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Structural controls on geometry, continuity and mineralisation for the Kamoa-Kakula deposits of the Western Foreland shelf domain of the Central African Copperbelt

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The Central African Copperbelt (CACB) is contained in the Katangan basin, an intracratonic rift straddling Zambia and the Democratic Republic of Congo (DRC). Rifting commenced at ~840 Ma, characterised by episodic pulses of extension and rapid sediment accumulation, followed by periods of gradual sediment accumulation and near basin-wide evaporite sheet accumulation.

Mineralisation occurred when a copper-bearing fluid passed up through an oxidized aquifer to interact with a reducing horizon. In the DRC sector, laterally extensive salt sheets prevented this process occurring until halokinetic modification allowed deeper-level brines and possibly downward percolating brines access to the intrasalt stratigraphic levels to interact with reducing horizons, principally the carbonate and siltstones of the Mines Subgroup deposited during the latter stage of the initial rift phase. The second phase of rifting marked an abrupt transition to sub wave-base sedimentation during the Mwashya Subgroup, before deposition of a distinctive glaciogenic diamictites of the Nguba Group equated with an age of ~740Ma.

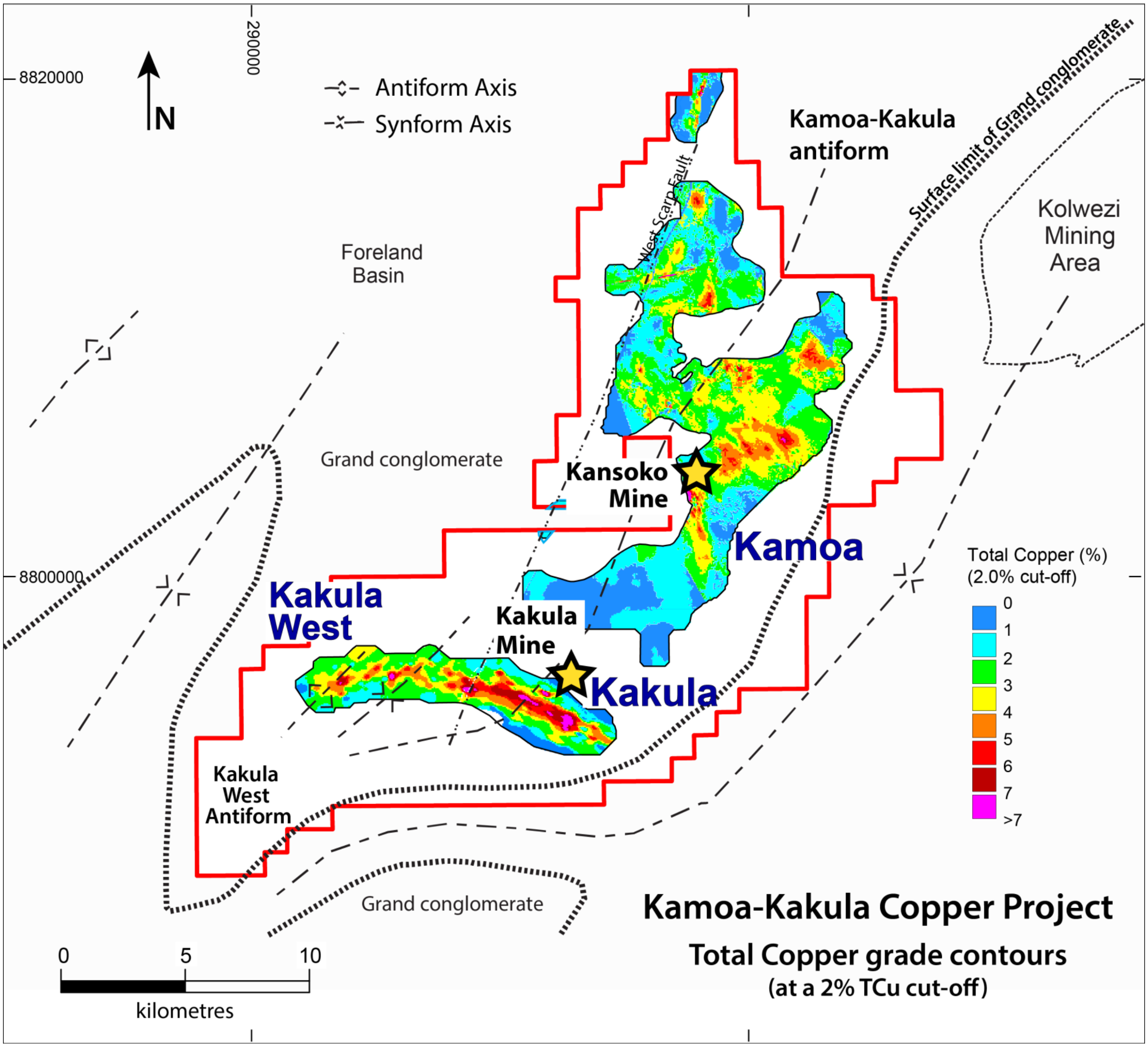
Occurring outside the traditional limit of the CACB, Kamoa-Kakula occurs in a much higher stratigraphic position at the base of the Nguba Group. It occupies a salt-marginal position within the Western Foreland shelf domain, is relatively undeformed, and thus much easier to reconcile the fundamental control exerted by the rifting geometry.

Aquifer quality exerts a fundamental control on fluid flow. At Kamoa-Kakula, the Mwashya Subgroup (R4.2) is a medium to coarse grained subarkose, with variable proportions of siltstone and conglomerate. Textural changes within the R4.2 can be abrupt suggesting they are controlled by local rift architecture. These facies can locally be linked to facies changes in the overlying Nguba sediments, suggesting that fundamental sub-basin-bounding elements were inherited and multiply reactivated through these depositional periods.

The Nguba marks a transition to deposition under largely reducing conditions, with a combination of diamictite units and laterally discontinuous sub-basin-controlled siltstone and sandstone units. Rift climax events are marked by strongly sulfidic intervals within two laterally continuous, siltstones (the Ng1.1.2 and Ng1.1.4), the Ng1.1.4 marking the uppermost pyrite-rich siltstone. Overlying diamictites can be pyritic due to ingestion of the upper portion of the siltstone during emplacement, redistributing primary sulfide.

There is strong evidence for structural controls on mineralisation. The distribution of copper remains fundamentally controlled by the interplay of hydrologic and redox architecture; principal sulfidic hosts formed in isolated sub-basins would have required very particular, but very subtle fault configurations, ensuring sediment starvation and hydrological proximity to the aquifer, whilst also amplifying permeability and connectivity within the aquifer.

Faults can be discontinuous with variable offset and reflect the complex interplay of the WNW Monwezi, ENE Kansuki and NNW Manika regional structural influences. These fundamental elements were multiply reactivated throughout lower Nguba sedimentation, influencing thickness and facies variation, giving each deposit unique characteristics.



8820000
290000
8800000
N
Antiform Axis
Synform Axis
Kamoa-Kakula antiform
Surface limit of Grand conglomerate
Kolwezi Mining Area
Foreland Basin
West Scarp Fault
Grand conglomerate
Kansoko Mine
Kamoa
Kakula West
Kakula Mine
Kakula
Kakula West Antiform
Grand conglomerate
Total Copper (%) (2.0% cut-off)
0
1
2
3
4
5
6
7
>7
0
5
10
kilometres
Kamoa-Kakula Copper Project
Total Copper grade contours
(at a 2% TCu cut-off)