Characterization of fault zone, using audio-frequency magneto telluric survey, in the Horonobe area, northern Japan

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Fault zones have significant influences on ground water flow. It is important to understand the positions and internal structures of fault zones for hydrogeological modeling. These structures include fault cores and damage zones (Caine et al., 1996).

The Japan Nuclear Cycle Development Institute is performing research on investigation and modeling techniques in the process of mapping the geological environment from surface to deep underground in the sedimentary rocks of northern Hokkaido. The main research area is located around the Hokushin district in the Horonobe-cho. Neogene siliceous sediments, divided into the Wakkanai Formation(hard shale) and the Koetoi Formation(diatomaceous mudstone), are distributed in the area. The Omagari fault runs with a NNW-SSE strike, but its detailed position has not been confirmed. The ground water is saline in the deeper part, and fresh in the shallower part. We investigated the position and the internal structure of the Omagari fault, using the results of geological mappings, reflection seismic surveys, audio-frequency magneto telluric surveys, and borehole investigations (HDB_1-8).

An outcrop of the Omagari fault is located 5 km south from the main research area. At the outcrop, the internal structure of the Omagari fault consists of a thin fault core (about 10 cm width) and a wide damage zone (over 150 m width).

In the main research area, the results of the reflection seismic surveys and of the borehole investigations show the discontinuous nature of the structure known as the Omagari fault.

The results of magneto telluric surveys show two high-resistivity zones having a flower-shape structure, especially in the deeper part. These high resistivity zones overlap with the low saline concentration zones. The overlapping suggests the infiltration of the fresh water from the surface into the deeper part through permeable structures. One of the two high-resistivity zones corresponds to the position of the Omagari fault. Therefore, the Omagari fault is believed to be permeable. Oil/gas shows exist near the surface position of the Omagari Fault, and the Omagari fault includes a wide damage zone that is a permeable structure as classified by Caine et al. (1996). This information supports the previous surmise.

In addition, the other high-resistivity zone appears to be a permeable structure like the damage zone of the Omagari fault. The fracture zone, similar to the damage zone of the Omagari fault, is distributed in the borehole intersected by the other. Therefore, the Omagari fault may be distributed in the other zone and form over-step structures.

References

Caine, J. S., Evans, J. P., and Forster, C. B., 1996, Fault zone architecture and permeability structure. Geology, 24, 1025-1028.