IRON OXIDE-COPPER-GOLD MINERALIZATION IN THE LUFILIAN ARC OF ZAMBIA AND NAMIBIA

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Large mineral deposits of the iron oxide-copper-gold (IOCG) family are thought to be present in the the Lufilian Arc.

This poster describes evidence of such deposits in the region, including iron oxide bodies and hydrothermal breccias.

IOCG SYSTEMS IN LUFILIAN ARC

IOCG systems on & around granitoid massifs
Widely spread out environments for IOCG development
Massive FeOx bodies formed by replacement + infill of host rocks

Various types of host rocks
- true granites
- syenites
- carbonatites
- quartz "blobs"
- albitized schists
- volcaniclastic deposits
- carbonates

"Pregnant" granitoids produced
- extensive hydrothermal alteration
- and variable FeOx mineralization

especially when intruding reactive rocks

Hydrothermal FeOx bodies found near intrusive contacts.

Many types of mineralization geometries:
- -bx pipes
- -tabular vertical & horizontal breccioid bodies

Most mineralization is accounted for by:
- Subvolcanic intrusive
- main massif apophyses

Close temporal/spatial relationships between FeOx bodies & granitic rocks occur throughout Lufilian Arc.

IRON OXIDE ALTERATION

Photo 1 **Hematite "disease" that overprints a polymictic hydrothermal breccia**. Small round clusters of red hematite nucleate and grow until the entire volume of rock is replaced by minute hematite crystals. Sometimes the previous texture is completely obliterated and original protolith is unrecognizeable. All components of the previous rock have been replaced by a massive, non-selective process. This type of hydrothermal alteration increases towards the IOCG mineralization, and towards the intrusive bodies responsible for the alteration/mineralization. For scale, centimetric lines.

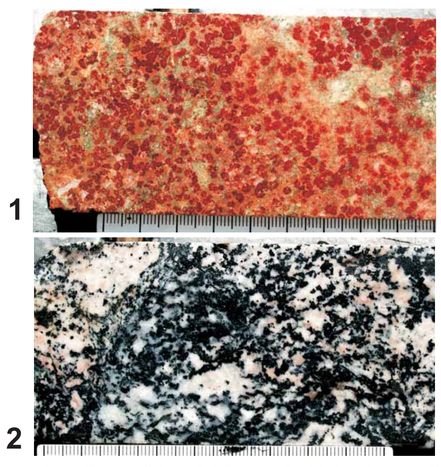


Photo 2 **Magnetite "disease" in a felsic granitoid that is very light pink when fresh**. This is an example of progressive magnetite replacement of silicates near mineralized IOCG systems. For scale, ticks are millimeters. This type of hydrothermal alteration grades from very slight to completely pervasive.

Photo 3 **Progressive "red-rock" hydrothermal alteration in round-pebble hydrothermal breccia**. Fresh rock in the lower core, almost completely red rock in the upper one. Example of hydrothermal iron oxide alteration. It can take place in almost any type of rock, obliterating previous textures and all features. Sometimes previous quartz fractures seem to be leached away and nothing is left behind except for massive red hematite. Core fragments were taken every 3 m to show variation, but a complete continuum occurs in outcrop and core.

HYDROTHERMAL BRECCIAS

Photo 4 **Poly-brecciated polymictic round-pebble hydrothermal breccia.** The large fragment to the upper right of the photograph is composed of round-pebbles and polymictic fragments. It has been rounded itself and makes up a large clast of the new breccia. For scale, millimetric ruler. Taken from a mineralized IOCG system near Kasempa, Zambia.

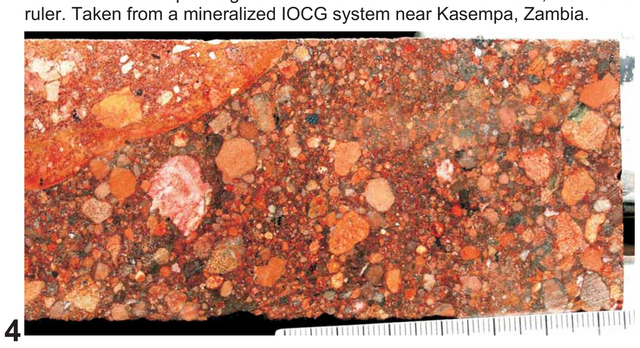
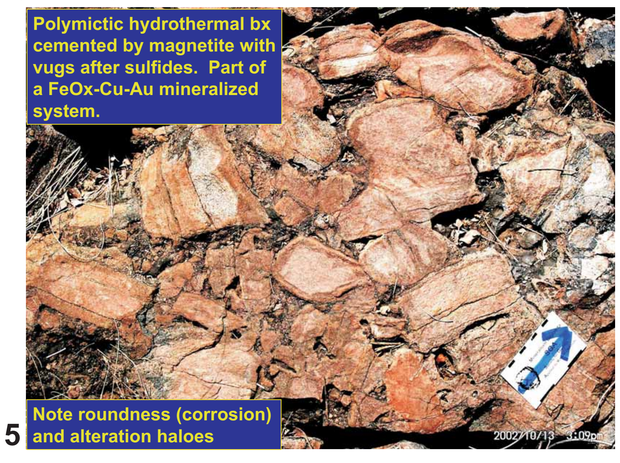


