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Structural analysis of Pan-African deformation and implication of potential gold-bearing in Neoproterozoic West Congo Belt, DR Congo.

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Keywords: *West Congo belt, Gold, Riedel, shear zone, Thrust, fold, Neoproterozoic.*

Abstract

Neoproterozoic West Congo Belt comprises of complexity structural fabrics such as schistosity, crenulation, fault, shearing system characterized by mylonite fabrics related to the thrust-fold and associated with hydrothermal alteration and sulphides mineralization formed during a Pan-African deformation events provide a favorable environment of gold deposit.

Rocks occurring in thrust slices were extremely deformed forming tight, asymmetric, East–Northeast-verging folds which contain a prominent axial-planar schistosity characterized mainly by a NW-SE trending foliation (S1), steeply to moderately dipping towards SW that overprints primary bedding surfaces (S0). Poles to the foliation, measured throughout study area, shows a fold system including tightly to isoclinal folds of which the fold axis is parallel to the northwest plunging lineation with a vergence to the northeast. A fine crenulation cleavage (Sn) generally trending WNW and steeply dipping towards NNE, shows symmetric and asymmetric cm-scale folds especially well developed in finer grained lithologies.

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Riedel shear structures, defining in this area, developed during a transpression thrust-fault-fold belt and could be associated with the mineralization fluid event. Gold mineralization occurs in both metavolcanic and metasedimentary rocks with sulphides observed are essentially coarse to fine-grained mainly pyrite with trace chalcopyrite and pyrrhotite. The associated hydrothermal alteration is characterized by a combination of chlorite-feldspar-carbonate-sericite-silica-magnetite-pyrite mainly observed in metabasalts and weakly in metarhyolites. The metasediments shows a weak alteration in silica and sericite-chlorite.

However, the gold associated by hydrothermal alteration in this zone has not yet been deeply investigated by geochemical studies and it is not known if the observed alteration is linked to a hydrothermal activity associated with the emplacement of the mineralization or if it is simply related to an earlier metamorphism.

The Thrust-Fold Riedel sinistral shear contact zone between Zadinian, Mayumbian and West Congolian Groups and folding deformation are more prospective for gold exploration because competency contrast during the shearing increase the permeability in dilatational zone and provide a well system for gold deposition with the major structures as a path way of mineralizing fluid.

I. Introduction

The structural complexity including lithologies competency contrast of deformed metamorphic terranes provides a favorable environment for the establishment of gold mineralization (Groves et al.,1998). Identification of favorable large-scale structural framework is the key for future exploration of gold deposit.

Pan-African orogeny has a great importance as recent discoveries show that this event initiated a period of orogenic gold-forming events. The most important gold-forming

event often taking place in late Neoproterozoic and early Paleozoic contain more than 100 Moz Au along the southern margin of the Siberian platform (Goldfarb et al., 2001). These events took place from around 600 Ma to 566 Ma (Maurin, 1993; Tack et al, 2001; Goldfarb et al, 2001; Milesi, 2006) and could be related to Neoproterozoic collisions indicating initial phases of the Gondwana. These collisions mark the beginning of the relatively continuous formation of orogenic gold veins in accretion terranes that progressed to the Tertiary and until nowadays probably (Goldfarb et al., 2001). The Panafrican orogeny events were controlled by the thermo-tectonic activity occurring near the transcrustal shear zones (Goldfarb et al, 2001; Kröner and Stern, 2004; Pedrosa-Soares and Alkmim, 2011).

Affected by the Panafrican event orogenic, the Neoproterozoic West Congo Belt, long of ca.150km in the Democratic Republic of Congo (DRC-Kongo Central province). The belt extends northwards to Cabinda, Republic of Congo (Brazzaville) to Gabon and southwards to Angola into Namibia with a total of ca.1000km and is defined as fold-and-thrust belt, with east-verging, gently-dipping and imbricated thrust slices (Tack et al., 2001). This belt comprises of the West Congo super group rocks from 1000 to 910 Ma (Maurin, 1993; Tack et al., 2001; Milesi et al., 2006) to such as siliciclastic metasediments, metabasalts, felsic volcanic-plutonic sequence with sedimentary intercalations.

