島嶼沿岸地下水における季節的な水位変動にともなう流動系の変動について

Dynamics in groundwater flow system with seasonal water table variation in a coastal and island

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In islands, freshwater water resources are valuable as living and agricultural use, and dug wells water and reservoirs had been utilized for more than 100 years. In order to use such water resources sustainably, it is important to evaluate groundwater flow as well as water budget.

In this research, we examined to confirm the seasonal variation in water stable isotopic ratios in observation boreholes at the coastal lowland in Ikuchi Island Hiroshima prefecture. Moreover, considering that the target area is coastal, Cl^- concentration was analyzed to evaluate the influence of salt fresh water boundary.

The experimental site is located on Ikuchi Island in Hiroshima prefecture. The highest altitude is 456 m. The basement rock is mainly composed of granite. Annual average precipitation is 1058.8 mm. Observation boreholes are located at the coastal lowland in the southeastern part of the island. The upper site (Site U) with the altitude of 5.1 m asl has 3 boreholes with the depths of 2 m, 15 m, 30 m, the lower site (Site D) with 2.5 m asl has 8 with the depth of 1 m, 2 m, 3 m, 10 m, 15 m, 20 m, 30 m, 40 m, respectively. The water sampling was carried out from monthly to half year interval since 2015. Every samples were analyzed for water isotopic ratios by PICARO and anion component by ion chromatography. Especially samples in January in 2019 were analyzed for CFCs and SF6.

Based on the previous study (Saito and Onodera, 2007), the distinct altitude effect of isotopic ratio in precipitation has been confirmed. Due to spatial and temporal variations in isotopic ratios, recharge process to groundwater was suggested as follows, 1) recharge on site to shallow groundwater (2-3m deep) at D ($\delta^{18}O$: -7.8 to - 7.4 ‰), 2) river water contribution to the shallow groundwater (2-15m) at U ($\delta^{18}O$: - 8.3 to - 7.5 ‰), 3) recharge in the mountain slope with the altitude of about 360 m to deep groundwater (30m) at U ($\delta^{18}O$: - 8.4 to - 8.1 ‰), 4) recharge at 400 m on near the mountain top to deep groundwater (10-30 m) at D($\delta^{18}O$: - 8.7 to - 8.4 ‰), 5) recharge of precipitation with lower isotope than in present to deeper groundwater (40 m) at D ($\delta^{18}O$: -8.9 to - 8.8 ‰)

The deepest groundwater (40m) at D had lower isotopic ratios with higher Cl^- concentration (250 to 584 mg / L) during a lower water table in the winter. This indicated the seawater –fresh water boundary rose with water table according to Gyben-Hrzberg concept. These phenomena also suggest to cause the rise of deeper and older groundwater flow line. Consequently, we suggest the lower isotopic ratio in deeper groundwater indicates the immobile water which were recharged in the glacial period. Based on other tracers (CFC, SF 6), we will discuss more.

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