Mega-scale interaction among seafloor-hydrothermal activity-ecosystem: tectonics of southern Central Indian Ridge

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The interaction between biosphere and lithosphere plays important role in evolution of earth and life. Along mid-ocean ridges, especially through hydrothermal system, rocks / fluid / ecosystem are interacted each other and form an integrated system. The interaction ranges from micro-scale to mega-scale (segment scale-several tens to hundreds kilometer) and here we focus on mega-scale interaction where the tectonic setting controls or constraints the hydrothermal activity and / or the ecosystem developed there. We need to have two different points of view: 1) the linkage of present-day ecosystem and its geological environment, and 2) the continuity and diffusion of ecosystem in larger scale tectonic setting and tectonic evolution.

Recent findings in ultramafic hosted hydrothermal vent system along the Mid-Atlantic Ridge is an example of the former linkage. We present here another good example in the southernmost Central Indian Ridge.

The Central Indian Ridge (CIR) is categorized into intermediate spreading systems and its southern end forms a R-R-R triple junction with SWIR and SEIR. The southern CIR shows slow-spreading morphology, where the axial valley develops along the ridge crest and an oceanic core complex has been reported near the southernmost segment. Two hydrothermal fields were reported in southern CIR, Edmond and Kairei. Edmond field is located in the northern end of CIR segment 3, which is approximately 160 km from the triple junction, and is considered as usual basalt-hosted hydrothermal field. The Kairei hydrothermal field is located near the triple junction and shows unique character in its hydrogen rich fluids and unique ecosystem. The vent is surrounded by normal basalt lava, but an exhumation of lower crust/ mantle (maybe small scale oceanic core complex) was discovered about 15 km behind (off-axis) the hydrothermal field. The existence of olivine-gabbro and peridotite in shallower part of the crust may lead to serpentinization of these rocks through seawater circulation and contribute to form unique hydrothermal fluid in Kairei field. At the opposite side of the Kairei field another oceanic core complex was reported near 25S. The existence of oceanic core complexes indicates that the southernmost CIR has experienced avolcanic, melt-starved spreading phase in recent 1 m.y. The other part of the ridge and its off-axis are generally characterized with well-organized abyssal hills, so the unusual avolcanic setting near the triple junction may be related to the eastward propagation of SWIR where the melt starved spreading is attributed to the underlying cold mantle. The unique ecosystem of the Kairei hydrothermal field seems to be explained by geochemistry of rock/fluid interaction and by tectonic setting at present. But, when we consider the longevity of hydrothermal field (10-100 year?), the similar tectonic setting and ultramafic hosted hydrothermal vent should exist in longer time scale to sustain the ecosystem, that is still unknown.