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Supplement of

Non-cylindrical parasitic folding and strain partitioning during the Pan-African Lufilian orogeny in the Chambishi–Nkana Basin, Central African Copperbelt

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1 **Supplementary Material S1: Selection of ages of relevant tectono-metamorphic events in the Central African**
2 **Copperbelt**

Age	Error	Authors	What	Dating technique
883	10	Armstrong <i>et al</i> 2005	Nchanga Red Granite A-type	U–Pb SHRIMP on magmatic zircons in cross-bedded Lower Roan quartzite
880	12	Johnson <i>et al</i> 2007	Kafue Rhyolite (likely associated with anorogenic-Nchanga granite)	U–Pb on zircon grains
880	14	Johnson <i>et al</i> 2007	Nazingwe Rhydacite	U–Pb on zircon grains
879	16	Hanson <i>et al</i> 1994; Johnson <i>et al</i> 2007	Emplacement of Kafue rhyolite	U-Pb SHRIMP zircon
877	11	Armstrong <i>et al</i> 2005	Nchanga Red Granite A-type	U–Pb zircon of Nchanga granite
876	10	Johnson <i>et al</i> 2007	Kafue Rhyodacite Tuff	U–Pb on zircon grains
821	51	Muchez <i>et al</i> 2015	Disseminated Cu-Co sulphides in nodules and layers	Re–Os on Cu-Co sulphides
820	62	Muchez <i>et al</i> 2015	Disseminated Cu-Co sulphides in nodules and layers	Re–Os on Cu-Co sulphides
816	62	Barra (2005)	Disseminated and pre-folding veinlet chalcopyrite and bornite at Konkola in COM and dolomites of Upper Roan Group	6 point isochron of Re-Os
787	26	Muchez <i>et al</i> 2015	Disseminated Cu-Co sulphides in nodules and layers	Re–Os on Cu-Co sulphides
765	5	Key <i>et al</i> 2001	Mwashya Group Lwawu lava mafic volcanic rocks	U–Pb SHRIMP zircon
753	8.6	Barron <i>et al</i> 2003	Upper Roan dating of geochemically similar gabbro sills	
745	7.8	Barron <i>et al</i> 2003	Upper Roan dating of geochemically similar gabbro sills in Solwezi area	
735	5	Key <i>et al</i> 2001	Mafic porphyries and breccias in contact with Grand Conglomerate at base of Nguba Group	U–Pb concordia
652	7.3	Decrée <i>et al</i> 2011	Uraninite in Luishia, Shinkolobwe, Swambo, Kalongwe	U–Pb discordia line with concordia intercepts
603	31	John <i>et al.</i> 2005	Recrystallized monazite of Luiswishi	U–Th–Pb on recrystallized monazite of Luiswishi
597	27	John <i>et al.</i> 2005	Recrystallized monazite of Luiswishi	U–Th–Pb on recrystallized monazite of Luiswishi
592	22	Rainaud <i>et al</i> 2005	Metamorphic growth monazite eclogite facies Zambian Copperbelt	U–Pb monazite
585	0.8	Rainaud <i>et al</i> 2005	Metamorphic growth biotite eclogite facies Zambian Copperbelt	⁴⁰ Ar– ³⁹ Ar biotite
583	24	Barra <i>et al</i> (2004); Barra (2005)	Hypogene Cu-Co sulphide mineralisation - early orogenic cf. (Van Wilderode <i>et al.</i> , subm)	Five point Re–Os isochron age with analyses from the Nkana, Chibuluma and Nchanga deposits
573	5	Master <i>et al</i> 2005	Detrital muscovites in Bianco Fm of Kundulungu Group in foreland	⁴⁰ Ar– ³⁹ Ar muscovite

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Age	Error	Authors	What	Dating technique
566	5	Hanson <i>et al</i> 1993	Synorogenic granites	U–Pb
559	18	Hanson <i>et al</i> 1993	Synorogenic granites	U–Pb
556	29	John <i>et al.</i> 2005	Recrystallized monazite of Luiswishi	U–Th–Pb on recrystallized monazite of Luiswishi
538	1.5	Hanson <i>et al</i> 1993	Post-orogenic rhyolite	U–Pb
548	7.6	Rainaud <i>et al</i> 2005	Monazites from Kalumbila, NW Zambia	U–Pb on monazites
532	2	John <i>et al</i> 2004	Whiteschist metamorphism in Kabombpo, Mwombezhi, Solwezi Domes	U–Pb on monazite grains
531	12	Rainaud <i>et al</i> 2005	HP talc-kyanite whiteschist	SHRIMP U–Pb metamorphic monazite
530	5.9	Decrée <i>et al</i> 2011	U-Pb mineralization at Nkana	²⁰⁷ Pb/ ²⁰⁶ Pb ratio and concordant age
529	2	John <i>et al</i> 2004	Whiteschist metamorphism in Kabombpo, Mwombezhi, Solwezi Domes	U–Pb on monazite grains
526	3.4	Barra <i>et al</i> 2004	Mo from late chalcopyrite bearing veins	Re–Os
525	2	John <i>et al</i> 2004	Whiteschist metamorphism in Kabombpo, Mwombezhi, Solwezi Domes	U–Pb on monazite grains
512	17	Rainaud <i>et al</i> 2005	Regional pulse	SHRIMP U-Pb metamorphic monazite
		Cosi <i>et al</i> 1992; Torrealdy <i>et al</i> 2000; Rainaud <i>et al</i> 2002, 2005; John <i>et al</i> 2004	Postorogenic cooling 510 to 463 Ma	Ar–Ar biotite Rb/Sr muscovite and biotite
489.6	2.2	Sillitoe <i>et al</i> 2017	Upper limit of molybdenite ages from deposits and prospects in the Eastern Zambian Copperbelt	Re–Os on molybdenite
519.9	2.1	Sillitoe <i>et al</i> 2017	Lower limit of molybdenite ages from deposits and prospects in the Eastern Zambian Copperbelt	Re–Os on molybdenite

