Gold Targeting at the Kalimva Deposit, Kibali Gold District: Hydrothermal Alteration Vectors Interpreted from Multi-Approach Analyses

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Explorationists use hydrothermal wall-rock alteration haloes to vector gold-mineralised veins or structures because of their limited thickness. These alteration haloes may be orders of magnitude greater than narrow auriferous veins and may indicate major mineralogy changes or more subtle "cryptic" alterations to wall-rock mineral chemistry. Thus, wall-rock alteration halo investigations are becoming mineral exploration guides.

The Kalimva gold deposit is located in the northern part of the Kibali gold district in the Neo-Archean Moto greenstone belt in the Democratic Republic of Congo. The deposit comprises a complex ore system that poses substantial challenges for exploration targeting. The main ore-bearing structures are hosted in metamorphosed volcanic and volcaniclastic sequences. This work used multi-element analysis of 1,140 samples from eight drill holes and 2,183 shortwave infrared (SWIR) spectra to map lithologies and fluid–wall-rock alteration envelopes. The selected samples underwent detailed petrography and scanning electron microscopy analysis with energy dispersive spectrometry to corroborate the data sets.

The results indicate that the distal and medial zones of the alteration halo are characterised by MgFe-rich chlorite, phengite, epidote, and hornblende. In contrast, rocks proximal to ore mineralisation have been altered to Fe-rich chlorite with minor Mg and FeMg-chlorite, calcite, and muscovite. This is supported by the SEM chlorite chemistry, which shows low Fe/(Fe+Mg) ratios in medial locations to mineralisation and higher ratios for samples proximal to the ore zone. In these analyses, lithological continuity was well constrained using immobile trace element measurement from the whole-rock geochemistry data set. Assay results highlight a strong correlation between gold and Fe-enriched mineral parageneses. These insights suggest an addition of Fe into the wall rock during the main gold mineralisation event; a finding which holds potential value for gold exploration targeting. This study thus demonstrates the effectiveness of integrating SWIR spectroscopy, petrography, and geochemical analyses for Au mineralisation vectoring.