Subsurface Temperature Profile Database in Japan

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We generally know that distribution of subsurface temperature is affected by not only thermal conduction but also advection owing to groundwater flow. The effect of thermal advection is especially large in shallow sedimentary layer with good groundwater flow. In the field of geophysics, thermal gradients have been calculated linearly using difference from borehole bottom temperature and surface temperature to estimate heat flux. This method is to remove the effect of advection due to groundwater flow, therefore, there is a few discussion about shape of temperature profile. In this study, we deal with temperature profiles from hydrological point of view. The object of this study is to construct subsurface temperature database and to make clear the effect of subsurface temperature field.

We generally know that distribution of subsurface temperature is affected by not only thermal conduction but also advection owing to groundwater flow. The effect of thermal advection is especially large in shallow sedimentary layer with good groundwater flow. In the field of geophysics, thermal gradients have been calculated linearly using difference from borehole bottom temperature and surface temperature to estimate heat flux. This method is to remove the effect of advection due to groundwater flow in shallow layer, therefore, there is a few discussion about shape of subsurface temperature profile. In this study, we deal with temperature profiles from hydrogeological point of view. The object of this study is to construct subsurface temperature database and to make clear the effect of shallow subsurface temperature field.

Measuring groundwater temperature in the observation well means that measuring subsurface temperature, because there is thermal equilibrium between water in borehole and the surrounding subsurface temperature. Temperature profiles are one-dimensional sequential data arrays so that areally distributed temperature profiles provide three-dimensional subsurface information. Subsurface temperature field is affected by not only groundwater flow but also by surface temperature change. The most recent major climatic change, the rapid warming of 1880 - 1940 A.D., has caused a temperature inversion that is manifested as a low or inverse temperature gradient in the subsurface shallow layer in many parts of North America, Europe and Australia, at a depth of 50 to 100 m, depending on the thermal properties of the rock .

It has been made clear the effect on subsurface thermal regime through the latest studies in Japan. Comparing and examining two or more regions become possible by constructing the thermal database in Japan. This database includes location of well, groundwater temperature in observation well, geological column, well diameter and depth of screen. Moreover, this database system can display the groundwater temperature profile.

Subsurface temperature distribution is affected by regional groundwater flow system mainly, therefore, temperature profiles generally can be classified into three types, recharge type, discharge type, and intermediate type, according to temperature gradient. In the northeastern area of Japan, such as Yonezawa Basin and Nagaoka Plain, temperature profiles have the evidence of pumping withdrawals for melting snow during the winter. There are many subsurface temperature inversions that are manifested as low or inverse temperature gradient in the subsurface shallow layer at a depth of 50m to 100m in Nobi Plain, Tokyo, and Chiba, but we could not recognize the inversion in not so urbanized area, such as Yamagata basin, Yonezawa basin. This inversion must be caused by surface temperature warming by urbanization. Thus subsurface thermal regime are affected by many factors and has regional differences.