

Geology, Mineralization, Geochemistry, Geochronology, and Ore Potential of Cu Deposits, Central African Copperbelt: A Review

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The Central African Copperbelt is the most mineralized Neoproterozoic basin on Earth, preserving a spectacular scale of Cu mineralization with 8.7 billion tons of ore reserve grading at 2.6% Cu. Deposits occur within stratigraphic layers of Mines-Kitwe and Mwale subgroups, as stratiform and vein-type deposits with ore zoning consisting of chalcocite + bornite + chalcopyrite outward to chalcopyrite and then to pyrite. Chalcocite is common within the Congolese orebodies, whereas chalcopyrite is the main ore mineral of the Zambian deposits. The $\delta^{34}\text{S}$ sulfide values (-28 to +29‰) of Cu sulfides display lighter sulfur isotopes in the Congo part (-14 to +2‰) and become heavier within Zambian deposits (-16 to +23‰). The heavy $\delta^{34}\text{S}$ values (-2 to 25‰) are consistent with the $\delta^{34}\text{S}$ data of Cu-veins (-4 to +23‰) and host granitoid (+3.5 to +10.9‰). The $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values (-23.1 to +8.7‰, -1.8 to -28.0‰) of carbonate from ores are consistently lighter than sedimentary host carbonate values, implying the oxidation of organic matter during carbonate deposition. $^{206}\text{Pb}/^{204}\text{Pb}$, $^{207}\text{Pb}/^{204}\text{Pb}$, and $^{208}\text{Pb}/^{204}\text{Pb}$, with μ between 9.44 and 10.66, suggest multisource of ore. The dating data fall within a ca. 670–490 Ma window, yielding two major spectra at ca. 670–645 Ma and 540–490 Ma for early stratiform and late vein stages of Cu mineralization.

Virtually, the Lufilian orogeny (ca. 600–465 Ma) may have strongly influenced the Cu deposits in the Central African Copperbelt, particularly in the Zambian deposits. The Copperbelt displays a prograde metamorphic trend varying from the prehnite-pumpellyite facies in Congo to greenschist-amphibolite facies in Zambia. The metamorphic process during orogeny may have led to metal redistribution characterizing the Zambian deposits. Common features include large ore reserves but relatively low grades (averaging 1.9% Cu versus 2.7% Cu in Congo), chalcopyrite as the main Cu sulfide, and heavy $\delta^{34}\text{S}$ values for sulfides.