The Kibali ‘orogenic’ gold deposit, NE Democratic Republic of the Congo: Investigation of a world class gold resource*

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The Kibali ‘orogenic’ gold project, located within the Neo-Achaean Kibali granite-greenstone belt of NE Democratic Republic of Congo is one of the most significant gold projects under development in the world. The principle deposit, the Karagba-Chauffeur-Durba (KCD), constitutes 70% of a total resource of 22.4Moz at 3.25g/t. Gold production began in Quarter 4 of 2013 and produced 88koz by end of year 2013.

Three major terranes are identified in the project area: the Neo-Achaean Kibali granite-greenstone belt (2.63-2.64Ga), the Upper Zaire Granitic massif (2.62-2.67Ga) and the Proterozoic West Nile Gneiss. The Kibali granite-greenstone belt is an east-west trending elongate feature that consists of thrust stacked volcano-sedimentary units, carbonaceous shales, banded iron formations, and sub-aerial basalts. These are intruded by numerous igneous bodies that range from granite to gabbro in composition. Metamorphic grade is variable across the belt, increasing progressively from sub-greenschist in the west to amphibolite facies in the east. Two major structural components have been identified that deform the Kibali terrane: early ductile NW-SE trending NE-dipping thrusts and backthrusts (S1) and a later set of sub-vertical NE-SW semi-brittle anastomosing shear structures (S2), interpreted as lateral ramps, dividing the area into a series of mineralized corridors and associated with the development of mineralization.

Mineralization within the KCD and its satellite deposits occurs as NE-dipping tabular lodes which laterally steepen into the sub vertical (S2) structures. Mineralization is hosted within packages of greenschist facies volcano-sedimentary conglomerates which have been highly deformed with deformation increasing proximal to mineralized shear structures. Two pre-mineralization alteration events have been identified with early texture destructive silica (Q1) overprinted by ankerite/siderite (A1). Both events vary from poorly developed distal, to texture destructive proximal to mineralization. Mineralized micro-veins, associated with semi-brittle reactivation of the S2 structures, cut the Q1 and A1 phases forming coarse silica (Q2) and Ankerite/siderite (A2). Late alumino-celadonite mica (M1) and chlorite (C1) form minor alteration phases commonly concentrated along the interface between Q1/A1 and Q2/A2 zones. Seven distinct styles of mineralization are identified with cross-cutting brecciated veins, intraclast micaceous shears and disseminated sulphide masses strongly associated with Au mineralization. Pyrite, arsenopyrite, chalcopyrite, and pyrrhotite are the dominant sulfide phases, the relative proportions of which vary significantly between individual deposits although pyrite 2 is the most abundant phase and shows the strongest correlation with primary Au mineralization in all cases. Au mineralization occurs as rounded sub-micron to millimeter size occluded particles. A secondary Au phase occurs as late fracture filling interpreted as a remobilization of the primary Au during late fracturing. δ\textsubscript{34}S analysis of pyrite from the KCD and satellite deposits range from -1.4 to +7.5‰ with an average of +4.4‰. Deposits are internally heterogeneous although all deposits have a similar spread of δ\textsubscript{34}S data.
The Kibali deposit is interpreted as having formed within a thickening thrust stack that underwent metamorphic devolatilization at depth. Fluids generated through this process scavenged Au as they ascended through the S1 and S2 structures, depositing it in chemically favorable clastic packages in a single district wide event.