Study on long-term variation of geoelectric field observation

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Kakioka Magnetic Observatory, Japan Meteorological Agency, has observed the geomagnetic and geoelectric fields for several decades at Kakioka, Kanoya and Memambetsu. Vitage differences between two electrodes are observed in the geoelectric field observation. The baseline length is about 200-300m and the electrodes are installed at 3m deep. The data of the geoelectric field are used worldwide as a unique data set to investigate induced electric fields for last several decades.It is slightly troublesome for us to use the geoelectric field data set by Kakioka Magnetic Observatory because the geoelectric fields at three sites shows long-term variations and especially the north-south component of the geoelectric field at Kakioka clearly changes.Although some studies (e.g., Morinaga and Toya, 2015; Okawa et al., 1995) reported that this long-term variation is related to rain, details of how this long-term variation occurs are still unknown. This study aims to reveal the cause of the long-term variation.
Based on Morinaga and Toya (2015) and Fujii et al.(2007), we focus on geological structures around the electrode at the south end of the north-south line at Kakioka. We infer the geological structure from the distribution of the electrical resistivity.
The electrical prospecting was applied to an area of 20m x 20m with the south electrode as the center. Observations were conducted in March, May and October giving 7 observation lines around the south electrode, 2 lines around the east electrode, and 1 line around a boring hole (fig.1). Apparent resistivity was estimated from the observed currents and voltage differences.
We assume that the subsurface structure is one-dimensional and three layers are stratified. An optimal model of the resistivity distribution was obtained by inversion. All lines show a high resistivity layer at the surface followed by a low resistivity layer and then a high resistivity layer at the bottom. The thickness of the first layer is increased eastward from the south electrode.
The optimal model was compared with a boring profile obtained near the investigated area. We interpret that the resistive surface layer is permeable top soil and the second conductive layer is impermeable clay(Figure 2).We suspect that rain water flows on the top of clay to the east and the south electrode suffers from larger amount of water than the other electrodes.

Keywords: geoelectric field observation, electrical prospecting

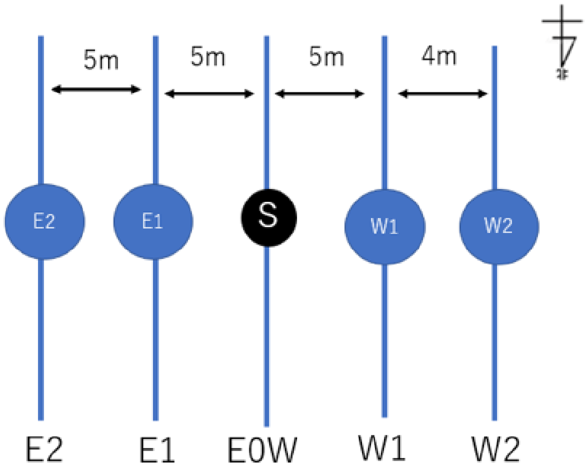

Figure 1

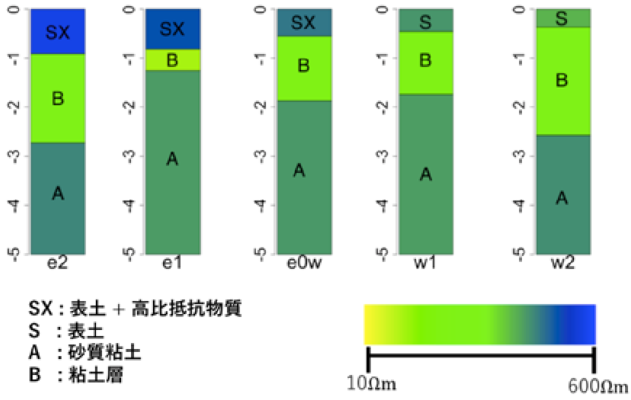

Figure 2