3D mapping of groundwater geochemistry in Osaka Basin

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Osaka Basin is a large reservoir of groundwater resources, which can be used for various applications as industrial and domestic purposes. The uptake of groundwater has been strictly regulated in the center of Osaka Basin since 1960's to avoid geogenic disasters such as land subsidence. 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 in the whole basin down to 1500m depth was drawn to discuss the groundwater flow system of the basin and the effect of the land subsidence to the present groundwater geochemistry. This study was successful to visualize the groundwater chemistry as three-dimensional maps, which clearly show the following features of groundwater chemistry.

In the western plain of Uemachi plateau, of which altitude is below sea level, the stable isotope ratios of groundwaters shallower than 100m depth (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 from the western coast. While, the stable isotope ratios of the groundwater were low (δ^2H: ~-55‰, δ^{18}O: ~-8‰) in the deeper aquifers than 100m depth. Lower isotope ratios of the groundwaters than those of local meteoric water suggested that the groundwater contained squeezed pore water from the overlying clay layers. It would be the evidence of excessive usage of groundwater when the land subsidence actively occurred.