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# Gold grade variation and particle microchemistry in exploration pits of the Batouri gold district, SE Cameroon

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ABSTRACT

The Batouri area hosts lode-gold mineralization under several-m-thick lateritic cover. Pitting to bed rock on a geochemical Au anomaly defined from previous reconnaissance soil sampling identified five horizons ranging from saprock at the base to laterite at the top. Analysis of bulk samples from each horizon by fire assay shows that most of the horizons are barren although 119 ppb and 48 ppb Au values were obtained from one laterite horizon and one saprolite horizon, respectively, from two separate pits. All the horizons were panned and particulate gold was also recovered only from these two horizons. The gold grains from both horizons are morphologically and compositionally indistinguishable with rare quartz, pyrite and galena inclusions. The grains have irregular, sub-rounded, bean to elongated shapes and they show a remarkable core–rim zonation. Electron microprobe analysis of the grains recorded high gold content in the rims (86.3–100 wt%) and along fissures within the grains (95.1–100 wt%). The cores are relatively Ag rich (11.8–14 wt% Ag) while the rims (0.63–13.7 wt% Ag, most of the values fall within the lower limit of this range) and fissures (0.03–5.02 wt% Ag) are poor in Ag. The low Ag concentration in the rims and along fissures is attributed to preferential leaching of Ag; a process recognized in gold grains and platiniferous alloys from alluvia. The core composition of the grains is similar to that of primary gold composition in the bedrock. These results show that gold in the soil is relic particulate gold derived from the primary source with no evidence of secondary gold precipitation in the weathering cycle. In all the pits no horizon was systematically enriched in gold suggesting there has been no chemical remobilization of gold in this environment. Rather the dispersion of gold here is in the particulate form. Therefore combining particulate gold features with assay data is relevant to exploration in such tropical environments.



## 1. Introduction

In humid tropical terrain mineral exploration is often hampered by thick soil cover and innovative approaches to overcome this difficulty include using soil geochemistry and analyzing the residual material for a range of elements in combination with geophysical methods (e.g. Fon et al., 2012). Gold is usually the best indicator element for primary gold mineralization (Reis et al., 2009), however, soil geochemistry for Au can be tricky due to the fact that in soils gold mainly occurs as native gold which is chemically and physically resistant, implying that the dispersion of gold occurs predominantly in the particulate form (Antweiler and Campbell, 1982; Reis et al., 2009). Therefore, the selection of the most suitable soil horizon along a soil profile is most important. Two approaches of soil geochemical survey are commonly in use: (i) sampling top soil down to ~65 cm depth along pre-defined equally spaced grid lines, and (ii) digging exploration pits or trenches down to the bedrock through the various horizons, and sampling each soil layer separately. The first approach gives rise to spatial patterns for element dispersion and identification of anomalies, although complex processes of Au redistribution in soils can lead to false anomalies. The second approach allows for the identification of the best soil horizon enriched in Au, and by studying gold particle microchemistry

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from such layers allows for the distinction of primary gold grains from secondary gold particles developed within the weathering cycle. The microchemistry of the gold particles also allows for inferences on the nature of the primary gold in the unexposed host rock (Chapman et al., 2000a,b, 2011; Moles et al., 2013). Analysis for particulate gold is widely carried out using the electron microprobe technique (Suh and Lehmann, 2003; Chapman et al., 2000a,b, 2011; Moles et al., 2013).

Primary gold occurrences in the Batouri area are related to Pan-African granitoids (Asaah et al., 2014) especially along shear zones. Due to deep weathering, these primary features are poorly constrained and exploration has met with variable success (see www.africanaura.com, for example). In this study we examine nine exploration pits (3.2–5.6 m deep) in part of the Batouri area. The pits were positioned over an anomaly identified from a previous grid-controlled soil geochemistry programme carried out by African Aura Resources Ltd (www.africanaura.com). The aim of this study was to investigate the reliability of this anomaly and also to ascertain the nature of gold distribution within the soil horizons as well as characterize the particulate gold in the samples. Here, samples from the various horizons (37 samples in total) were analyzed for Au by fire assay (NiS) with ICP-AES finish. Gold grains from the saprolite horizon and laterite layer with anomalous Au assay values were studied further to elucidate their nature and explore their origin. The link between gold abundance and mineralogy is also explored. This contribution is a case study with

