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Characteristic resistivity structure in and around the deep low-frequency tremors area inferred from the MT method

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Deep low-frequency tremors and short-term slow slip events, which were found in some subduction zones such as the Nankai trough (Obara, 2002; Hirose and Obara, 2005), are considered to be related with the dehydrated water from the subducting plate (e.g. Shelly et al., 2006; Matsubara et al., 2009). In order to further reveal the characteristics of phenomena caused by the dehydration reaction, we conducted the resistivity survey with wideband magnetotelluric (MT) method at the western Shikoku region, and revealed the following two characteristic structures (Yamashita and Obara, 2009): (I) low-resistivity zone (~10 ohm-m) lying beneath the survey line with the depth from ~5 to 20 km; (II) rather high-resistivity pillar cutting across the conductive layer (I). These characteristics of resistivity structure are consistent with the seismic velocity structure estimated by Matsubara et al. (2009). Under the assumption that the low-resistivity in the area (I) is caused by the pore water including some salts, we calculated the pore-water's resistivity using the seismic data by Matsubara et al. (2009) based on the analytical model by Takei (2002). The calculation suggested that the pore-water's resistivity was extremely low (Yamashita and Obara, 2009). In this study, we also estimated the pore-water's resistivity at the various points, and investigated the distribution. The analytical results show that the pore-water's resistivity ranges 10^{-2}-10^{-1}ohm-m at the depth of 10-15 km, and 10^{-1}-10^{0}ohm-m at the depth of 20 km. Comparison between the estimated distribution and the calculated water's resistivity profile by Nesbitt (1993) suggested that the pore-water in the region (I) needs salinity higher than that of sea water, if we assume that the low-resistivity of pore-water is caused by only dissolved salts. However, if we consider that the low-resistivity is derived from the dissolved CO_2, the resistivity can be explained by the general amount of CO_2. In addition, the relative increase in pore-water's resistivity at the depth of 20 km can be also explained. Therefore, pore-water in the region (I) should contain $CO_2$and salts. We also investigated the horizontal distribution of pore-water's resistivity. Although the resistivities at the same depth are almost constant, they decrease just above the tremors area. This characteristic becomes remarkable at depth. From these results, we conclude that $CO_2$and salts are diffusing from the tremors area toward the shallow and surrounding region. This idea is consistent with the fact that the waters derived from the mantle are sampled at the various points at Shikoku region (Dogan et al., 2006).

Keywords: Deep low-frequency tremor, Slow slip, Subduction zone, Resistivity, Magnetotelluric method