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Comparison of one-dimensional electrical conductivity models along East Asia Continent to Northwestern Pacific

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Many seismic tomographic studies (e.g. Fukao et al, 2001) showed that subducting Pacific plate stagnates in the mantle transition zone (MTZ) beneath East Asia continent (EAC) and Japan Sea (JS). A large amount of the thermal and chemical heterogeneity yielded by this stagnant slab is expected to influence the mantle dynamics or mantle convection. Recent studies attempt to estimate the thermal and chemical heterogeneity combining various kinds of geophysical parameter models in the upper mantle (e.g. Shito & Shibutani, 2003; Matsukage et al., 2005). The use of electrical conductivity as well as elastic parameters improves the estimation of the hydrogen dissolution in the nominally anhydrous minerals, which drastically changes the viscosity or strain rate of the fundamental factor in the mantle flow. Our final goals are (1) to obtain the electrical conductivity distribution and (2) to estimate the thermal and chemical heterogeneity around the stagnant slab using the electrical conductivity structure as well as seismic structures around the stagnant slab beneath EAC and JS. In this study, we show one-dimensional electrical conductivity structures along EAC - JS - Japan Island Arc - Northwestern Pacific (NWP), and reveal the characteristic of electrical conductivity of the stagnant slab comparing with that in the laterally adjacent MTZ.

Electrical conductivity structures are estimated by joint analyses of magnetotellurics (MT) and geomagnetic depth sounding. Four observation sites locate on land (EAC: 2; Japan Island: 2) and the other sites are on the seafloor (JS: 4; NWP: 2). The land electric field data were acquired using long baseline telephone line cables (Uyeshima et al, this session). The seafloor data were collected in temporary observations using ocean bottom electromagnetometers. The electromagnetic response functions are well determined up to 10 powered 6 seconds in period. The MT phase response functions at EAC increase at longer period (about 5 x 10 powered 5 seconds) than those at JS and PAC. This feature implies that the stagnant slab is relatively resistive. We adopted Occam (Constable et al., 1987) and Rho+ (Parker & Booker, 1996) inversions to estimating one-dimensional conductivity structure. In the upper mantle (200-400 km in depth), the electrical conductivity beneath EAC shows monotone increasing as increasing depth, while those beneath JS and NWP indicate complicated electrical conductivity distributions. In terms of MTZ, conductance delta function at about 400 km in depth corresponding to the MTZ is below 10 powered 5 S beneath EAC but over 10 powered 5 S beneath JS and NWP, respectively. Occam models show the electrical conductivity beneath EAC is about 0.03-0.3 S/m in the MTZ and that beneath JS and NWP is over 1 S/m. These results suggest that electrical conductivity of the stagnant slab is apparently resistive comparing with that in the laterally adjacent MTZ.