Volcanic facies architecture, hydrothermal alteration and subsea-floor replacement at the Neves Corvo deposit, Iberian Pyrite Belt

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The Volcanic-Sedimentary Complex (VSC) of the Iberian Pyrite Belt consists of an Upper Devonian to Lower Carboniferous submarine succession, which consists mainly of mudstone and felsic volcanic facies.

Three felsic volcanic sequences constitute the host succession to the Neves Corvo VHMS deposit. The lower volcanic sequence (late Famennian) consists of a rhyolitic fiamme-rich facies association that comprises polymictic and overall graded quartz-phyric fiamme breccia units (up to 60 m thick). These units have pyroclastic origin and constitute the substrate to the rhyolite facies association (intermediate volcanic sequence). The rhyolite facies association (late Strunian) comprises intervals of coherent quartz-feldspar-phyric rhyolite (up to 10 m thick) that are enclosed by much thicker intervals (up to 250 m) of jigsaw-fit and clast-rotated monomictic rhyolite breccia. Laterally these breccias grade to beds of monomictic rhyolite breccia that alternate with crystal-rich sandstone. The units defined by the rhyolite facies association are rhyolitic lavas. The massive sulfide orebodies (late Strunian) directly overly the lavas or are interleaved with relatively thin (up to 50 m) intervals of mudstone. The upper volcanic sequence (early Visean) consists of a thin interval of monomictic dacite breccia. The host succession to the Neves Corvo orebodies thus comprises proximal to source vent deposits from submarine explosive and effusive eruptions. However, the ore-forming process relates both in time and space with the rhyolitic lavas, which are coeval with the mineralization.

Neves Corvo is well known for its high-grade Cu ores and unique cassiterite mineralization. Ore-related hydrothermal activity overprints an early metasomatic stage and relates with a multi-sourced hydrothermal system, responsible for early stringer and massive cassiterite deposition and subsequent massive sulfide ore-generation. In the Corvo orebody, the early deposition of massive cassiterite ores was fed by an independent stockwork in a tectonically-bounded alignment. Textural and petrographic analyses, geochemistry and oxygen-isotope data indicate brusque flushing of the tin-bearing fluid into seawater after minimal fluid-rock interaction during up flow.

Massive sulfide-related hydrothermal alteration is essentially stratabound and controlled by permeability contrasts. Alteration zonation is classical, consisting of an inner chlorite/donbassite-quartz-sulfides-(sericite) core that grades into sericite-quartz-sulfides-(chlorite) and paragonite-quartz-sulfides-(chlorite) peripheral envelopes. The aluminous hydrothermal alteration mineralogy coupled with elemental and stable isotope geochemistry indicates very low pH, unusually high maximum interaction temperature and predominant low-sulfidation alteration/mineralization conditions. Textural and mass-balance analyses show extensive silicate-sulfide replacement in the coherent volcanic rocks of the footwall sequence, and disseminated replacement mineralization in the volcaniclatic/sedimentary units.
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