Photo 5 **Polymictic hydrothermal breccia cemented by magnetite that is associated to an extremely explosive IOCG system in the Lufilian Arc.** Note dense fragment packing, their rounding and alteration haloes of iron oxide. Note wide variety of clast types that incude gneiss, bedded volcanic rocks, sandstone, granitoids and schists. Most of the abundant vugs carried sulfides and have been leached. For scale, card with centimeters and inches. This type of rock is like a sponge: an ideal host for mineralization. Slight rounding of clasts is interpreted to have been produced by hyper-alkaline hydrothermal solutions.



Details of selected IOCG deposits and prospects, Lufilian Arc, Africa

Deposit/ Prospect	Tons x10^6	Cu wt.%	Au g/t	Mineralization Styles	Associated Metals	Associated Rocks
Okatjepuiko, Witvlei, Nm	Undim.	Undim. X n.a.	Undim. X n.a.	Ht bxs in subvolcanic porphyritic intermediate rks. FeOx bodies replacing bxs + fracs. Bn rk altn	Cu,Au	Subvolcanic porphyritic intrusions, gabs + felsic intrusions, subrounded ht bxs
Kombat Mine, Nm	~12	~2.94	X n.a.	Large FeOx bodies serve as nucleus for copper sulfs hosted in ht bxs + stwks. Grades of silver and lead: ~20gAg/t,~2%Pb.	Ag,Pb,Mn,Zn,Ba, As,P,Ni,Co	Otjiwarongo Batholith may be source
Otjikoto Au Deposit, Nm	n.a. ****	n.a.****	n.a.****	FeOx nucleation? Coarse free Au, tourmalinization, sheeted vein systems controlled by E-W structures	PGEs,Cu,B	Otjiwarongo Batholith may be source, hosted by albitized metapelites, siliciclastics + carb
Mesopotamie Farm Area, Nm	n.a.	X n.a.	X n.a.	Massive FeOx bodies along E-W structures + sulfidation around them. Ht bxs.	Au,Cu,LREE	Graphic alkali granites intrude other gtds
Dunrobin Au Mine, Zm	~0.002	n.a.	9.3*	Structurally-controlled; FeOx nucleates sulfidation+Au. Diss + replacements in country rks. Qtz+py veins. Replacement FeOx bodies.	Ag,Bi,Mn,Pb,Sb, As	hosted by folded Katangan carb + gtds
Nampundwe Pyrite Mine, Zm	23 (Cu) 10 (Fe)	0.79	X n.a.	Selective mag replacement in folded sedimentary rocks. Specularite-matrix in polymictic multiphase ht bxs associated to gtds.	16% pyrite. 57% Fe	Small bodies of gab +felsic intrusives, mag-bear diorite; lamprophyres
Kasempa Prospect Area, Zm	n.a.****	X n.a.****	X n.a.****	Selective mag replacement in folded sedimentary rocks. Massive FeOx w/ sulfs. Stwks, round-pebble ht bxs, sheeted mag veins. Various large size prospects.	LREE,Co,Au?	Small bodies of alkaline gabs intrude Katangan lss, masive FeOx hills; lamprophyres
Kalengwa Mine, Zm	0.6 init 1.9 fin	16 init 9.44 fin	n.a.	Tabular replacement in sediments, ht bxs, supergene enrichment to chalcocite body; polymictic hydrothermal bxs; Cu sulfs dissemination	50gAg/t,LREE,U**	gabic rocks, hosted by Katangan siliciclastics. Syenites + granites; lamprophyres
Quartzite-Hosted Deposits, Nm	n.a.	X n.a. **	n.a. **	Sulf-bear ht bx veins cemented by mag, hydroth. Bx bodies. All frac controlled.	LREE,Fe,U,Zn **	Brittle quartzites + carb, small subvolcanic porphyritic bodies, + qtz blobs
Deposits in Alkaline Rocks + Carbonatites, Nm	n.a.	X n.a.	X n.a.	Diatremes, stwks, bx bodies, round-pebble ht bxs, braided veins, masive FeOx bodies, controlled by regional structures.	Fe,LREE,Zr,La, Nb,Zn**	Lamprophyre + carbonatite dikes, syenites, alkaline granites
