

Reconstruction of climate change from borehole temperature

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Subsurface temperature profiles are used as a signature to evaluate the past climate change, because the signature of ground surface temperature changes is preserved in the subsurface thermal regime as a deviation from the steady state conditions. In a field of hydrology, temperature-depth profiles have been used as a tracer to evaluate groundwater fluxes, because heat in the subsurface is transported not only by heat conduction but also by heat advection caused by groundwater flow.

Effects of surface warming due to urbanizations on subsurface thermal regime were found in many cities over the world. Although the effect of global warming from borehole temperatures is evaluated, the effects of urbanization and groundwater flow on subsurface environment are not clear yet. Comparisons between observed subsurface temperature and calculated one show that the estimated ratios of surface warming due to urbanization and global warming during last century were 2.5, 2.0 and 1.5 degree centigrade in Tokyo, Osaka and Nagoya, respectively. The heat convection-conduction analyses also showed that the effect of groundwater on subsurface temperature was largest in Nagoya, followed by Tokyo and Osaka. This is confirmed by hydrogeological conditions in three cities, Japan.

Reconstructions of climate changes from borehole temperature have been made for global scale by IGPC Project Climate and Boreholes and IUGG IASPEI Heat Flow Committee. Reconstructions of sea water temperature from borehole temperature below the sea floor, and repeated and continuous measurements in boreholes are new areas of the studies on reconstructions.