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Existence of the long-term groundwater flow system in the Nakano-shima Island, Oki-Dozen, Japan -A preliminary study-

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It is known that groundwater flow system in the coastal area is affected by sea level changes. We have been attempting to reveal the groundwater flow system in the Nakano-shima Island, which is situated in the Sea of Japan, using several indices of the residence time of groundwater (CFCs, ^{3}H, SF_6, and ^{14}C). In this paper, end-member waters with different residence times are clarified, and the formation of groundwater and hot spring water in the Nakano-shima Island are discussed.

The Nakano-shima Island was formed by volcanic activities which erupted alkali basalt lava c.a. 6Ma (Tiba et al., 2000). Thickness of the lava is about 300 to 400m. The lava overlies the sedimentary rocks of which deposition ages were Lower to Middle Miocene (Tiba et al., 2000).

Groundwater samples were collected from five springs, thirteen water-supply wells (screen depth: GL-10 to -100m) and a hot spring well (screen depth: GL-560 to -870m). All samples were analyzed for CFCs, ^{3}H, SF_6, and stable isotopes of oxygen and hydrogen. Samples from four water-supply wells and the hot spring were analyzed for ^{14}C and isotopic ratios of helium.

Stable isotopic ratios of oxygen and hydrogen of all samples were plotted on or near the meteoric water line. Those values of the hot spring were lower than other samples. Samples from two water-supply wells and the hot spring well showed much lower CFCs and ^{3}H concentrations than other wells, and their ^{3}H concentrations were close to detection limit (0.2 TU). ^{14}C concentrations were analyzed for samples from the hot spring, two water-supply wells containing lower CFCs and ^{3}H, and a water-supply well containing higher CFCs and ^{3}H concentration. ^{14}C concentrations of theses samples were 17pMC, 57 to 77pMC, and 96pMC, respectively. The samples analyzed for ^{14}C were also analyzed for $^{3}He/^{4}He$ and $^{4}He/^{20}Ne$. Those values of all samples were plotted in the zone which can be explained by the mixing of air, mantle, and crust components, suggesting that mantle-derived fluid is added to groundwater. Thus, pMC values are considered to be higher than those measured by subtracting the addition of ^{14}C -free fluid derived from mantle. In addition, groundwater containing lower CFCs and ^{3}H and the hot spring water are considered to be the mixture of young groundwater containing CFCs and ^{3}H and old groundwater free of CFCs and ^{3}H, and hence, it is necessary to consider the mixing effect to estimate the pMC values. This analysis is under progress.

Lower delta D and delta ^{18}O values of the hot spring suggest that the hot spring water might be recharged in colder climate, and this result is consistent with lower pMC value of the hot spring water. It is considered that fresh groundwater recharged during the last glacial period still remains in the aquifers. Further consideration is needed for understanding the formation process of such long-term groundwater flow system in the island, with the focus on the effect of sea level changes and the paleo-topography of the island and its surroundings.

Reference

Tiba, T., Kaneko, N., and Kano, K.. Geology of Urago district. Geological survey of Japan, 74p, 2000.