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Imaging of temporal change of fresh/salt water boundary in a coastal zone by electric resistivity survey

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Hydrogeologic structures in coastal zones are important for disaster prevention and mitigation against large earthquakes that originate in latent fault movement in the sea areas, identification of fresh/salt water boundary, and evaluation of nutrient loads on sea environments associated with groundwater discharge. However, geological investigations in the coastal zones have not been much accumulated because of the difficulty in approaches. Then, we applied an electric survey method to clarify hydrogeologic structure in a coastal zone.

The Kumamoto Plain facing the Ariake Sea is well-known groundwater resource because of high mountains behind the plain such as Mt. Aso. Resistivity value is an important physical property of geologic media, which is related to porosity of rocks and soils. Chargeability is also an important electric property which is calculated from the temporal change of electric potential after stopping the current supply. In addition to the traditional electric survey, we measured temporal resistivity change and calculated the saturation of shallow sediments based on the Archie's law which were aimed at detecting inflow and outflow of groundwater (or seawater) in the sediments using the large difference in resistivity between seawater and groundwater. The measurements were carried out five times during 2007 to 2009 with 2D measurement lines of 150 m and 260 m lengths, using an equipments, Syscal-R2 (IRIS instrument) and multi electrode system. The measurement lines were set to be parallel and perpendicular directions to the coastal line.

By measuring the resistivity and grain size distribution of the sediments sampled from the tideland at a laboratory, resistivity over the study area was interpreted to be affected by the mud content. The change in fresh/salt water boundary was seen in a place that was deeper than 20m in the underground.

Keywords: resistivity, chargeability, fresh/salt water boundary, groundwater, Uto Peninsula