Submersible magnetics reveals relationship between off-axis volcanism and hydrothermal systems of the Kairei and Yokoniwa fields at the Central Indian Ridge

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The Kairei (KHF) and Yokoniwa hydrothermal fields (YHF)are hosted in mafic as well as ultramafic rocks distributed at an off-axis volcanic knoll of the Central Indian Ridge. Despite intensive investigations, their geological and geophysical background is still debated. Here, we show the results of near-seafloor magnetic anomaly surveys conducted using a submersible. We investigated the bulk magnetization of the hydrothermally altered zone and the surrounding lava flows and evaluated their intensities compared with previously reported values at axial areas of seafloor spreading environments. The KHF is characterized by low coherence between observed and modeled anomalies and low values of magnetization. This result suggests that magnetic minerals within basaltic lava flows were likely altered by hydrothermal fluid circulation. The variation pattern in the observed magnetic anomalies above the lava flows is in phase with that of the modeled magnetic anomalies for the simple assumption that the magnetization direction is parallel to the geomagnetic field. This result suggests that these lava flows preserve normal magnetic polarity corresponding to the Brunhes Chron. The estimated magnetic-anomaly-derived absolute magnetizations (MADAM) show a reasonable correlation with the natural remanent magnetizations of rock samples collected from the seafloor of the same region; their relationship is consistent with previously reported datasets from the Mariana Trough and Mid-Atlantic Ridge. The estimated MADAM intensity reaches 20 A/m in the study area, which is clearly greater than those of previously reported off-axis areas, suggesting that recent volcanic eruption may have occurred in these off-axis areas. The high magnetization distributions are commonly observed at the bottoms of the western slope from the KHF and YHF. This finding provides new insight into the distribution of highly magnetized lava flows in the off-axis areas and indicates the distribution of recent off-axis volcanic activities, which is potentially linked to the sub-seafloor hydrothermal circulation.

Keywords: Central Indian Ridge, Seafloor hydrothermal system, Near-seafloor magnetic anomaly