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# Distribution and decadal changes of subsurface temperature in the northern Kanto Plain

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Since 1999, our group has been conducting a survey to evaluate the subsurface temperature environment in the Kanto Plain, Japan. Miyakoshi et al. (2003) showed the existence of high temperatures beneath the northern Kanto Plain. However, the reason why the high temperature area is formed has not been explained. To make clear a distribution of subsurface temperatures and its change in the northern plain, we conducted the measurement of temperature-depth profiles at 66 observation wells in Gunma and Tochigi Prefectures in 2011.

Distribution of observed subsurface temperature pattern changes with depth. Temperatures beneath the foot of the Asio Mountains are higher than the plain region at the shallow part (50m depth). At the deep part (100m depth), high temperatures are found regionally beneath the Watarasegawa lowland and the central part of the plain. This regional distribution of subsurface temperatures is considered to be formed by the effects of heat advection caused by groundwater flow, and three dimensional distribution of subsurface temperature shows the existence of local and regional groundwater flow systems in this area.

Moreover, the tendency and factor of decadal temperature changes were examined through a comparison between past (in 2001) and present (in 2011) temperature-depth profiles at 21 observation wells. All of temperature-depth profiles showed changes in a decade. Temperature increases were founded at the shallow part of 19 wells, and these were considered to be caused by effects of surface warming. Additionally, temperature changes were shown at the deep part such as 100m depth. Some observation wells also show large temperature changes at the specific depth. These temperature changes suggest that groundwater flows are changing caused by artificial effects such as groundwater pumping in the northern Kanto Plain.

Keywords: subsurface temperature, groudwater flow, surface warming, groundwater development, urbanization, Kanto Plain