Evolution of oceanic core complexes in the Shikoku Basin: when backarc basins cease to open

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How and why backarc basins cease to open is one of the unsolved questions in plate tectonics. The Shikoku Basin is a typical backarc basin, that was formed behind the proto Izu-Bonin arc and stopped opening at ca.15 Ma. The post-spreading volcanism has formed a series of seamounts along the remnant spreading axis in the northern basin, whereas multiple oceanic core complexes have developed just before the spreading stop in the southern basin. Oceanic core complexes (OCC) are exposed lower crust and/or upper mantle materials along detachment faults, that are supposed to develop when melt supply rate M (=magmatic accommodation / plate separation) is around 0.5. The OCC is, therefore, a good indicator for temporal variation of melt supply when the backarc system died. During Yokosuka YK18-07 and Hakuho-maru KH-18-02 cruises in 2018 summer, we conducted the geophysical mapping (multibeam bathymetry, scalar and vector magnetics, and gravity) of an OCC at 23°50’ N, 138°50’ E in the southernmost Shikoku Basin and its adjusting areas. The OCC is tentatively named Mado Megamullion. We compiled these new datasets and previously collected data and analyzed detailed bathymetry and magnetic and gravity anomalies. In this presentation, we show the results and discuss the structure and evolutionary process of this OCC and its implications for demise of backarc opening system.

The Mado Megamulliion is about 20 km square domed high, located at the intersection of remnant ridge segment and transform fault. Its surface is characterized prominent corrugations parallel to flow lines. The mantle Bouguer anomaly is about 20mGal higher than the surroundings. This observation is consistent with the fact that high-density gabbro and peridotite samples were recovered both by Shinkai6500 dive in YK18-07 and dredge hauls in KH-18-02. A part of recovered rock samples show the deformation structure, suggesting that the surface of this OCC is a detachment fault surface. Magnetic anomaly distribution shows generally linear, positive and negative bands over the OCC as same as in the well-ordered abyssal hill area, suggesting continuous crust formation from ridge segments. The widths of lineations are, however, longer at the OCC, indicating clear asymmetric spreading during detachment faulting. The spreading asymmetry is often observed over world OCC areas. The equivalent magnetization value seems to be positively shifted, that may suggest the effect of induced magnetization of OCC massif. The result of vector magnetic field analysis shows clear, strong and ridge-parallel magnetic boundaries in well-ordered abyssal hill areas, that is consistent with normal seafloor spreading and block model. In contrast, the clear, systematic magnetic boundaries don’ t exist. The estimated three dimensionality is not so strong. Within the rift valley south of the Mado Megamullion, a small domed high with high Bouguer anomaly exists. This is likely NTO (non-transform offset) massif, previously reported along mid-ocean ridges. Another corrugated surface is observed at neighboring segment, that shows typical detachment surface morphology but are not accompanied by gravity anomalies.
The structure and evolutionary process of the Mado Megamullion and the adjacent OCC-like massifs infer the temporal variation of melt supply on the final stage of backarc opening. Multiple core complexes including world largest Godzilla Megamullion are distributed along the Parece Vela Rift, south of the study area. The integrated analysis of these OCCs is a key to understand the demise of backarc systems.

Keywords: backarc opening, oceanic lithosphere, oceanic core complex