ULF electromagnetic changes possibly associated with the fluid flow under the ground

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Electromagnetic phenomena preceding large earthquakes have been reported in DC-VHF frequency. ULF electromagnetic phenomena are the most promising among them because of the deeper skin depth. In order to study the earthquake-related ULF electromagnetic phenomena, discrimination of the signals is very important. In this aim, we developed the interstation transfer function (ISTF) method with the wavelet transform and eliminated the variations due to global natural source in the ULF electromagnetic data. The geomagnetic data obtained at Kakioka Magnetic Observatory, JMA are used as remote reference data.

In this paper, we would like to show you the anomalous electromagnetic changes observed at Boso Peninsula, Japan in 2002 and 2007.

In the period of the 2002 Boso Slow Slip event, the anomalous transient changes are detected simultaneously in the geomagnetic and geoelectrical data at the sites in Boso Peninsula. We paid attention to polarities of the strange geomagnetic changes at three stations and found these signals are generated under the ground by electric current.

The characteristics of these signals are as follows;

(1) the waveforms similar to DC driven train noise and (2) the magnetic anomalies also appear at Kanozan (KNZ), which belongs to Geological Survey Institute, Japan and is apart from about 25 km west of our Southern Boso stations. (3) However, the DC driven train noises from near our ULF stations are not observed in KNZ.

Then, we carried out the 2-D FDTD (Finite Difference Time Domain method) simulation to evaluate the received signals, which is to estimate the source location. In the FDTD computation, the line source current is assumed and ionospheric model is also adopted.

As a result, if we assume the source locate under the ground, the simulation results suggest the possible current source should locate at the depth d less than 0.5 km in the point of view of the observed amplitude.

In 2007, the anomalous transient changes are also detected simultaneously in the geomagnetic data at the sites in Boso Peninsula. We assume these signals are not generated under the ground, but there are signals from ionosphere, which are observing in the limited areas. These sources are local source in Boso Peninsula.

However, the anomalous transient changes which are generated under the ground by electric current are detected at September.11, 2007. This means the possibility of underground water channel which is independent of the crust activities.