On 3-D resistivity structure in the SW part of Shikoku-Island, SW Japan, and sensitivity of the Network-MT responses to the structure

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In the Bungo channel region at the western margin of the Nankai megathrust rupture zones, the long-term slow slip events (SSE) repeatedly occurred about every 6 or 7 years and we are now having the most recent event. The SSE also activate deeper episodic tremors and slips (ETS) on the plate interface. In order to examine mechanism of the SSE and/or concurrent ETS activities, especially to clarify influence of interstitial fluids on occurrence of the events, or to detect movement of the fluids associating with the events, we have started the Network-MT survey in the western part of the Shikoku Island facing the Bungo channel since April, 2016.
We use metallic telephone line network of the Nippon Telegraph and Telephone Corp. to measure the electrical potential difference with long baselines of from several kilometers to 10 and several kilometers. We selected 17 areas in the western part of the Shikoku Island and installed 3 or 4 electrodes in the respective areas. The electrical potential differences measured in this way are known to be less affected by small scale near-surface lateral resistivity heterogeneities (e.g. Uyeshima, 2007). We also measure the geomagnetic field at two stations in the target region. With the aid of the BIRRP code (Chave and Thomson, 2004), we could estimate the frequency-domain response functions of good quality. After applying the 3-D DASOCC inversion code (Siripunvaraporn et al., 2004), which directly invert the Network-MT response between the voltage difference on each dipole and the magnetic field, we could obtain the 3-D resistivity structure in the target region. Data from Apr. to May, 2016 are used. Site (dipole) and period numbers are respectively 53 and 10 (from about 20 s to 10,000 s). Grid sizes of the model are 60 (NS), 57(EW) and 45 (vertical). We started from an initial model of uniformly 100 Ohm-m in land portion and sea water is fixed to be 0.3 Ohm-m. The initial RMS was 12. We got a model with RMS 2.42 on 5% error floor.
First, cross sections along lines in NNW-SSE with and without the slow slip events are examined. The most remarkable low resistivity anomalies are detected in the middle crust of the hanging wall of the subducting Philippine Sea slab in all the cross-sections. As was often pointed out in the previous studies (e.g. Hata et al., 2018; Ichihara et al., 2014), earthquakes also in this region tend to occur in the resistive area avoiding those low resistivity anomalies. Due to existence of this shallower crustal conductive anomalies, however, it was difficult to resolve resistivity distribution along the subducting slab. No remarkable conductive anomaly could be imaged in both of the areas with and without the slow slip events. In order to clarify the relationship between the resistivity structure and the slow slip area, plan view conductivity distributions parallel to the slab surface are examined and compared with the seismic Qp structures (Kita and Matsubara, 2016). Some positive correlation between both parameters can be detected. Mantle wedge above the slab with the slow slip event is relatively resistive and high Qp. On the other hand, mantle wedge above the slab without the slow slip event is relatively conductive and low Qp. The resistive and high Qp layer may indicate an impermeable layer which confine the fluids along the subducting slab. The confined fluids may cause slow slip events, although the fluids could not be explicitly imaged as the conductive anomaly. We also want to show temporal variation of the Network-MT responses.
As was written above, significant slow slip event occurred recently. Then, we want to show how the Network-MT responses are sensitive to temporal resistivity change along the slab. In a test model, 10 km

thick conductive layer is assigned just beneath the top surface of the slab. The resistivity is set to be 20 Ohm-m (thus 500 S anomaly). RMS of the best fit model was 2.42, whereas 3.65 for the test model. Decrease of the apparent resistivity and increase of the phase value in the relatively higher frequency range can be detected.

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