Several alluvial gold deposits were exploited since the colonial periods around 1932 with a gold production of about 1365 kg in the Mayumbe region (DRC). From 1947 to 1961, the BAMOCO carried out exploration and came to the conclusion that the Kongo Central province did not contain mineral deposits of economic interest (Forminière, 1945, 1948). Schwartz & Lanfranchi (1990) suggested a biochemical origin of alluvial gold which is exploited in the Mayumbe region of the Brazzaville, in the Dimonika and

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Mvoula sectors. However, Samax Gold Inc. has undertaken several exploration work including soil sampling, geological mapping, trenching and many drill holes test at Republic of Congo (Brazzaville) specially in Kakamoeka, Dimonika and Ngongo districts. Its discovery primary gold mineralization is confirmed by diamond drilling at Mougongo Prospect with 28.5m @ 3.7 g/t Au in DH4A and 18.8m @ 3.8g/t Au in DH5 within the silicified sandstone and that mineralization striking along several meters in the NW-SE regional trend in the belt. This mineralization is suggested epithermal system forming during the first opening of the Atlantic Ocean (Coakley, 1998; Samax Gold Inc. report, 1998; CRGM, 2011).

Recently in DR Congo, Loncor Inc. is doing some exploration work at Mbata-Siala and find narrow mineralized quartz veins. Several artisanal workers are operating until now along the alluvial gold. Lack of published documents on this gold mineralization can lay to future research, need to be carried out.

Structural complexity including lithological competency contrast of deformed metamorphic terranes provides a favorable environment for the establishment of a gold mineralization (Groves et al., 1998). Identification of favorable large-scale structural framework is the key for future exploration of gold deposit.

The aim of this study is to investigate the structural features, lithological contrast and hydrothermal alteration related to the gold mineralization environment at the Neoproterozoic West Congo belt.

