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The Geological Setting of the 14.0°S Hydrothermal Field (Mid-Atlantic Ridge) and Its Comparation with Other Inside-corner Related Fields

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High inside corners at ridge-discontinuity intersections at slow-spreading ridges are the favorable off-axial settings for hydrothermal activities(Kelley et al., 2001; Fouquet et al., 2010). At least 5 fields had been identified to be occurred at these special highs: the Menez Hom and Saldanha are fields occurred at ridge-non transform offset intersections, while Lost City, 12°50′N (North Mid-Atlantic Ridge) and the newly-discovered 14.0°S (South Mid-Atlantic Ridge) are fields occurred at ridge-transform intersections (Fouquet et al., 2010; Li et al., 2014).

Early found hydrothermal-fields related to inside corners with variably metamorphosed ultramafic rocks on the corrugated surfaces are all interpreted as detachment faults and related Oceanic Core Complex (OCC). As for the 14.0°S field, it has a rough seafloor topography and is interpreted as having a volcanic origin. The 14.0°S field, which hosted in gabbroic-basaltic material differ from those occurring on OCCs, its special tectonic properties and host rocks are the most fundamental differences from other inside-corner related fields.

Nearly no inside corner-related hydrothermal fields show relationships with axial magma chambers. As for the ultramafic-host fields, serpentinization reactions, mantle upwelling, and cooling of shallow gabbroic bodies within ultramafic rocks (Allen and Seyfried, 2004; Lowell et al., 2010) are all likely to bring potential heat supply for hydrothermal convection. In contrast, the 14.0° S hydrothermal field is largely driven by cooling of gabbroic-basaltic substrates, especially the deep high-temperature intrusive bodies.

As for fluid pathways, active detachment faults act as the prominent channel for the other 4 fields, shallow tectonic fractures which connected with the deep detachment faults made up the upper pathway networks. However, as for 14.0° S field, a subsurface inactive detachment fault was speculated to act as deep fluid pathway, while some high angle normal faults developed in the volcanic high were also speculated to be the main fluid channel. Differences between heat sources and fluid channels were the direct reasons for the special off-axis mineralization model of 14.0°S field.

Unlike the 14.0°S field, the other inside corner related fields were all lack of abundant heat storage which makes it impossible to drive large-scale high-temperature hydrothermal convections. These fields are as a result characterized by low-temperature hydrothermal conditions. lack of sulfides. However, the 14.0° S hydrothermal field, been driven mainly by deep high-temperature gabbroic bodies, is characterized by high temperature massive sulfide deposits, besides, the sulfide in this field is generally rich in siliceous gangue minerals which is closely related to the gabbroic-basaltic substrates, however, the occurrence of significant silica-rich gangue minerals is rare in the previous four fields.

Though 14.0°S hydrothermal field occurred on mafic rocks, the oceanic crust suffered from strong off-axis tectonic cracking events, leading to the elevated crust permeability and corresponded large 3-dimensional spatial range of release area. Hydrothermal upwelling are mainly diffusive flows and the formed mound-stock work complex thus shows weak vertical zonation, which show some similarities with ultramafic-hosted hydrothermal fields.

All five fields were associated with different evolution period of the OCC, but different types of hydrothermal systems could be related to different stages in OCC evolution, as for the 14.0S field, it could be associated with a later stage: post-evolution of an OCC, because the driving force originates from axial magmatism enhancement, which may play a key in leading to the termination of previous OCC.

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