Competency-Controlled Copper Mineralization at the Onganja Mining District, Namibia

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The Onganja Mining District, Namibia, comprises several subvertical breccias and stratiform massive sulphides. These orebodies are reported to have formed during the late phases of the Pan-African Damara Orogen (ca. 517 Ma); a period contemporaneous with significant copper deposition within the African Copper belt.

The ore and alteration assemblages bear some similarity to iron oxide-copper-gold deposits; however, geochemical analyses and monazite age-dating data suggest that biotitisation was related to metamorphic processes, while REE enrichment significantly postdates the sulphide mineralisation. Likewise, magnetite trace-element chemistry and whole-rock chemistry are distinct from that of typical IOCG deposits. In addition, based on field and petrographic analyses, the controls on mineralisation appear to be related to specific lithologies and structures associated with D_3 folding.

Both the subvertical breccias and massive sulphides have spatial relation to a N-S–trending quartz-albite vein system. The subvertical breccias, however, are limited in strike along the system but show regional occurrences along lithological strike. Furthermore, old workings have a near-ubiquitous occurrence of biotite-scapolite schists with lenses of amphibolite as country rock to both the breccias and massive sulphides.

Structurally, three phases of folding are recognised within the mining licence. Shearing occurred along an axial-planar foliation that developed with the third phase of folding, while the fold hinges of F_1 and F_2 are preserved within lenses enveloped by the shears. Jointing is restricted to these lenses and has comparable orientations to that of the vein system. Furthermore, veins show brecciation and displacement when intersected by these shears, with breccias in more pelitic units being barren.

As such, lithological and structural data suggest that the ore-forming fluids migrated through the axial-planar shears, mobilising sulphides from the amphibolites, before escaping upwards through structures that formed in the more competent veins and schist lenses.