6 Table S1: Selection of ages of relevant tectono-metamorphic events in the Central African Copperbelt

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Supplementary Material S2: List of studied boreholes and sections at Nkana-Mindola

This study (Torremans, field campaign 2012)

Several underground crosscuts and boreholes were studied at Nkana South ($n_{\text{crosscuts}} = 7$, $n_{\text{boreholes}} = 8$), Nkana Central ($n_{\text{crosscuts}} = 2$, $n_{\text{boreholes}} = 2$) and Mindola ($n_{\text{crosscuts}} = 2$, $n_{\text{boreholes}} = 5$) as well as the Nkana South open pit and Mindola Open pit. Boreholes at Mindola are always collared in the top of the Mindola Clastics Formation and drilled at 0° inclination through steeply inclined strata ($60^\circ - 80^\circ$). These boreholes are situated in different parts of the Mindola mine between 1274 m and 1541 m depth relative to the headgear of the shaft at Mindola and lie between two barren areas (Kitwe barren gap and North Shaft barren gap). Production boreholes at Nkana South and Central have variable inclination and a core diameter of 3.3 cm whereas those in Nkana Central and Mindola were 5 cm in diameter. All holes are semi-continuous with recovery $> 90\%$.

- Nkana South Orebody (SOB) open pit
 - Detailed structural mapping of two benches of the north-west-flank of open pit. More general less detailed mapping of other areas in the open pit.
- Nkana South Orebody (SOB)
 - Boreholes:
 - SE797 @ 2880L
 - SE800 @ 3140L $+90^\circ$
 - SE801 @ 3220L
 - SE802 @ 3140L 1230S $+90^\circ$ vertical borehole
 - SE804 @ 3140L $+10^\circ$
 - SE805 @ 3140L c. 70S XC $+0^\circ$
 - NS0351 @ 3220L $+2^\circ$, 331° azimuth
 - NS0352 @ 3220L $+10^\circ$
 - Crosscuts:
 - 3460S X/C @ 2260L with pegs T2669 and T2667
 - 473N X/C @ 3220L with pegs T2605, T2601 and T2275
 - 190S X/C @ 3360L with peg T2642
 - 910 X/C @ 3290L with peg T2679
 - 1230S X/C @ 3140L
 - 35S X/C @ 3140L
 - 16S & 60 X/C @ 3140L
- Nkana Central shaft
 - Boreholes:
 - CE0680 100N X/C @ 3140L with $+0^\circ$ inclination
 - CE0675 100S X/C @ 600L with $+30^\circ$ inclination
 - Crosscuts:
 - 1450N XC @ 3280L
 - 480S decline @ 3140L
- Nkana Mindola
 - Boreholes:
 - ME1220 2170N X/C @ 4716L with 2.929° inclination 217.03° bearing with 84.0m length starting from 37611.514mN, 30470.539mE, -205.657m relative to sea level
 - ME1215 1270S X/C @ 5045L with 5.542° inclination bearing 210.541° with 45.0m length starting from 37102.707mN, 31074.402mE and -306.115m relative to sealevel.
 - ME1219 2980N X/C @ 4418L with 4.138° inclination and bearing of 212.732° and a length of 49.0m starting from 37587.338mN, 30343.410mE and -255.636m relative to sea level.
 - ME1221 3900S X/C @ 4370L 45,0m long 0.867° inclination $220^\circ 36' 05''$ azimuth 36607.721mN 31661.337mE starting at -87.133m relative to sea level.
 - ME1224 5150N X/C @ 4180L with 0.504° inclination and bearing of $217^\circ 48' 51''$ and length of 56.5m starting from 38141.523mN, 29728.732mE and -36.606m relative to sea level
 - Crosscuts:

- 3900S #1 X/C @ 4370L
- 2630N #1 X/C @ 4716L

Ellen Clara, An De Cleyn (Muechez *et al.*, 2010)

- Borehole CE570 3660N X/C @ 3760L with +2° inclination 270° azimuth 12°49'43.413"S and 28°11'27.846"E and 113.95 m above sea level with EOH at 484m.
- Borehole CE555 3660N X/C @ 3760L with +4.2° inclination 281.84° azimuth 12°49'43.413"S and 28°11'27.846"E and 113.95 m above sea level with EOH at 292.5m.

