by repeated observations of temperature-depth profiles at monitoring wells from 2000 to 2014 in groundwater temperature monitoring from 2007 2012, to evaluate effects of regional groundwater flow and environmental changes due to urbanization on subsurface thermal environment in the Tokyo metropolitan area, Japan.

Subsurface warming has been found at shallow depths in the whole study area by our previous study (Miyakoshi et al., 2010). Especially, subsurface temperature beneath the city center was particularly high not only at shallow part but also deep part. In contrast, relatively low temperatures were found beneath the suburban area. Comparison result between past subsurface temperature data (2004 to 2005, previous study) and present subsurface temperature data (2013 to 2014, this study) showed that subsurface warming was found at the shallow part in the last 9 to 10 years. Subsurface temperature increase in the city center was larger than the suburban area, and the temperature difference between both areas showed an increasing tendency. Additionally, subsurface warming in the present data was recognized deeper than the past data. This result suggests that distribution of subsurface warming is expanding toward the deeper part.

Moreover, results of subsurface temperature monitoring showed difference of subsurface warming tendency by area and depths. The difference suggests that subsurface warming is affected by not only surface warming but also many factors such as geological condition, groundwater flow and waste heat from subsurface structure. Results of this study suggest that mechanism of subsurface warming is able to be evaluated by combined analysis of geological condition, groundwater flow and subsurface temperature changes.

This study was supported by JSPS KAKENHI Grant Number 25871190. This study was conducted as a part of Civil Engineering Support and Training Center, TMG - Akita Univ. - AIST Joint Research and Saitama Pref. - Akita Univ. - AIST Joint Research.

Keywords: subsurface temperature, groundwater flow, subsurface warming, urbanization, Tokyo metropolitan area

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AHW25-P04 Room:Convention Hall Time:May 27 18:15-19:30

Long-term monitoring for groundwater temperature at closed loop GSHPs installed site

PARK, Youngyun[1*] ; MOK, Jong-koo[2] ; JANG, Bum-ju[2] ; LEE, Seung-jin[2] ; PARK, Yu-chul[3] ; LEE, Jin-yong[1]

[1]Department of Geology, Kangwon National University, Republic of Korea, [2]Geo3eco Co. Ltd., Chuncheon, Republic of Korea, [3]Department of Geophysics, Kangwon National University, Republic of Korea

This study was performed to evaluate the influence of closed loop ground source heat pumps (GSHPs) on groundwater temperature. The closed loop ground source heat pumps was installed in 2009 and their capacity is 6,952 kW. The monitoring well was installed between wells used to closed loop GSHP and was located approximately 3.5 m away from well used to closed loop GSHP. The groundwater temperature were hourly measured from May 2010 to June 2013. The air temperature had ranged from -15.7 to 30.4^{o}C and showed significant seasonal variations. The water temperature at monitoring well ranged from 13.3 to 16.3^{o}C and their fluctuation trend was similar to air temperature. However, background of groundwater temperature showed narrow range (12.8 to 14.7^{o}C) compared with that at monitoring well. In addition, background of groundwater temperature showed relatively weak seasonal variations. The phase difference between air and groundwater temperature at monitoring well was from approximately 4 to 5 months. The slope of regression line for air and background groundwater temperature was -0.006 and -0.01 ^{o}C/day, respectively. In contrast, the slope of regression line for groundwater temperature at monitoring well was 0.05 ^{o}C/day. These results indicate that thermal energy is cumulated in groundwater owing to operation of closed loop GSHPs in the study area. These trends can keep going. Therefore, the influence of closed loop GSHPs on groundwater temperature has to be evaluated to conserve groundwater from thermal contamination by operation of closed loop GSHPs and to keep energy efficiency. This work is supported by the Korean Ministry of Environment under ”The GAIA project (2014000530001)”.

Keywords: Open loop, Ground source heat pump, Groundwater temperature, Korea

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AHW25-P05 Room:Convention Hall Time:May 27 18:15-19:30

On the origins of nitrate and sulphate ions in urban shallow groundwater of Shakujii-gawa basin, Tokyo

YASUHARA, Masaya[1*] ; INAMURA, Akihiko[1] ; NAKAMURA, Takashi[2] ; HAYASHI, Takeshi[3] ; ASAI, Kazuyoshi[4]

[1]Geological Survey of Japan, AIST, [2]University of Yamanashi, [3]Akita University, [4]Geo Science Laboratory

A nitrogen and sulfur isotope study was carried out for both groundwater samples, and various kinds of fertilizers and detergents, to discuss possible origins of nitrate and sulfate ions in shallow groundwater of the highly-urbanized Shakujii-gawa basin on the Musashino plateau, Tokyo, Japan. Nitrogen and sulfur isotope measurements suggest contribution of the end-member with high isotopic values such as organic fertilizers used in field cropping, miscellaneous household waste water once infiltrated into the soils, and/or leaking sewage from aging, deteriorated sewer pipes, accounting for high nitrate and sulfate concentrations in shallow groundwater of the Shakujii-gawa basin.

Keywords: urban groundwater, nitrate ion, sulfate ion, origin of ions, isotopes