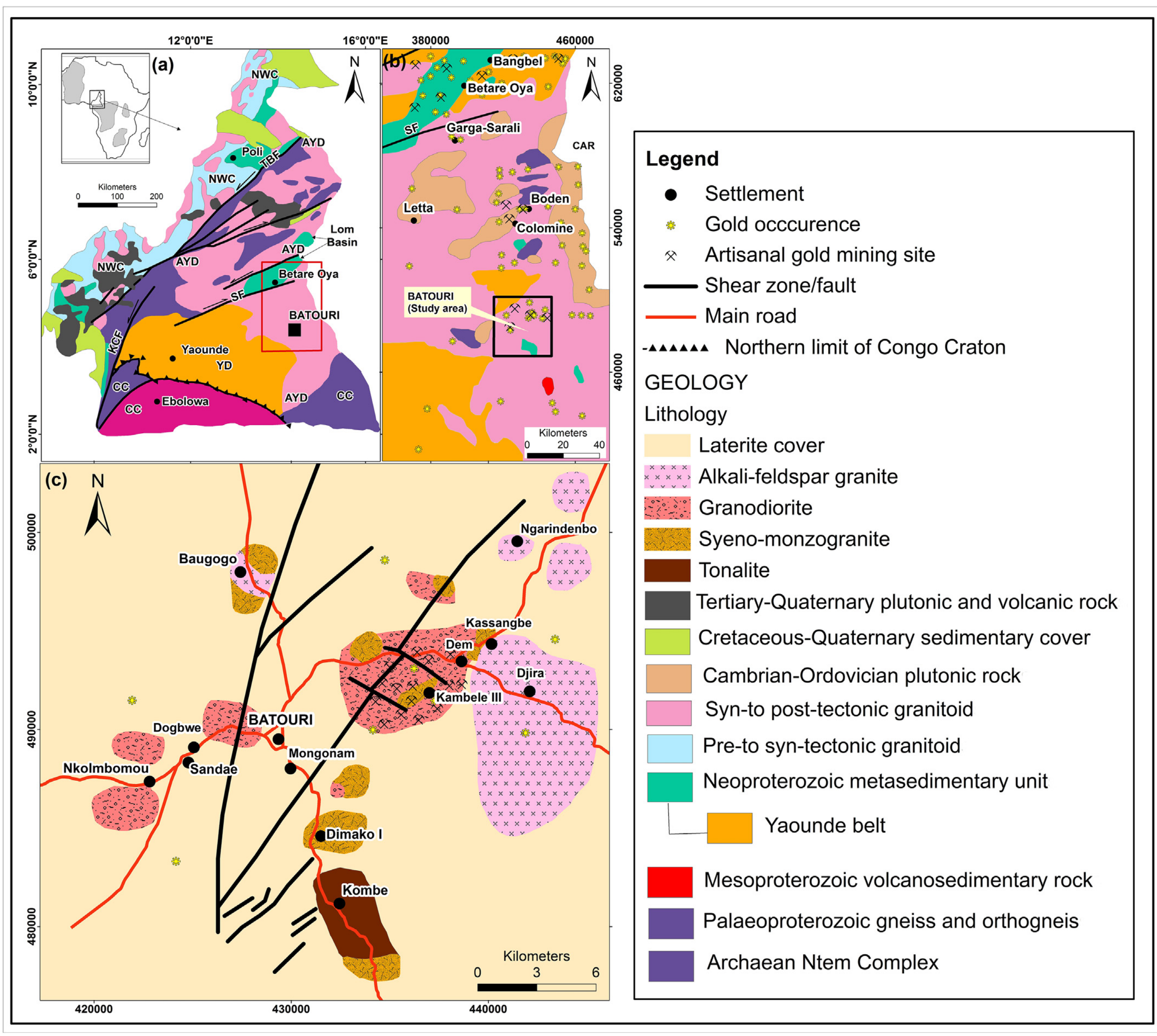


**Fig. 1.** Geology of Cameroon. (a) Geological map of Cameroon (modified after Toteu et al., 2001; Asaah et al., 2014). The Central African Shear Zone is defined by a system of NE-trending faults comprising Tchollire-Banyo Fault (TBF), Adamawa Fault (AF), Sanaga Fault (SF), and Kribi-Campo Fault (KCF). The inset is the map of the African continent, showing the location of Cameroon relative to the distribution of cratons and mobile belts. NWC, North western Cameroon domain; AYD, Adamawa-Yadé Domain; YD, Yaoundé Domain (b) Regional geological map of south eastern Cameroon showing artisanal gold mining sites and other reported gold indications (modified after Milési et al., 2004). (c) Geology of the Batouri gold district. The area is characterized by a predominant NE–SW trending shear zone. It is composed predominantly of Pan African granitoids and has a thick lateritic cover.