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Hydrogeological Characteristics of Groundwater and Surface water in King George Island, Antarctica

Jisun Kim (1), Jiyoung Kang (1), Sung-Wook Jeen (1), Jeonghoon Lee (2), Hyoun Soo Lim (3), Hyoungseok Lee (4), and Soon Gyu Hong (4)

(1) Department of Earth and Environmental Sciences, Chonbuk National University, Jeonju, Republic of Korea (sjeen@jbnu.ac.kr), (2) Deptartment of Science Education, Ewha Womans University, Seoul, Republic of Korea, (3) Department of Geological Sciences, Pusan National University, Busan, Republic of Korea, (4) Korea Polar Research Institute (KOPRI), Incheon, Republic of Korea

In order to evaluate influences of climate changes on ecosystems in the polar regions, it is necessary to understand the hydrological cycle in those regions. While interactions between groundwater and surface water have been recognized as an important component of the hydrological cycle, studies have been rare with regard to this aspect in the polar regions, particularly for groundwater. This study investigated hydrogeological characteristics of groundwater and surface water in the region near King Sejong Station, King George Island, Antarctica. Forty seven groundwater, surface water, and snow samples were collected in January 2018, and major anions, cations, trace elements, and oxygen and hydrogen isotopes were analyzed. Also, groundwater influx and outflux to/from two small ponds were measured using seepage meters. The results of water analysis indicated that groundwater chemistry is distinguishable with those of surface water and snow by higher concentrations of calcium, magnesium, silicone, and bicarbonate. The composition of snow appeared to be affected by sea spray. The isotopic compositions of hydrogen and oxygen for snow followed the Global Meteoric Water Line; however, those of groundwater and surface water slightly deviated from the line, indicating that there might be isotopic fractionation due to sublimation and melting of snow after precipitation. The measured groundwater influx to surface water was relatively consistent between 2.2×10^{-9} m/s and 3.0×10^{-9} m/s in one pond, while in another pond, both influx (2.0×10^{-10} m/s$\sim$$2.7\times10^{-9}$ m/s; from groundwater to surface water) and outflux (-9.9×10^{-10} m/s$\sim$$-7.3\times10^{-9}$ m/s; from surface water to groundwater) were measured, indicating that groundwater-surface water interaction can be very dynamic in the study site. This study presents groundwater chemistry and groundwater-surface water flux data in an area of Antarctica, which have not been reported in previous studies; thus, it can provide a basis for evaluating hydrogeological characteristics of and impacts of climate changes on active layers and permafrost in Antarctica.
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