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

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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

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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

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

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

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

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

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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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Utilization and environmental suitability of excavated and recovered soils

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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