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Lucky Strike: is it a TAG (Trans-Atlantic Geotraverse) precursory hydrothermal system?

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Abstract

Lucky Strike hydrothermal field is located in Mid-Atlantic Ridge (MAR - 37ºN), in the Azorean plateau, southwest of the Azores islands. In the areas surrounding the active sites, the alteration processes affecting basaltic rocks are prominent and form hydrothermal breccias by the circulation of low temperature hydrothermal fluids in diffuse vents. These breccias are found near the vents and play an important role in the protection of subseafloor hydrothermal sulphide deposits forming an impermeable cap due to the high content in siliceous material. The forms of silica are mostly amorphous and precipitate when the fluid is conductively cooled. The process evolves gradually from an initial stage where there are just basaltic fragments and circulating seawater. The ascending hydrothermal fluid mixes with seawater, which favours the precipitation of the sulphide components (namely pyrite, chalcopyrite and sphalerite), also found in the breccias. Sealing of the initially loose fragments begins, the temperature rises below this crust, and the processes of mixing fluid circulation and conductive cooling are simultaneous. At this stage the fluid becomes oversaturated with respect to amorphous silica. This form of silica can precipitate in the open spaces and seal the system. Once the fluid is trapped under this impermeable layer, conductive cooling is enhanced and mixing with seawater is restricted, making the precipitation of amorphous silica more efficient.

TAG Hydrothermal Field is also on the Mid-Atlantic Ridge (26°N), characterized as one of the largest sites of high-temperature hydrothermal activity found on the seafloor and is comprised of active and relict deposits in different stages of evolution (Humphris *et al.*, 2015). The system lies on basaltic oceanic crust as Lucky Strike.
Recently some intensive work has been developed in TAG (Murton *et al.*, 2019). Combine observations based on surface geology and sub-seafloor drilling found, among other hydrothermal deposits, superficial (just below pelagic sediment) layers of dense jasper, several meters thick, that transitions downwards into massive brecciated sulphides. In the jasper samples overgrowths of sulphides, often comprising euhedral pyrite and minor chalcopyrite, were observed.
If the jasper formation is a result of silica precipitation from low temperature, diffuse hydrothermal venting that has resulted in silicification of pre-existing iron-rich sediments, the TAG jaspers are a late stage deposit on fading hydrothermal systems (Murton *et al.*, 2019). The location of the jasper layer immediately above the massive sulphides suggests it acts as an impermeable barrier protecting from the contact with seawater.

It is remarkable the similarity with the ancient seafloor massive sulphide deposits studied in geologic record. Siliceous rocks, as jaspers, were found in the hanging wall of the ore bodies from the Iberian Pyrite Belt some decades ago. Barriga & Fyfe (1988) proposed a protecting role for these jaspers, saving the underlying ore bodies from oxidation.

In conclusion, the highly silicified breccias seems to show a precursory stage of the jasper material recovered from the inactive seafloor massive sulphide deposits from the TAG hydrothermal field. Although the content in iron is lower in the Lucky Strike breccias when compared with TAG jaspers, both have high contents in silica. They both seem to form an impermeable barrier protecting the lower sulphide deposits from the contact with seawater, but in different stages of evolution.
Comparative geochemical and petrographic works must be done to draw more accurate conclusions about these two MAR important hydrothermal systems.

Keywords
Seafloor Hydrothermal breccia; Jasper; Silicification

References

Barriga, F J A S, and Fyfe, W S (1988). Giant pyritic base-metal deposits: the example of Feitais (Aljustrel, Portugal). Chemical Geology, 69: 331-343.

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Humphris, S.E. *et al.* (2015). The Trans-Atlantic Geotraverse hydrothermal field: A hydrothermal system on an active detachment fault. Deep Sea Res. Part II 121, 8–16. (https://doi.org/10.1016/j.dsr2.2015.02.015).

Murton B J *et al.* (2019). Geological fate of seafloor massive sulphides at the TAG hydrothermal field (Mid-Atlantic Ridge). Ore Geology Reviews, Volume 107, pages 903-925 (https://doi.org/10.1016/j.oregeorev.2019.03.005).

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