



Synthesis of subsurface temperature information and evaluation of the potential for setting up borehole heat exchanger in the central part of the Kanto Plain, Japan

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Borehole heat exchanger (BHE) is an economical and environmentally friendly technology that is widely used in Europe and North America, but rarely used in Japan. One of the reasons for this is the relatively complex topography and geological structure in Japan compared with those in Europe and North America.

Complex structures produce regional differences in subsurface thermal properties and temperature structures, leading to regional variation in the efficiency of BHE. It is thus important to evaluate the available subsurface heat energy through thermal response tests and/or numerical simulations and to design appropriate systems (depth and number of boreholes for heat exchange). Geological structures, groundwater properties, and subsurface temperatures are essential input data for numerical simulations. However, there is little information available concerning subsurface temperatures. Thus, we have decided to construct a database of subsurface temperatures in the Saitama region, which is in the central part of the Kanto Plain in Japan. The Kanto Plain contains the capital city of Japan and has a population of more than 40 million. Therefore, it is important to evaluate the energy potential of BHE in a part of this area. We have performed measurements of subsurface temperatures at 23 stations in the Saitama region.

We have illustrated a numerical simulation for BHE using the recent subsurface temperature data. Furthermore, we have discussed the regional characteristics of potential assessments for BHE. The results are expected to be utilized as information prior to the installation of BHE. For evaluating the potential assessments, we have developed a new method using an existing geological model with a high spatial resolution and applied this method to the southeastern part of the Saitama region. The results show that the potential of the plateau area in the central part of the region is higher than that of the lowland area in the eastern part.

Furthermore, the results of the subsurface temperature profiles show long-term subsurface warming in the Kanto Plain during the last century. We also estimated the influence of subsurface warming on the long-term efficiency of BHE.