Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

AHW27-02 Room:424 Time:May 1 09:15-09:30

The subsurface distribution of saltwater and freshwater in the Nakano-shima island, by electromagnetic exploration

KUSANO, Yukiko[1*] ; SUZUKI, Koichi[2] ; TOKUNAGA, Tomochika[1]

[1]The University of Tokyo, [2]CRIEPI

Groundwater recharged during the last glacial period is revealed to remain in coastal aquifers and sub-seafloor formations, and it has been interpreted that the low-permeability formations have delayed the intrusion of saltwater into sub-seafloor formations (e.g. Groen et al., 2000). Thus, the effects of long-term sea-level change should be taken into account to better understand the groundwater flow system in coastal areas.

The Nakano-shima island, Oki-Dozen, is a volcanic island on a continental shelf. Because the island is situated on the continental shelf, the seafloor around the islands was most likely widely exposed during the last glacial period, and hence the distribution of salt/fresh water in subsurface is estimated to have been affected by the sea-level change after the Last Glacial Maximum. According to a well-drilling report of a hot spring well in the island, groundwater of which Cl concentration corresponds to 20% of sea water was obtained when the well reached to 320 m deep, and groundwater of which Cl concentration corresponds to 5% of sea water was obtained when the construction was completed (screen depth: 560 - 866 m). In addition, the hot spring water taken from the screen depth is suggested to be recharged in colder climate than present based on the stable isotopic ratios of water, dissolved components, and groundwater-age indices (Kusano et al., in press). These results suggest that the groundwater containing higher salinity exists in shallower than 320 m deep, and that the groundwater containing lower salinity and recharged in colder climate exists in deeper formations. In this study, electromagnetic exploration using CSAMT method was conducted to reveal the distribution of salt/fresh water beneath the island.

A 2.5 km-long measurement section for the electromagnetic exploration was set, along which the hot spring well exists, in east-west direction. Measurement points were placed at about 100 m intervals. Measured apparent resistivity data were used to obtain a two dimensional resistivity structure along the measurement line by two-dimensional inversion scheme developed by Uchida and Ogawa (1993). For better interpreting the resistivity structure in the island, volcanic and sedimentary rock samples obtained from the island were used to measure the bulk resistivity as a function of salinity of the pore water.

The result of two-dimensional inversion showed the higher resistivity zone from the surface to about 100 m depth, a continuous lower resistivity zone throughout the section in between 100 and 200 m depth, higher resistivity zone below, and lower resistivity zone further below, i.e., existence of four distinct resistivity zones. Resistivity values in between 100 and 200 m depth and those in the deepest zone were consistent with bulk rock resistivities saturated with higher salinity water. The results are consistent with the fact that groundwater with higher salinity was obtained when the well reached to 320 m depth and that groundwater with lower salinity was obtained after the well reached to 866 m depth. The obtained resistivity structure might suggest that fresh groundwater recharged in the last glacial period remains in the subsurface of the island, and salt water was intruded into the 100-200 m deep zone after transgression.

References

Groen, J. et al., 2000. J. Hydrol. 234, 1-20.
Kusano, Y. et al., in press, J. Hydrol.
Uchida, T. and Ogawa, Y. 1993. Geological Survey of Japan Open-File Report, 205.

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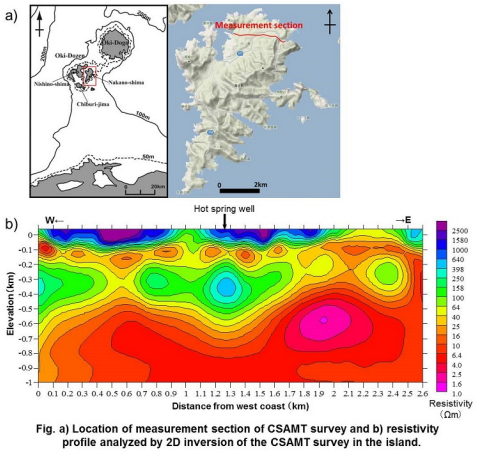

Fig. a) Location of measurement section of CSAMT survey and b) resistivity profile analyzed by 2D inversion of the CSAMT survey in the island.