

AHW025-P01

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Arsenic contamination of groundwater at recharge area in Sonargaon, Bangladesh

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Formation process of arsenic contaminated groundwater at a recharge zone in Sonargaon, Bangladesh

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Arsenic contaminated groundwater had been expanding in Asia. Particularly serious health problems have been reported from various area of Ganges delta, where reductive dissolution of Fe oxyhydroxide via biodegradation is the consensus model to explain the mechanism of dissolution of arsenic into groundwater. However throughout the research work in Sonargaon, Bangladesh, we suspect since highly arsenic contaminated groundwater appears in a recharge area where the groundwater has dissolved oxygen. We can observe the earliest stage of formation of arsenic contaminated groundwater in this area. In this study, groundwaters were collected from household tube wells in September and December 2010. Twelve test Tube wells in a recharge zone were drilled at three different depths (5 ,10 and 15m) in the September, and the groundwaters were collected from those wells.

Total arsenic concentration of groundwater collected from the test tube wells increases with increasing depth. Arsenic concentration exceeds 0.2mg /L at 5m depth, indicating that dissolution of arsenic starts just after groundwater in infiltrated into the aquifer. Arsenic concentrations at depth 10 and 15m are approximately 0.8mg/L. Arsenic concentration of an adjacent tube well exceeds 1mg/L at 30m depth. Therefore, the arsenic is most actively released into the groundwater between 5 to 10 m depth. Arsenite/arsenate ratio changes with depth, As (3):As(5) = 4:6 at 5m depth, 1:9 at 10m depth, 0.5:9.5 at 15m depth, and 0.5:9.5 at 30m depth. Reduction of arsenic seems to be completed at 15m depth.

Reduction of groundwater would not be an important to release arsenic since dissolved oxygen is present in the groundwater at 30m depth. Highly arsenic contaminated groundwater appears in a circled area of 150m radius. Arsenic-free groundwater is present around the arsenic contaminated area.

The previous study documented the three sedimentary layers were present beneath this area, i.e., Holocene sand layer (upper aquifer) including high arsenic groundwater as an aquifard , and Pleistocene sand layer (lower aquifer) . However, the mud layer does not appear beneath the recharge zone where high arsenic contaminated groundwater appears, and the Holocene and Pleistocene sand layers directly contact. Presumably, the uptake of groundwater for irrigation from the Pleistocene aquifer promotes the downgoing flow of groundwater, and such a flow promotes release of the arsenic into the groundwater.

Keywords: Arsenic, groundwater, Bangladesh, Sonargaon, Arsenite/arsenate, oxyhydroxide

Chemical forms of arsenic in the arsenic polluted groundwater aquifer

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To identify the host phase(s) of arsenic in eolian sediment taken from the Punjab, Pakistan, where arsenic polluted groundwater is found in an aerobic environment, concentration of arsenic and the related elements and chemical forms of the arsenic were analyzed.

To analyze the chemical forms of adsorbed arsenic onto the sediment particles, the sediment samples were shaken in a centrifugation tube with the solution, of which pH was adjusted using hydrochloric acid or nitric acid and sodium hydroxide. Filtrated supernatant was used to quantify total arsenic concentration using ICP-MS and different chemical forms of the arsenic using HPLC/ICP-MS, and the related elements (Fe, Si, and Al) were analyzed by ICP-AES. Sequential extraction of arsenic was also tried; the sediments were shaken with 6M hydrochloric acid and the residual sediments were shaken with the mixture of 1M sodium hydroxide and 0.1 M sodium chloride at room temperature. The extracted arsenic in hydrochloric acid and sodium hydroxide solutions were analyzed using HPLC/ICP-MS. Mineral composition of the residual sediments was analyzed by XRD. Ionic valency of arsenic of the bulk sediment and separated chlorite were determined using XAFS at SPring-8.

