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Pan-African structural evolution of Paleoproterozoic basement gneiss and Cu-Co mineralized shear zones in the Domes Region of the Lufilian Belt, Mwombezhi Dome, Zambia

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A B S T R A C T

In the Domes Region of the Lufillian Belt, world-class stratiform Cu (± Co, ± Ni, ± U, ± Pb, ± Zn) deposits are closely associated with tectonized pre-existing basement unconformities, *viz.* the pre-Katanga-basement décollement (KD). In the KD footwall on the Mwombezhi Dome, the Lumwana Mine exploits mineralization within < 60 m thick, laterally-extensive shear zones beneath kilometer-scale thrust sheets of Paleoproterozoic gneiss and schist. New field data and structural analysis highlight preferential strain localization, kinematics and sequential reactivation of multiple shear zone generations ($D_{1\text{-}3}$) under high- to medium-grade, metamorphic conditions and clockwise P-T-t path during the Lufillian Orogeny (*ca.* 550-500). Regional, progressive, top-to-the-NNE fore-thrusting is assigned to D_1, while D_2 represents localized, opposite, top-to-the-SSW kinematics attributed to under-thrusting by dome-scale fore-thrusted basement slivers. Subsequent D_3 shear zones transposed $D_{1\text{-}2}$ structures and represent overall top-to-the-NNE extensional detachment and NNE-SSW-elongation along a maximum principal extension axis (L_3) which defines kilometer-scale shear- or asymmetrical-boudins of competent gneiss in the KD footwall. A pre-existing NNE-SSW prolate dome asymmetry ($L_{1\text{-}2}$) dictates a downlimb-directed sense of shear on the short axes of D_3 asymmetrical boudins (WNW-ESE). D_3 shear zones are preferentially localized along relict pre-Katanga anisotropy and $D_{1\text{-}2}$ mylonitic horizons, while Cu–Co bearing ore shoots are associated with passive fold hinges in these asymmetrical boudin necks.

1. Introduction

The Lufillian Belt, encompassing the Central African Copperbelt, forms part of the Pan-African orogenic system that hosts the world's largest known endowment of stratiform Cu (± Co, ± Ni, ± U, ± Pb, ± Zn) deposits (Cailteux et al., 2005; Selley et al., 2005; Muchez et al., 2015). The Lufillian Belt (or Arc) has a distinct, *ca.* 900 km long, north to north-northeast convex geometry and straddles the border between the southernmost Katanga Province of the Democratic Republic of the Congo (DRC) and the Copperbelt and northwestern Provinces of Zambia. Regionally, the belt is divided into five tectono-metamorphic domains from south to north: namely the (1) Katanga High, (2) Synclinorial Belt, (3) Domes Region, (4) External fold-and-thrust belt and the (5) Lufilian Foreland (Porada, 1989; Cosi et al., 1992; John et al., 2004a; Selley et al., 2005) (Fig. 1). These domains preserve a broad, south-to-north decrease in metamorphic grade from upper amphibolite to lower greenschist facies, typifying the transition from hinterland to foreland (Selley et al., 2005).

Extensive research on the Copperbelt provides insight into ore mobilization and regional-scale geological and metallogenic processes from *ca.* 540–490 Ma, driven by a protracted orogenic process (Key et al., 2001; Cailteux et al., 2005, 2007; Selley et al., 2005; Kampunzu et al., 2009; Decrée et al., 2011; Turlin et al., 2016; Eglinger et al., 2016 and references therein; Sillitoe et al., 2017). In the Domes Region, significant Pan-African Cu–Co mineralization occurs at various stratigraphic levels but is hosted predominantly within (1) clastic and chemical meta-sediments of the lowermost Roan Group, which constitute the basal part of the Neoproterozoic Katanga Supergroup and (2) reworked pre-Katanga basement gneiss and schist near the margins of regional-scale domes (e.g. Lumwana Mine) (Fig. 1). Cu–Co mineralization is largely attributed to syn-to late-tectonic, hydrothermal fluid-flow (metasomatism) along structures that were associated with either thick- or thin-skinned tectonics (e.g. Porada, 1989; Cosi et al., 1992) or metamorphic core complex formation (Eglinger et al., 2016).

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