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Underground electrical resistivity and soil water content on the surface around former river channel of Tone River

NAKANO, Takayuki[1*] ; KOARAI, Mamoru[1]

[1]GSI of Japan

Land liquefaction occurred in a land reclaimed water area such as former river channel induced by the 2011 off the Pacific coast of Tohoku Earthquake. The land liquefaction was a biased distribution even in former river channel. We assumed that groundwater level and/or shape of former river bed (depth of former river) have a significant influence though the factor of this phenomenon is various. Therefore, we conducted electrical prospecting (2-D electrical resistivity prospecting) on former river channel of Tone River around Kozaki Town, Chiba Prefecture, to estimate a distribution of groundwater level and/or shape of former river bed from underground distribution of electrical resistivity. In addition, we considered a relationship between underground distribution of electrical resistivity and soil water content on the surface by measuring soil water content on the surface along the electrical prospecting line. In this survey area, there are data of layer profiles (trench survey profiles) and boring core stratigraphes by the National Institute of Advanced Industrial Science and Technology (AIST) and the Chiba Prefectural Environmental Research Center (CERC) (Mizuno et al., 2013; Miyaji et al., 2013).

Electrical prospecting was performed by the pole-pole array in 280m length, electrode intervals of 1m and until 15m deep. Measurement of soil water content was performed by volumetric soil water content sensor (by the method of responding to changes in the apparent dielectric constant) and weight water content sensor (by alternating current two electrode method). These measurements of soil water content were performed intervals of 10m on the electrical prospecting line, and three times in each measurement points and each sensors. We used these average values.

Electrical resistivity profile indicated clearly difference between reclaimed soil in the former river channel with relative high electrical resistivity (more than 20-30 ohm-m) zone and a ground out of former river channel with relative low electrical resistivity (less than 20-30 ohm-m) zone. The position where the boundary of these zones reaches near the surface was correspondent with a boundary of land liquefaction (sand volcano) area by the 2011 off the Pacific coast of Tohoku Earthquake. It is possible that the underground distribution of electrical resistivity is affected by a soil property more than soil water content. Distribution of groundwater level was unclear though it was estimated to be 1.5m in depth from that usual electrical resistivity of saturated sand is 80-100 ohm-m (The Japanese Geotechnical Society, 2003). As a groundwater level near this survey area by the boring survey (Mizuno et al., 2013) was 0.7m in depth, it is possible that electrical resistivity near the groundwater level is higher than 80-100 ohm-m.

As a result of compared the soil water content on the surface with the electrical resistivity beneath the surface, there was a correlation that weight water content is low in a high electrical resistivity. However, there was not a correlation between volumetric soil water content and electrical resistivity. Also, it was not able to confirm the relationship between soil water content and groundwater level because of the groundwater level was not able to estimate from the distribution of electrical resistivity.

This result indicated a detection of the shape of former river bed and a correlation between the soil water content on the surface and the electrical resistivity beneath the surface. We would like to find out an index with land liquefaction in former river channel due to perform a ground penetrating radar survey in the same field.

Keywords: former river channel of Tone River, Kozaki Town, electrical prospecting, distribution of electrical resistivity, soil water content