Total arsenic concentration of bulk sediment was 35.4 mg/kg. As(III):As(V) ratio of the bulk sediment was 0.14:0.86, and that of goethite bearing chlorite was 0.31:0.69. Extracted arsenic in the solution of pH 1 to 14 was only arsenate. Although the arsenic concentration extracted in the solution pH ranging 4 to 8 is less than 1 mg/kg, it increases in the solutions pH <3 and >9, in which the arsenic concentration is >8 mg/kg, and 31 mg/kg at the maximum when the pH was 14. Only arsenate was extracted in the 6M hydrochloric acid solution, however, arsenite was also extracted in the sodium hydroxide and sodium chloride mixing solution. The concentrations of As(III) and As(V) were 2.6 and 4.0 mg/kg. Most of arsenate is not adsorbed onto Fe-oxyhydroxides and/or the other particles, since it is not extracted in the solution ranging pH 2 and 8, where the arsenate is most preferable to be adsorbed.

Goethite can be dissolved in hydrochloric acid solution, as noted by the previous researchers, while it cannot be decomposed in neutral and alkaline solution. Chlorite was decomposed in alkaline solution, assured by XRD. Iron (0.3% as Fe₂O₃) was dissolved in the solution pH <2, while it does not considerably dissolved in the solution pH >3. Silicon (1% as SiO₂) was dissolved in the solution pH <2 and >11. Aluminum gave the similar trend of dissolution; 0.4 % of Al₂O₃ was dissolved in the solution pH <2 and >11. Thus, the goethite was decomposed in the solution pH <2, and chlorite was pH >11. Arsenic concentration is higher in the solution pH >11 than in that <2, indicating that a part of arsenic is fixed in the chlorite.

Based on the above results, the As(V) is fixed in both Fe-oxyhydroxides and chlorite, while the As(III) is fixed only in the chlorite.

Keywords: arsenic, pH

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Estimation of evapotranspiration, transpiration and soil evaporation in three crop fields with different irrigation

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Projected increase of water consumption due to the planned expansion of agricultural land in Egypt is one of the problems for the sustainable agriculture. Control of evaporative water consumption is suggested as one of the water-saving measures to remedy this issue. Thus it is important to verify the effect of such control measures. Three fields covered with maize within the Nile delta were the target of the study. Two fields employ conventional fallow irrigation while one uses drip irrigation method. Also one of the conventional field was covered with mulching. At three fields, eddy correlation system with relevant meteorological, hydrological and vegetation measurements was installed in June of 2010. Together with data obtained in an intensive measurements in the summer of 2010, data were applied to the Deardorff model to separate evapotranspiration into transpiration and soil evaporation during growing season of maize. Some initial findings will be presented.

Keywords: Nile delta, soil evaporation, transpiration, irrigation

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Atmospheric water balance and cloud formation over Nile Delta

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Application of the atmospheric water balance approach allowed determination of evaporation (E) over and around Nile Delta. It was found that E from Nile Delta was larger than that of the deserts, probably because of the extensive irrigated farmland in Nile Delta region. The moisture flux from the surface (i.e., evaporation) could generate larger amount of clouds and they can have positive and negative feedback to climate on a regional scale. However, the relative contribution of evaporation to the cloud formation of the area was in general smaller than that of moisture convergence in atmospheric columns, except for summer season when former influence was large.

Keywords: Nile Delta, evaporation, atmospheric water balance, cloud formation

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Windbreak trees for water-saving agriculture in Nile delta: are they effective?

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Measurements of sapflow and sapwood area of windbreak trees (Casuarina) in Nile delta allowed determination of transpiration. Relation between tree transpiration and characteristics of sample trees such as DBH or height, and detailed meteorology was examined. It was found that a good correlation exists between transpiration and vapor pressure deficit and downward short-wave radiation. Thus Penman-Monteith equation was employed to estimate long-term transpiration. By applying results of previous studies on the performance of windbreak trees of various densities, an estimate was made on the effectiveness of windbreak tree for water saving in Nile delta farmland. The results shows that the transpiration of windbreak trees occupies only 0.28 % of the total evapotranspiration of the farmland, whereas evaporation reduction by the introduction of windbreak trees could be as large as 20-24% of the total evapotranspiration.

