Submersible Magnetics for Understanding Off-axis Volcanism and Hydrothermal Systems of the Central Indian Ridge

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Hydrothermal circulation within oceanic lithosphere is a fundamental process in mid-ocean ridges, and it essentially affects the solid-Earth cooling, ocean temperature, and material cycles. The Kairei and Yokoniwa hydrothermal fields are located at an off-axis volcanic knoll of the Central Indian Ridge, and known as their unique geological background where both mafic and ultramafic rocks are involved. Despite intensive investigations, their geological and geophysical background is still debated. Here, we show new results of near-seafloor magnetic data obtained by the submersible Shinkai 6500. We investigated crustal magnetization of the hydrothermally altered zone and surrounding off-axis lava flows, and evaluated their intensities compared to previously reported values at axial areas of seafloor spreading environments. The Kairei hydrothermal field 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 modeled magnetic anomalies for a simple assumption with a magnetization direction parallel to the geomagnetic field. This result suggests that this lava flows preserve normal magnetic polarity corresponding to the Brunhes chron. The estimated magnetization intensity reaches 20 A/m in this area, which is clearly greater than that of previously reported off-axis areas. This study provides new insight into the distribution of highly magnetized lava flows and indicates the distribution of recent off-axis volcanic activity, which is potentially linked to sub-seafloor hydrothermal circulation.