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The Kibali (KCD) Orogenic Gold Deposit: Gold Without Quartz Veins

Doug MacKenzie[1], Andrew Allibone[2], Carlos Vargas[3], Etienne Mwandale[3], Joel Holliday[3]
1. University of Otago, Dunedin, New Zealand, 2. Rodinian(NZ) Ltd, Wanaka, New Zealand, 3. Barrick Gold Corp, Toronto, ON, Canada

The Kibali (KCD) orogenic gold deposit in northeast Democratic Republic of the Congo is one of the largest gold deposits in Africa with a current gold resource of >16 Moz and 2020 production of 808 Koz. The deposit is hosted in the Kibali Greenstone Belt in a package of sedimentary, volcanic, and porphyritic intrusive rocks that were deposited and emplaced between ca. 2629-2625 Ma and then metamorphosed to lower greenschist facies. The metasedimentary rocks were deposited as part of an extensional basinal succession that was subsequently compressed and complexy folded between ca. 2625-2610 Ma. This coincided with generation of late metamorphic gold-bearing fluids that were focused along the basinal margin, forming a 60-km-long regional shear zone known as the KZ Trend.

The deposit is hosted within polymict conglomerates, sandstones, siltstones, black carbonaceous shales, BIF, and chert that interacted with these fluids and were extensively hydrothermally altered and mineralized. A notable feature of the deposit is the lack of fracture-controlled vein mineralization and the dominance of Au-bearing disseminated sulphides which have locally replaced host lithologies.

Mineralized zones are developed within and along the margins of folded Fe-rich BIF, fractured chert rocks, and in carbonaceous shears that developed along the margins of deformed black shales. Economic zones within the deposit are termed the 3000, 5000, 9000,11000, and 12000 lodes and are centred on a series of discrete, locally contiguous folded zones (Fig. 1). The lodes are controlled by and plunge parallel to fold axes of km-scale, NE-plunging, tight to isoclinal folds. In general, lodes hosted within the hinges of fractured cherts are smaller and more rod-like than the more voluminous BIF-hosted lodes which are more curviplanar where they extend around fold hinges and for short distances along limbs.

Rather than a large fracture-feeder system where mineralizing fluids have overwhelmed the host rocks and dominated the chemistry of the deposit, gold-bearing fluids at Kibali permeated along pervasive axial planar foliation and subparallel microshears, and the resultant mineralization and alteration assemblages are strongly controlled by the host lithologies. Sericite-ankerite-pyrite has replaced metamorphic chlorite-muscovite-calcite ± epidote in the metaclastic rocks, sericite-pyrrhotite-pyrite has replaced metamorphic sulphides in graphitic chert and carbonaceous rocks, and siderite-magnetite-pyrite has replaced metamorphic magnetite and Fe-carbonate in BIF. Gold occurs predominantly as microparticulates in the cores of disseminated pyrite grains and pyrite in mm-scale sulphide veinlets. Some gold-bearing sulphides have been remobilised along the margins of post-mineral, intermediate to mafic dykes where they cut across pre-existing mineralized zones. Arsenopyrite is less common and typically occurs as disseminations and rare sulphide veinlets within a distinctive polymict conglomerate horizon in structurally lower parts of the sequence. Mineralized rocks are locally overprinted by a later crenulation cleavage and subsequent generations of more brittle, cataclastic shears and faults that are barren.

Figure 1. A) Geological map with location of the Kibali mine and the Kibali Greenstone belt in NE, DRC. B) Geological plan map of the KCD open pit and location of the cross section. C) Representative cross section through the KCD deposit showing mineralized lodes.