Tevrede deposit, Kamanjab, Nm	n.a. ****	X n.a. ****	n.a. ****	Ht polymictic bxs cemented by mag and/or hematite; braided vein systems, stwks, frac-controlled mnzn. Massive FeOx bodies	LREE**	alkaline granites, granites
Shimyoka Area, Kafue Flats, Zm	Cubic kms****	0.2 **	X n.a. ****	FeOx bodies w/ diss cp+py, ht bxs, shear zones, stwks. Mnzn related to intrusive bodies.	LREE,P,F,U,Co	Syenites, Katangan carb, qtz bodies, gabs, red-altered gtds
Kantonga prospect, Zm	n.a. ****	X n.a. ****	X n.a.****	Tabular replacement of mag & hem in sedimentary units; large bodies of mag and hem filled polymictic ht bxs; stwks; various Cu sulfs disseminated in FeOx.	Cu,Au,Mn,LREE, phosphates	Syenites and granites that intrude Katangan carbs, syenites and granodiorites
Kitumba prospect, Zm	Cubic kms, n.a.****	X n.a. ****	X n.a. ****	Very large extension of hem-filled polymictic ht bxs & stwks w/ py and cp, bornite, digenite & covellite. Large zones with massive mag.	Cu,Au,Mn,LREE, Phosphates	Syenites, granites, granodiorites and diorites that intrude Katangan carbs and other metaseds
Silver King, Zm	n.a.	X n.a.	n.a.	Sideritic ht bxs, supergene Cu mnzn	Ag,Au,Cu,LREE	Lamprophyre dikes
Sable Antelope, Zm	n.a.	X n.a.	n.a.	Sulf-bear FeOx-filled ht bxs, diatremes, bn-rk altn, network of fissure veins, FeOx bodies	Ag,Ba,Zn,LREE**	Hosted by Katangan massive white or pink dol ls, in flank of anticline
Hippo Mine, Zm	0.016	9.4 ***	2.1	Sulf-bear frac-controlled FeOx, bx + stwk	Fe, F, As, Pb, Zn	Hosted by Katangan silststone. Very little outcrop, all covered
Luiswishi Mine, D.R. Congo	8**	2.5	X n.a.**	Tabular FeOx controlled by fault system. Supergene Cu-Co mnzn. Not true strata-control	1.15%Co,Ni	Hosted by Katangan dol shales, dols, carbonaceous shales
Shituru mine, D.R. Congo	0.085**	2	0.2-0.5**	Fault-controlled, tabular FeOx body underlain by oxidized Cu-Co mnzn. Stwk, shear zone w/ mylonitization, and sed-hosted sulf mnzn w/ organic carbon. Carolite in bk shales, specular hem nucleates sulfs.	1.59 Aug/t in slimes dump, Co(0.05-0.1%),U	Hosted by Katangan bk shales, siltstones and carbs
Kamoya mine, D.R. Congo	1.2**	2.5	<0.01**	Fault-controlled, tabular FeOx body underlain by oxidized Cu-Co mnzn. Stwk, shear zone w/ mylonitization, and sed-hosted sulf mnzn w/ organic carbon. Carolite in bk shales, specular hem nucleates sulfs.	0.58% Co 0.2-0.3% Ni Pd, Zn, La, Ta	Hosted by Katangan ls, dols, sandstones, siltstones and bk shales

CONVENTIONS: *Dunrobin mine produced over 40,000oz of gold by 1935. It produced 13,817oz of gold from 1936 to 1961. ** not well studied. *** Hippo mine produced 2280 tons of ore at an average grade of 27.4% Cu. **** Well studied by mining companies, but information is not publicly available. altn = alteration; bear = bearing; bn = brown; bx = breccia; bxs = breccias; carb = carbonate; cp = chalcopyrite; D.R.Congo = Democratic Republic of Congo; diss = disseminated, dissemination; dol = dolomite, dolostone; FeOx = iron oxide; fin = final; frac = fracture; gab = gabbro; gtd = granitoid; ht = hydrotermal; init = initial; LREE = light rare earth elements; mag = magnetite; n.a. = not available; Nm = Namibia; po = pyrrhotite; py = pyrite; qtz = quartz; rk = rock; stwk = stockwork ;sulf = sulfide; undim. = undimensioned; X n.a. = metal is present but data is not available; Zm = Zambia.

IRON OXIDE-COPPER-GOLD PROSPECTS AND DEPOSITS, LUFILIAN ARC