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In-situ direct measurement of hydrothermal flow rate along the Central Indian Ocean Ridge (9-16º S)

HEEJUN KIM, WONNYON KIM, JONGUK KIM, JIHOON KIM, SEJIN JUNG, CHANG HYEON SEO AND HEUNGCHAN KIM

Korea Institute of Ocean Science & Technology

Accounting for more than two-thirds of global volcanic activity and emitting ten times the volume of hydrothermal fluids compared to arc or back-arc systems, mid-ocean ridges and their hydrothermal systems play a significant role as crucial conduits for the transfer of heat and materials from the geosphere to the hydrosphere.[1] Additionally, the reducing environment of slow-spreading centers facilitates the active release of hydrogen and methane, along with mantle-derived helium, through interactions between the geosphere and hydrosphere.[2] While the composition of hydrothermal fluids from mid-ocean ridges has been relatively well documented, their quantitative flux has only been reported for select locations, including the East Pacific Rise, Juan de Fuca Ridge, and segments of the Mid-Atlantic Ridge.[3][4][5]

Here, we present the first direct measurements of discrete hydrothermal flux from the Central Indian Ridge, obtained during the 2024 expedition aboard R/V ISABU, utilizing the Remotely Operated Vehicle (ROV) CSSF-ROPOS. Fluid discharge rates were measured at 10 orifices across six hydrothermal fields using a mechanically operated stainless steel flowmeter in combination with high-resolution imaging data.[6] The flow velocity was calibrated in a circulating water channel(CWC) using an acoustic doppler velocimetry. Moreover, we aim to assess discrete material and heat fluxes by integrating these measurements with helium, hydrogen, and methane concentrations from hydrothermal plumes measured in 2023 expedition. This study provides high-resolution flux data, enhancing our understanding of material transport in deep-sea hydrothermal systems.

[1] Sigurdsson *et al.* (2015) *The encyclopedia of volcanoes*. Elsevier/AP. [2] Früh-Green *et al.* (2022) *Nat Rev Earth Environ.* **3,** 852-871. [3] Converse *et al.* (1984) *Earth Planet. Sci. Lett.* **69**, 159-175. [4] Rona *et al.* (1992) *Earth Planet. Sci. Lett.* **109,** 57-71. [5] German *et al.* (2010) *Deep-Sea Res. Part I-Oceanogr. Res. Pap.* **346**, 118-133. [6] Germanovich *et al.* (2015) *JGR Solid Earth.* **120**, 8031-8055.