Electrical resistivity modeling in megathrust earthquake regions of hot and cold subduction margins along Japan Island Arc

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SUMMARY

Physical properties around subduction interfaces strongly depend on characteristic of an incoming plate. Because physical properties control the occurrence of megathrust earthquakes, understanding of structural variation between subduction zones is essential. In this study, we compared electrical resistivity distributions around the megathrust earthquake regions in the two different types of subduction zones in the Japan Island Arc, the Tohoku-oki area (cold/old Pacific plate is subducting) and the Kumano-nada and Hyuga-nada area (hot/new Philippine Sea plate is subducting). These resistivity models were obtained based on the marine magnetotelluric investigations.

The mega-thrust earthquake region in the Tohoku-oki area, where the resistive Pacific Plate is subducting, is basically resistive. On the other hand, a conductive region is revealed in the shallowest edge of the subduction interface where the huge coseismic slip of the 2011 Tohoku-oki earthquake occurred (Ichihara et al., 2023). The former resistive and latter conductive areas are interpreted as low and high porosity areas, respectively, suggesting that pore fluid controls the fault slip behaviour. The Hyuga-nada area, where the relatively conductive Philippine Sea plate is subducting, is known as a region where various type of slow earthquakes and regular earthquakes occur. Our resistivity model shows low and high resistivity areas in the slow and regular earthquake areas, respectively. They also imply heterogeneous pore fluid distribution that possibly affect the fault slip behaviours.

Keywords: subduction interface, megathrust earthquake, marine EM, magnetotelluric