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Electrical resistivity imaging in Eastern Japan Sea deformation zone

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Shonai-Shinjo area in Eastern Japan Sea deformation zone which shows many active faults triggering large inland earthquakes has been thought as a good field for study of active tectonics (e.g. Sato and Amano, 1991). In this study, we performed magnetotelluric survey in the Shonai-Shinjo zone to reveal electrical conductivity distribution, which gives important constraint to estimate crustal fluid and geological distribution around earthquake zones (e.g. Utada, 1987; Ichihara et al., 2008).

We obtained MT data long the survey line across the fault zone to image 2-D conductivity structure; however, they shows 'anomalous phase' data which distort MT data and complicates to apply conventional 2-D inversion. Ichihara and Mogi (submitted) indicated that this distortion is induced by three-dimensional distribution of surface conductor (Tertiary sediments beneath Shinjo Basin and Shonai Pain and seawater in the study area). Thus, we firstly assessed how the three-dimensionality of the area affects the observed data using 3-D forward modeling. As a result, we found that TM mode data are not seriously distorted by the 3-D effect. Therefore we imaged 2-D conductivity distribution using TM mode data.

The inverted resistivity distribution shows conductive zone corresponding to tertiary sediment in Shonai Plain and Shinjo Basin, and relatively resistive zone in the Dewa Hill area. The conductivity gap between Dewa Hill and Shonai Plain correspond to the Eastern Shonai Plain active fault zone. In addition, our conductivity image support the hypothesis of inversion tectonics suggested around the Eastern Japan Sea region. These results indicate that conductivity imaging by magnetotelluric survey can contributes to reveal tectonic records as well as seismic surveys.

In addition, we found conductive region within the Eastern Shonai Plain active fault zone. The conductor is possibly extended more than 7 km deep. Because fault zone conductor is thought as an important constraint of creep and lock behavior in major faults (e.g. Unsworth and Bedrosian, 2004, San Andreas Fault), precise imaging by additional survey is required.

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