Keywords: Windbreak trees, Casuarina, sapflow measurements, Evaporation reduction

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Correlation of a groundwater discharge with a tephra layer in Tottori sand dune

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The Tottori sand dune is located in the Sanin Kaigan national park. In this sand dune, there is a groundwater discharge point called an oasis. The oasis is grows after the rainfall, and an important factor of a natural landscape in the dune. Because the Tottori sand dune is registered in the global geoparks network, it is necessary to clarify the geoscience phenomenon of the dune academically. The sedimentary structure of the dune are researched. However, the generation mechanism of the oasis is not clarified. The purpose of this research is to clarify the generation mechanism of the oasis with the resistivity tomography method.

Non-polarizing Ag-AgCl electrode was used for resistivity tomography. The electrode interval was set to 3m, and the depth was analyzed up to 20m. The water level of the oasis was measured with pressure type level gauge. Precipitation was measured with rain gage.

The water level change of the oasis corresponded to precipitation by the day. The oasis disappeared when the no-precipitation day continued. From the past research result, it is suggested that groundwater that is shallower than 5m forms catchment of the oasis. From the resistivity tomography model, the low resistivity material below 200 ohm deposit horizontally at several meters depth from surface. The detected low resistivity material is thought to be a volcanic ash layer, for example, DKP (Daisen Kurayoshi pumice fall deposit). The old dune deposit under the loam layer.

A clear groundwater table was not detected from this result. This cause is thought not to be able to divide a volcanic ash layer and the upper aquifer. It is suggested that the catchment aquifer to the oasis is very thin and the perched groundwater that is holding on volcanic ash layer.

Keywords: Groundwater discharge, Tephra layer, Tottori sand dune, Resistivity tomography

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Hydrochemistry and isotopic composition of fossil seawater rich hot springs in the eastern Kanto Plain, Central Japan

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Major chemical, oxygen, hydrogen and sulfur isotopic compositions of the high chloride waters from six wells of the eastern Kanto Plain, additionally rock samples from four wells for mineral constituents, were analyzed to discuss water-rock interaction processes to make chemical properties of the fluids and flow system of deep fluids. The $\delta^{34}\text{S}$ value ranges between +16.1 and +51.2 permil, interpreting that sulfur is originated by several potential sources (sulphate reduction processes, anhydrite dissolution).

Keywords: fossil seawater, eastern Kanto Plain, hot springs

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Hydrochemistry and genesis of volcanic hot springs around the Haruna volcano

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Major chemical and isotopic ($\delta^{18}\text{O}$, δD and $\delta^{34}\text{S}$) compositions in hot spring waters from thirteen wells and four spring waters around the Haruna volcano, Gunma Prefecture were analyzed to discuss water-rock interaction to make chemical properties of deep fluid. The chemical compositions of the waters described in terms of relative concentrations of ions allow us to distinguish chloride-type (Na-Cl, Ca-Cl) and bicarbonate-type (Na-HCO₃, Ca-HCO₃) waters. The major chemical compositions of the waters are controlled by the following mechanisms: (1) formation of kaolinite by weathering of plagioclase (2) dissolutions of calcite, gypsum and anhydrite. Fluid-mineral interaction calculation results show that most deep fluids in the field are supersaturated with kaolinite, and undersaturated with calcite and anhydrite.

Keywords: Haruna volcano, Hydrochemistry, genesis, hot springs, water-rock interaction

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The behavior of heavy metals in river water around the Tada silver mine, southwestern Japan

