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Geometallurgy of Cobalt from Secondary resources from Kalyadi Copper -Cobalt Mines , Dharwar Craton for clean energy transition

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The Kalyadi copper deposit is located in Dharwar Craton, India, stands out as a notable magmatic copper sulfide deposit enriched with cobalt. One of India's earliest known Copper-Cobalt occurrences, Kalyadi was exploited solely for copper, which reaches concentrations up to 1%. Reported cobalt reserves total 5.8 million tons at a cut-off grade of 650 ppm. Initially mined for copper, operations and ceased due to volatile copper prices. Abundant fresh ore, accessible from 400 meters underground, remains in mine tailings and dumps, rich in copper sulfides. Reported cobalt reserves total 5.8 million tons at a cut-off grade of 650 ppm. Yet, research on this deposit has been limited, with prior studies emphasizing copper mineralization and its genesis. The preliminary chemical analyses reveal cobalt levels up to 3000 ppm, mainly locked in pyrite, while the primary copper mineral, chalcopyrite, hosts up to 95 ppm. Cobalt is interlocked into pyrite's crystal lattice, without distinct cobalt mineral phases in most cases . Elevated cobalt—up to 2000 ppm—occurs in pyrite-chalcopyrite zones within quartzite and metavolcanic rocks. Despite this potential, little geometallurgical work has characterized the mineralogy and petrology of cobalt-bearing sulfides or identified primary host minerals. The key primary sulfides include cobaltite as the main host, with minor safflorite (hosted in pyrite associations). The previous scientific studies estimated copper ore resources at 0.54% Cu, based on GSI and KCC data, classifying it as low-grade and pyrite-rich. This underscores Kalyadi's untapped strategic value in mine tailings for geometallurgy of cobalt, vital for modern technologies, warranting renewed exploration. we conclude that a potentially significant future source of cobalt is secondary resources such as mine tailings from Kalyadi will suffice critical mineral need in India.