Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SEM033-04 Room: 301B Time: May 26 14:30-14:45

Development of a joint 2-D inversion method for Wideband-MT and Network-MT methods

Yoshiya Usui[1], Makoto Uyeshima[1*], Tsutomu Ogawa[1], Yasuo Ogawa[2]

[1]ERI, the University of Tokyo, [2]Volcanic Fluid Research Center, TITEC

In the conventional Wideband MT method, there exist two main problems. Since observation duration is at most several weeks, it is sometimes very difficult to obtain longer period data (longer than 10^3 s) especially in the noisy areas. This results in difficulty in poor resolution of the deeper structures. Another problem is the static shift. Due to existence of lateral small-scale inhomogeneity near the surface, electric field measured by the short dipole (typically 100m) is distorted by some factor depending on the lateral contrast of the inhomogeneities. Thus the MT apparent resistivity is also distorted, while phase of the MT impedance is not affected by the static effect. Since the apparent resistivity value determines intensity of the resistivity values in the structure to be estimated and thus typical scale length of the structure, unless we correctly estimate the static shift level, we cannot estimate the correct resistivity structure.

With the Network MT method, where the electric field averaged over several km span is measured by using the metallic telephone lines, above two problems can be alleviated owing to the long observation duration and the long electrode spacings (Uyeshima et al., 2001). However, since artificial noise is significantly contaminated in the electric measurement, it is often difficult to obtain the short period data (typically of periods shorter than 10s). This results in poor resolution in the shallower fine structures.

In order to alleviate above problems inherently existing in the both methods, we try to develop a 2-D joint inversion scheme combining both the conventional Wideband MT and the Network MT datasets.

The new scheme is based on the 2-D ABIC inversion code for the conventional Wideband MT (Ogawa and Uchida, 1996). Main modifications are computation of the electric field averaged over the long dipoles in the forward part and computation of sensitivities based on the averaged electric field in the inversion part. After developing the Network MT part, we combine forward and inversion parts for both the conventional MT and the Network MT responses.

As a synthetic test, we put small scale conductive anomalies just beneath the wideband MT sites in addition to a regional structure. By the forward part, we could ascertain that the apparent resistivity of the conventional Wideband MT contains static shifts, whereas the apparent resistivity of the Netowork MT and the phase of both MT methods are not affected by the near surface small scale structure.

Then we tried to invert synthetic responses from above synthetic model to examine whether we can obtain the true regional structure. Only by the conventional Wideband MT method, we could not obtain the true regional structure, although static shift as well as model resistivity values were estimated in the inversion. The results showed that overall resistivity value is lower than the true regional model and typical scale length is shorter than that of the true model.

With the aid of the new scheme, where no static shift in the Network MT data is assumed and static shift parameters for the Wideband MT data is estimated as model parameters, we can successfully obtain the true regional model. We also applied the new scheme to real datasets around the Niigata-Kobe tectonic zone.

Keywords: 2-D resistivity structure, joint inversion, wideband MT, network MT