Seafloor electromagnetic investigations of the upper mantle of the Mariana back-arc spreading and subduction system

*Tetsuo Matsuno[1,2], Nobukazu Seama[2,1]

1. Kobe Ocean Bottom Exploration Center, Kobe University, 2. Department of Planetology, Graduate School of Science, Kobe University

The Mariana back-arc spreading and subduction system in the western Pacific is an obvious place to image the plate-subduction and the back-arc spreading processes, as it has a well-developed frontal arc, active arc volcanoes, and a slow-spreading back-arc ridge. There still remains unknown mechanisms with related to the release of water from the subducting slab, the subsequent melting of the mantle, and the delivery of melt to the surface in the Marianas system, as well as their relevance to surface processes such as asymmetric back-arc spreading and hydrothermal activities. Two seafloor electromagnetic transects imaging with ocean bottom electro-magnetometers (OBEMs) at the central and the southern Marianas (at 18°N and 13°N, respectively) have clearly unveiled electrical resistivity structures of the upper mantle in each area. The structures and their comparisons place constraints on thermal structure, a region of partial melting and the amount of melt existing within the region, the amount of water and melt in source mantle, and mantle upwelling. One crucial contrast between the two structures is found under the back-arc spreading ridge axis; resistive (>300 ohm-m) in the central Marianas and conductive (10-30 ohm-m) in the southern Marianas. This occurs even though the full spreading rates of the back-arc ridge are almost same (20-40 mm/yr at 18°N and ~45 mm/yr at 13°N, respectively), and provides insights on the amount and distribution of in-situ melt, the mantle upwelling process, and the influence of the plate-subduction on the back-arc spreading process. Implications and comparisons of other structural features will be presented in details.

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