Geochemistry of Fe-Si-(Mn) chimneys from Luso vent field, MAR

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Luso hydrothermal field was recently discovered during BlueAzores2018 cruise on the eastern slope of the Gigante seamount, Mid-Atlantic Ridge (MAR). At a depth of 570 m, low temperature and translucent fluids vent through well-developed ochre-colored chimneys hosted in basaltic rocks.

Here, we present major, trace and rare earth elements (REE) composition of Luso chimneys. Chimneys are formed by loose and poorly crystalline material dominated by Fe-oxyhydroxides and amorphous Si (Fe_2O_3 + SiO_2 ~72 wt%), showing a clear concentric zonation: (I) the inner wall (lining the vent orifice) is white in color and composed mainly by amorphous Si (Si/Fe = 142); (II) the intermediate zone, ochre in color, is a mixture of the material from the adjacent walls with patches of olive-green clay-like material, and with higher Fe and lower Si concentrations than zone I (Si/Fe ~7); (III) the outer wall, also ochre in color, is clearly enriched in Fe-(Mn)-oxyhydroxides (Si/Fe ~0.5). Although with low concentrations, Mn recorded higher values in zone III than in II [$(Fe/Mn)_{III}$ ~474; $(Fe/Mn)_{II}$ ~177), denoting a hidrogenetic origin for this element. S, Cu, Zn and Pb have overall negligible concentrations but higher contents in S, Cu and Zn were recorded in the intermediate zone and inner wall. Other trace metals, such as P, V, Cr, Co, Ni, As, Mo and ∑REE, are particularly enriched in the outer wall, indicating seawater-scavenged processes by oxyhydroxides. REE patterns lack Ce and Eu anomalies, although slightly negative anomalies (Ce/Ce* ~0.91; Eu/Eu* ~0.92) recorded in the outer wall confirms a larger contribution of seawater in its mineral formation. In the internal zones, a weakly positive Eu anomaly (~1.1) revealed the contribution of a higher temperature hydrothermal fluid in the chimney mineralogy, with a lower seawater/hydrothermal fluid ratio.

These geochemical variations indicate that Luso chimneys were formed through inward growth with an accompanying decrease in wall permeability and in the seawater/hydrothermal fluid-mixing ratio.