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A Metamorphosed Proterozoic Carbonaceous Shale-Hosted Co-Ni-Cu Deposit at Kalumbila, Kabompo Dome: The Copperbelt Ore Shale in Northwestern Zambia

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Abstract

The Kalumbila Co-Ni-Cu prospect (12°15' S, 25°20' E) is located ~300 km west of the Zambian Copperbelt on the southeastern flank of the Kabompo dome in the Middle Unit of the Lufilian arc. Kalumbila contains a drill-indicated resource of ~3.04 Mt at 0.67 wt percent Ni, 0.2 wt percent Co and 0.11 wt percent Cu using a 0.08 wt percent Co and ~0.3 wt percent Ni cutoff with an average thickness of 12.75 m. Ni-Co-Cu mineralization occurs as strata-bound, disseminated to finely laminated (locally semimassive) to locally discordant chalcopyrite, pyrrhotite, violarite, and siegenite within a finely laminated, highly carbonaceous and pyritic metapelite (300–500 m thick). Surface rock exposure in this low-relief terrain of woodland and seasonal swamp is <1 percent and geophysics (magnetic and electromagnetic surveys) is an essential exploration tool.

Detrital zircons in the Kalumbila metasediments (SHRIMP U-Pb ages of 2004–1884 Ma) are derived from the underlying Paleoproterozoic granitic gneiss such as that exposed in the adjacent Kabompo basement dome. The metasedimentary sequence grades upward from siliciclastic rocks (mica schists) to the carbonaceous metapelite, which hosts the Co-Ni-Cu. These units are overlain by dolomitic and Mg-rich schists (possible meta-evaporites) which are, in turn, succeeded by calc-silicate rocks and a deformed diamictite. This sequence is broadly similar to the stratigraphy in the Zambian Copperbelt and suggests that the Kalumbila carbonaceous metapelite may be the chronostratigraphic equivalent of the Katangan Roan Ore Shale, a significant exploration target.

Kalumbila occurs within a moderately (40°) north- northwest-dipping band of Wamikumbi Formation carbonaceous metapelite on the flank of a recumbent, south-southeast–verging F_1 or F_2 back fold. During the Lufilian orogeny, peak metamorphic conditions at F_1 were of amphibolite facies grade (~650°C, 13 kbars). Both monazites and rutiles within the Kalumbila metasediments have metamorphic characteristics and late orogenic, Lufilian, SHRIMP U-Pb ages (548.6 ± 7.6 Ma and 531 ± 21 Ma, respectively). Sulfides in the metasediments display metamorphic textures and, therefore, predate the peak of Lufilian tectonism and thermal metamorphism. A suite of spatially associated, apparently late Lufilian gabbros intrude the metasedimentary rocks. These gabbros are unmineralized, but the thermal effects of their emplacement may have modified ore distribution. A genetic model, in which synsedimentary pyrite in a carbonaceous pelite was partially replaced by syndiagenetic or metamorphic Co-Ni-Cu-bearing fluids of unknown origin, is favored.

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