Dieter Brems (Brems *et al.*, 2009)

- Crosscuts 90, 162, 794 and 1125 on 3360L
- Petrographic study on NS0168 +0° incl. 3360L, 400.5m NE direction starting from 31690.219N, 33375.967E or 12°51'5.072"S, 28°1151.460"E and 246.699m above sea level.

Supplementary Material S3: Orientation and statistical distribution data

Outcrop	Attitude (mean)	Data	n	β -girdle	π -axis	Shape (K)	Strength (C)
<i>Nkana all own data</i>	230/75	S ₀ -S ₁	226	139/85	319/05	2.48	2.27
<i>Nkana all own + Clara</i> (Clara 2009)	229/73	S ₀ -S ₁	241	139/90	319/00	2.16	2.19
<i>Nkana all own</i>	229/89	S ₂	75			2.51	3.05
<i>Section 1 (MMOP; Clara</i> (Clara 2009))	213/43	S ₀ -S ₁	15			7.07	4.99
<i>Section 2 (Mindola 2630N X/C)</i>	244/60	S ₀ -S ₁	5			3.82	7.03
<i>Section 3 (Mindola 3900S X/C)</i>	052/85	S ₀ -S ₁	7			1.31	7.34
<i>Section 4 (Central 480S decline)</i>	243/76	S ₀ -S ₁	14		328/21	1.23	3.30
<i>Section 5 (Central 1450N X/C)</i>	258/78	S ₀ -S ₁	23		346/08	4.35	2.10
	066/88	S ₂	12		349/81	2.20	3.79
<i>Section 6 (South 910N X/C)</i>	223/78	S ₀ -S ₁	31		313/01	7.26	2.32
	050/83	S ₂	20		321/08	1.74	3.51
<i>Section 7 (South 473N X/C)</i>	041/80	S ₀ -S ₁	26		130/08	1.13	2.80
	311/80	S ₂	8		316/67	1.17	2.93
Section 8 (South open pit)							
zone 1	227/64	S ₀ -S ₁	15				
zone 2	220/81	S ₀ -S ₁	17				
zone 3	225/69	S ₀ -S ₁	8				
zone 4	236/56	S ₀ -S ₁	4				
zone 5	239/47	S ₀ -S ₁	5				
zone 6	237/61	S ₀ -S ₁	26				
zone 1 & 2	223/71	S ₀ -S ₁	32	131/83	311/07	0.69	3.7
zone 2 & 3	222/75	S ₀ -S ₁	25	130/82	310/08	0.65	3.89
zone 3 & 4	228/64	S ₀ -S ₁	12				
zone 4 & 5	239/51	S ₀ -S ₁	9	145/87	325/03	1.48	3.85
zone 5 & 6	237/59	S ₀ -S ₁	31	333/81	153/09	1.01	3.08
zone 4, 5 & 6	237/58	S ₀ -S ₁	35	333/80	153/10	1.14	3.15
<i>South open pit fold train</i>	230/64	S ₀ -S ₁	75	138/87	318/03	1.29	2.96
<i>South open pit fold train</i>	218/84	S ₂	24	218/84			
<i>South open pit fold train</i>	299/08	L ₁ (S ₁ /S ₂)	14				
<i>Section 9 (South 16S-70S X/C)</i>	312/00	S ₀ -S ₁	10	132/90	312/00	0.88	4.16
<i>Section 10 (South 190S X/C)</i>	234/85	S ₀ -S ₁	17		312/66	2.80	2.87
<i>Section 11 (South 1230S X/C)</i>	223/56	S ₀ -S ₁	12		288/33	3.79	3.17
<i>Section 12 (South 3460S X/C)</i>	216/82	S ₀ -S ₁	15		296/51	2.81	3.94

Table S2. Orientation summary data and statistical distribution data for sections at Nkana (cf. Woodcock & Naylor 1983). Location of sections is indicated in Fig. 4. MMOP is Mindola Open Pit; X/C is mine crosscut. The π -axis-to-S₁-cleavage and β -girdle of the S₁-cleavage are only shown where relevant.

Supplementary Material S4: Location of photos

The following latitude and longitude coordinates are in decimal notation.

Fig 6

A -12.8500008, 28.2061363

B -12.8499181, 28.2060447

C -12.8497570, 28.2060380

D -12.8498958, 28.2062498

E -12.7921636, 28.1686772

F -12.7921636, 28.1686772

G -12.8501720, 28.2058390

H -12.8500673, 28.2013898

I -12.8502520, 28.2056520

Coordinates in Figure 7 are only a general approximation (underground)

Fig 7

A -12.8585947, 28.2102315

B -12.8476109, 28.2002014

C -12.8566482, 28.2088054

D -12.8528016, 28.2035765

E -12.8498958, 28.2062498

Photo 9

The photo was taken from approximately -12.853628, 28.208331 looking west.