

An estimation of compressibility of underground formations from groundwater level and land subsidence data in Tokyo area

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To achieve the sustainable use of groundwater in urban area, it is necessary to evaluate the possibility of land subsidence due to groundwater extraction. The first step should be the estimation of the state of underground formations, i.e, whether the formations are overconsolidated or not. Also it is important to know elastic compressibility of underground formations quantitatively.

We tried to estimate the above mentioned information from groundwater level and land subsidence data in Tokyo. Based on the obtained results, we studied the spatial distribution of groundwater resources which can be used sustainably.

Coefficients of volume compressibility under overconsolidation conditions were estimated both for the Kazusa Group and the Tokyo Group. The coefficient of volume compressibility of the Kazusa Group was found to be about half the value of the Tokyo Group. It is also found that the alluvial formations are continuously subsiding even in recent years.

Groundwater level corresponding to the yield stress of consolidation was estimated for each fluvial formation, and the spatial distribution of the yield stress was drawn from the reported groundwater potential distribution prior to the heavy extraction of groundwater. Here, we assumed that the yield stress of consolidation for each formation was more or less very similar before the groundwater extraction.

In the lowland area, land subsidence will occur by pumping groundwater because alluvial formations are continuously subsiding. In the Musashino upland, the northern part adjacent to Saitama Prefecture was evaluated to be nearly at the condition of yield stress of consolidation. On the other hand, in the southern part and in the western part, there existed the locations where we could use groundwater without significant subsidence, that is, the present groundwater potential is about tens of meters higher than that corresponding to yield stress of consolidation.