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Heavy metal concentrations in river water around an abandoned mine site are important for environmental conservation as well as understanding elemental behavior in nature. In this study, heavy metal concentrations of river water samples around one of the most historical abandoned mines in Japan, the Tada silver mine, were studied to understand the elemental behavior around the closed mine at regional levels. The Tada silver mine is located in the eastern part of Hyogo prefecture, southwestern Japan. The mine is classified as Cu-Sn and Zn-Pb polymetallic vein deposit including silver¹⁾, and it was closed in 1973. A total of 38 river water samples were collected around the Tada silver mine. Water temperature and pH were measured at the sampling site. All samples were filtered with 0.45 μm filter. Seven heavy metal elements (Cr, Mn, Ni, Cu, Zn, Mo, Pb) were analyzed with inductively coupled plasma mass spectrometer (ICP-MS), and six anions (Cl^- , NO_2^- , NO_3^- , Br^- , PO_4^{3-} , SO_4^{2-}) were analyzed with ion exchange chromatography (IC). Behavior of heavy metals in river water is mainly controlled by adsorption reaction. Adsorption rates of heavy metals are different among the elements, and are affected by the dissolving forms and pH. Cu, Zn and Pb in river water are commonly dissolved as cation, and are easily adsorbed when pH is high²⁾. Near the Tada silver mine, Cu (102 ppb), Zn (323 ppb) and Pb (59.9 ppb) concentrations are higher than the other river water samples far from the mine. These higher concentrations might be affected by the Tada silver mine. As increasing the distance from the mine, Cu, Zn and Pb concentrations decreased rapidly. Concentration of Cu becomes stable within 2,700 m away from the location of its maximum concentration. Zn concentration becomes stable at 6,400 m away from the location of its maximum concentration. Concentration of Pb becomes stable within 2,100 m away from the location of its maximum concentration. The distance to the stable concentration point of Zn is longer than that of Cu and Pb. This is concordant with the fact that Zn adsorption rate is lower than that of Cu in same pH condition. Mo concentration slightly increases with increasing the distance from upstream to downstream and correlates with the anion content, especially SO_4^{2-} . This might be because that : 1) Mo dissolves as anion ; 2) Mo adsorption rate is low in pH 7.5 - 8.0³⁾; and 3) Mo is supplied from the sediments.

References

- 1) Committee for Publication of Regional Geology of Japan, 2001, *Regional Geology of Japan Part6 KINKI*, Kyoritsu Shuppan, Tokyo, 297 p.
- 2) Mouvet, C. and Bourg, A.C.M., 1983, *Water. Res.*, **17**, 641.
- 3) Goldberg, S. et al., 1996, *Soil. Sci. Soc. Am. J.*, **60**, 425.

Keywords: heavy metals, adsorption, Tada silver mine

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Nitrogen and sulfur isotope analysis of anthropogenic nitrate pollution of river at the Tatebayashi city

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To identify anthropogenic sources of nitrogen in the Tsuruuda river of the Tatebayashi City, Gunma Prefecture, stable isotope composition of nitrogen ($\delta^{15}\text{N}$) and sulfur ($\delta^{34}\text{S}$) as well as the nitrate concentration in eleven river water were determined. The high proportion of $\text{Cl}^- + \text{SO}_4^{2-} + \text{NO}_3^-$ in the total anion concentration suggests strong influence of human activities on the groundwater quality. The $\delta^{15}\text{N}$ values of NO_3^- in the river range from +7.9 to +11.2 permil, suggesting that the NO_3^- contamination (2.4 to 7.9 mg L⁻¹) was caused by domestic sewage. The $\delta^{34}\text{S}$ values of sulfate in the river were in the narrow range from +1.4 to +2.8 permil, and suggest that the contaminant sulfur was also originated from domestic sewage and detergents (-2.9 to +3.6 permil). These results demonstrate that simultaneous analysis of $\delta^{34}\text{S}$ and $\delta^{15}\text{N}$ is very useful for reliable estimation of the origin of NO_3^- in river.

Keywords: pollution of river, stable isotope, Tatebayashi

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Environmental evaluation using the attached and drifting diatom assemblage :A case study in the Ai River, Osaka

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Diatom assemblage is an excellent bioindicator for river environment. Many water quality indices have been established based on the attached diatom assemblages. Meantime, drifting diatom assemblage as an environmental indicator has not been verified enough. We compared epilithic and drifting diatom assemblages in term of their nature of environmental indices in the Ai River flowing through Osaka prefecture in Japan. The species compositions of epilithic diatom assemblages varied between sites and they well represent the water environment in situ. In contrast, a saprophilous diatom *Nitzschia palea* was usually dominant in the drifting diatom assemblage despite the oligo- to beta-mesosaprobic water. Its dominance can be explained by the inflow from the paddy fields in the watershed. Therefore, we conclude that the drifting diatom assemblage is less effective as a water quality indicator, but it may be good indicator for geographical configuration and the land use of the watershed.

Keywords: river environment, diatom assemblage, bioindicator, environmental parameters