

Hydrogen-enriched black smoker venting on a basaltic edifice within a non-transform offset (NTO) of the slow-spreading Central Indian Ridge

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Diverse styles of hydrothermal activity along the slow spreading ridges reflect variations in rock types, heat sources, and faulting associated with detachment settings. These include high temperature (>300 °C) hydrothermal systems driven by cooling magmas and/or variable mixtures of gabbro and peridotite, as well as low- to moderate-temperature hydrothermal activity resulting from the cooling of ultramafic and mafic lithosphere, which has been reported in both slow- and ultraslow-spreading ridges. Along the middle section of the Central Indian Ridge (8°S-16 °S), which exhibits typical slow-spreading ridge morphology, several hydrothermal vent sites have been identified, particularly in off-axis ridge settings. During the MI2023 expedition aboard RV ISABU by KIOST, a new vent site, SAERO, was discovered at a plume-only location situated at the southern end of an extended non-transform offset (NTO) between segment 3-1 and segment 3-2. Plume signals suggest high temperature venting with ultramafic-influenced characteristics, as indicated by a high CH₄/dissolved Mn ratio. However, the volcanic edifice hosting the SAERO vent site is composed of basaltic pillow lava with no observed ultramafic and gabbroic rocks. The SAERO site comprises several high temperature black smokers with a maximum venting temperature of 360 °C. Preliminary gas analysis of vent fluids reveals substantial H₂ concentrations in the end-member fluid, comparable to values observed in ultramafic-influenced hydrothermal systems such as the Rainbow and Von Damm hydrothermal fields, despite the site being located on basalt. The high H₂ abundance suggests hydrothermal fluid reaction with ultramafic rocks in the seafloor before discharge. However, fluid-basalt reactions occurring at very high temperatures cannot be ruled out, as seen in the case of Piccard hydrothermal vent field. The discovery of the SAERO vent site expands our understanding of geodiversity of hydrothermal venting along slow-spreading ridges and highlights the complexity of seafloor fluid-rock interactions in these environments.