

# M'popo Deposit, a Granite-Hosted Gold Vein System in the MesoProterozoic of SE Angola

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## INTRODUCTION.

The study area is located on the south-central part of the Central Plateau of Angola at approximately 35 Km. southeast of Kassinga-Techamutete village (Huila Province).

There are two areas with gold mineralizations throughout the Huila Province: M'Popo and Chipindo.

There are more than 90 alluvial placer gold deposits and numerous primary deposits inside quartz veins (Fig. 1) emplaced in lower to middle Proterozoic materials. In this contribution we will focus on these vein gold deposits enclosed in granite.

At present, all the previous work done at the M'Popo region were focused on the geology of the area (Carvalho, 1984; Carvalho et al, 1969). However a study of vein mineralogy, of hydrothermal alterations and geochemical characterization of the host rock has not yet been done.

## GEOLOGICAL SETTING.

In the M'Popo region materials with metamorphic character outcrop (2,5-2,25 Ga; Lower Proterozoic) generated during the Eburnean Orogenic Cycle beside anorogenic granitic intrusions (1,7-1,1 Ga, Middle Proterozoic).

Metamorphic rocks correspond to the so-called Cassinga Supergroup or Zone which is divided, from base up, into three groups: Jamba and Cuandja, both with volcanosedimentary characteristics, and Bale, which is entirely sedimentary. Though only the last two groups outcrop in the study area (Carvalho, 1984). Stratigraphically, the Cuandja Group

represents a volcanosedimentary sequence that, from base up, is formed by metapsammites and metarudites, spilites, basalts, andesites and tuffs. This unit rests conformably upon the Jamba Group. The Bale Group has detrital character and is formed by quartzites, metaconglomerates, phyllites and schists. This group is unconformably overlaid by the two aforementioned units (Gonçalves, 2008).

The granitic rocks present on this area belong to the Plutonic Complex of M'Popo. This complex is a batholith formed by granites of several compositions, result of a multistage process that affected intrusive rocks of Lower Proterozoic and Archean. (Carvalho et al, 1969) superimposing contact metamorphic processes to the

regional metamorphism, which include granitization of Lower Proterozoic metamorphic rocks. This unit is formed by porphyritic biotite granites with potassium feldspar megacrystals and also by leucocratic granites in which the potassium feldspar rather than plagioclase predominates.

According to the analysis of the granitic rocks that outcrop in the study area they belong to the quartz-rich granitoid type and are calc-alkaline. There is a negative correlation between the contents of SiO<sub>2</sub> and TiO<sub>2</sub>, P<sub>2</sub>O<sub>5</sub> and MgO. There is also an increase of the K<sub>2</sub>O and Na<sub>2</sub>O content with SiO<sub>2</sub>.

Associated to these crystalline rocks there are two systems (NW-SE and N-S) of hydrothermal quartz veins. Their age

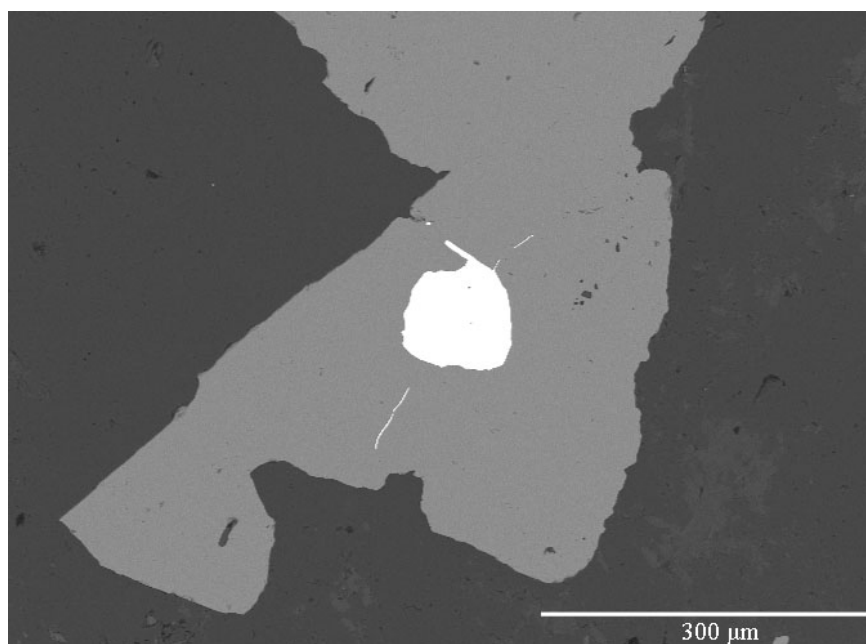


fig 1. Backscattered electron image (BSE) of one of the studied quartz veins that shows a pyrite crystal that contains a gold grain. Both surrounded by a mass of quartz and sericite.

