Three-dimensional resistivity modeling around the Hyuga-nada area

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Pore fluid is one of the key factors in earthquake occurrences including slow earthquakes (e.g., Warren-Smith et al., 2019; Obara, 2020). However, the role of pore fluid in earthquakes is not clear since its distributions are unknown especially deep subsurface in the subduction zones. Because electrical resistivity is sensitive to fluid, exploring the resistivity structure is a great tool to detect pore fluid. To understand the relationship between fluid and earthquakes, we estimated 3-D resistivity structures around the Hyuga-nada area, where both regular and slow earthquakes occur in the plate interfaces.
3-D resistivity modeling was performed based on marine electromagnetic records observed by Ocean Bottom Electro-Magnetometer in the Hyuga-nada and Network-MT record in the eastside of Kyushu Island. Because no inversion code handing both marine MT impedances and Network-MT response functions has been developed, we converted Network-MT response functions to the ordinary MT impedance tensor. Moreover, correction matrixes computed from model impedances were conducted in the inversion analysis and they were updated for each iteration. The initial model incorporated oceanic topography and a conductive sediment layer was created for inversion to avoid wrong structures estimation due to strong distortion of topographic effect (e.g., Baba and Chave, 2005) and coast effect (e.g., Key and Constable, 2011).
As the result of joint resistivity modeling, we obtained the 3-D resistivity model explaining the observed responses marine and Network-MT response functions. The inverted model showed the resistive anomaly around the plate interface and the conductive anomaly mainly inside the oceanic plate, which were consistent with the slip area of the 1968 Hyuga-nada earthquakes (Yagi et al., 1998) and the occurrence region of slow slip event (Takagi et al., 2019), respectively. We also founded the conductive area around the subducting region of Kyushu-Palau Ridge (Yamamoto et al., 2013). These resistive and conductive regions are considered to correspond to poor and rich regions for pore fluid, respectively. It is likely that pore fluids are mainly caused by dewatering from and/or dehydration reactions of the subducting slab.

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