**palabras clave:** M'Popo, Angola, filones, granito, oro.

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remains unknown but the upper part of the metamorphic series fossilized them, as it can be seen on the field. Only the NW-SW system shows some kind of mineralization. They can be from 0.15 to 2.4 meters wide and have a length between 200 and 600 meters. The average gold content is 10g/t but it can reach up to 82 g/t.

#### HYDROTHERMAL ALTERATION.

The host rocks show the following hydrothermal alterations: silicification, chloritization, carbonatization and sericitization.

Silicification affects both the granite and the veins but it predominates in the latter. It appears as fracture filling produced by sulphides (pyrite).

Chloritization can be seen in the external part of the mineralized zone and it partially replaces the quartz crystals.

Carbonatization is the less common alteration. It only appears in the granite and it occurred after chloritization because it sometimes fills veins formed in the carbonates.

Finally, sericitization prevails at the contact between the vein and granite. It locally fills fractures generated in chlorite and carbonates and/or replaces chlorites.

#### MINERALOGY.

The granite, apart from quartz, potassium feldspar and muscovite, also has iron oxides, rutile, zircon and thorite as accessory minerals.

The rutile crystals are sub-rounded in shape and up to 15 µm in size. They appear embedded in haematite masses.

Zircon crystals have sizes up to 90 µm and, in some cases, a small zoning can be observed at the edges. The presence of thorite was put into evidence using electron microscopy (SEM). It always appears associated to the latter mineral and in the outer zone of the zircon crystals.

Veins are mainly composed of quartz that can be more or less altered. The ore consists of pyrite, chalcopyrite, sphalerite, galena, haematite, with rutile, covellite and gold as accessory minerals.

Pyrite appears as isolated crystals or as clusters of idiomorphic to subidiomorphic crystals with sizes ranging from a few to hundreds of microns. Occasionally, some smaller pyrite crystals appear at the growth planes of quartz.

Chalcopyrite and sphalerite appear as allotriomorphic isolated masses and are often associated. Commonly, sphalerite has small chalcopyrite crystals inside (chalcopyrite disease). Surrounding chalcopyrite, the presence of covellite is very frequent as an alteration product.

Galena appears as small masses inside pyrite crystals.

Haematites has been formed as an alteration product of sulphides. It appears both as haematite pseudomorph of pyrite crystals (Fig. 2) and as in form of masses. In both cases, a banded can be seen inside them. The presence of magnetite has been observed in the outer zone of these haematite pseudomorphs of idiomorphic pyrite crystals.

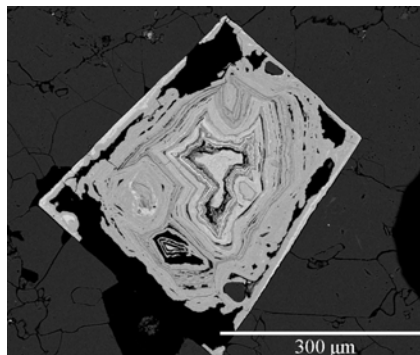


fig 2. BSE image of fan haematite crystal pseudomorph of pyrite where the banded can be seen. There is also magnetite in the outer part of the crystal.

Gold occurs as grains with a bimodal distribution of size. Larger grains are up to 120 µm and the smallest barely exceed 20 µm. The larger grains appear exclusively inside pyrite crystals and the minor ones inside chalcopyrite masses or in quartz. Analysis shows that the gold grains have an average Ag content of 5%.

Rutile occurs as small crystals of micron size and have an hydrothermal origin.

#### CONCLUDING REMARKS.

Intrusion-related gold systems constitute an important class of mineral deposits

containing at least 30 tonnes of gold known to exist in orogenic belts (Lang and Baker, 2001).

In spite of the dearth of geological evidence, structural and spatial constraints strongly suggest that the M'popo deposit are not orogenic in character. In other words, it was not formed synchronously with regional metamorphism and tectonism. Unlike orogenic (metamorphic-related) "gold-only" veins, the M'popo deposit is marked by a polymetallic ore assemblage. Also, mineralized veins are spatially and temporally closely related to intrusions, with the lode structures post-dating the emplacement of felsic bodies.

In view of the economic significance of the M'popo deposit, the recognition of granite-hosted gold veins in the study area should be of considerable interest to explorers.

#### ACKNOWLEDGEMENTS.

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