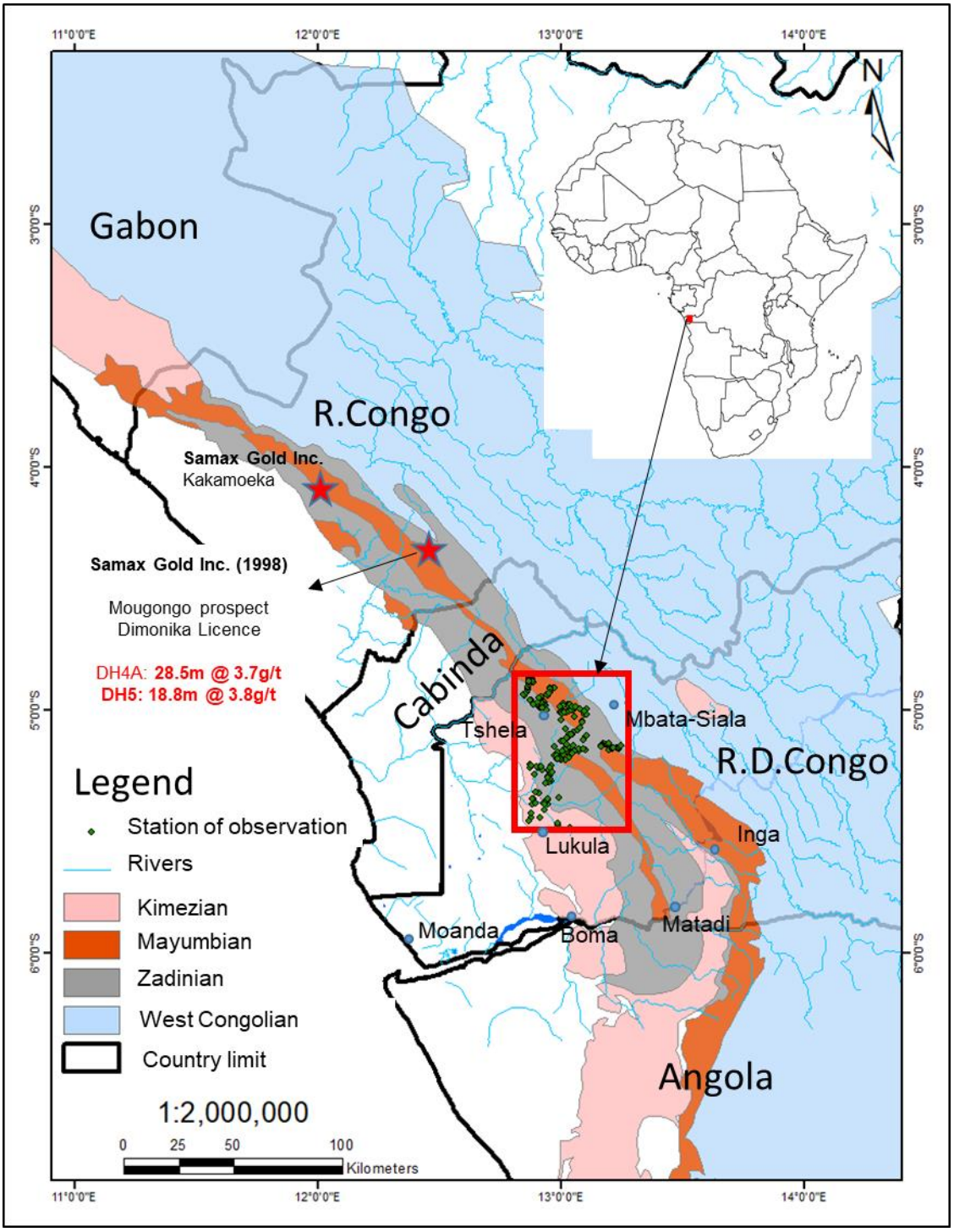

Figure 1. *Simplified geological map showing the study area (red box) close to the prospects exploring by Samax Gold Inc. (red star) within the West Congo Belt.*

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II. Geological setting

II.1. Regional geology

Regional geology of the studied area consists of the West Congo Supergroup specifically the Neoproterozoic Zadinian and Mayumbian *(Tack & al, 2001).* From oldest to youngest, the continental siliciclastic metasediment rift-related to the break-up of Rodinia 999 ± 7 Ma is overlain by Gangila metabasalt (Zadinian), a felsic volcanic-plutonic sequence with subordinate volcano-sedimentary and sedimentary intercalations of 910 Ma (Mayumbian) *(Tack, 1975a, 1983)* overlying the 2.1 Ga polymetamorphic Kimezian basement (Paleoproterozoic), and underlying the sedimentary rocks of the West Congolian Groups *(Fig. 1)* appears to represent passive margin siliciclastic and carbonate platform deposits preserved in the foreland domain of the West Congo Belt *(*Schermerhorn, 1982; *De Wit et al., 2015*).

Formation of the Araçuaí-West Congo orogen resulted from kinematically complex deformation involving, substantial crustal shortening which produced large volumes of magma *(Alkmim et al., 2006). Pedrosa-Soares et Alkmim (2011)* defined six rifting events preceding the development of Araçuaí-West Congo orogen.

Tack et al. (2001) and Alkmim et al. (2006) have shown that there are two different types of structural compression in terms of orientation, although they have worked in the same way: the EW oriented compression limited to the Boma region and the compression F2 which affected the entire West Congo orogenic belt. West Congo belt shows an East vergence of F2 folds, resulting from Pan-African tectonic events (600-566 Ma). This structural and metamorphic asymmetry (metamorphism of amphibolite facies followed by a retromorphism in the greenschist facies), in the mesonal internal domain of this belt, caused an overlap with a N-S oriented fault *(Nsungani, 2012).*

A low pressure, high temperature regional metamorphism affects the western-central region *(Tack, 1975b, 1979a)*, reaching the amphibolite facies but decrease to the east where greenschists are evident before disappearing in tabular regions where only diagenesis is present. This syn-kinematic metamorphism is associated with Pan-African orogeny.

II.2. Local geology

Lithology encountered in Zadinien and Mayumbian groups are characterized by metasediment, metavolcanic and metavolcanoclastic rocks including quartzites, quartzophyllites, graphitic schist, chloritoschist, sericitoschist, micaschist and amphiboloschist (Tack and al., 2001; Mpaka and Kandolo, 2015). The graphitic rocks seem to take their greatest development in the north and west of Mayumbe (Cornet, 1906; Cahen, 1954).

III. Research methodology

Different methods of investigation were applied for this research including field mapping, collecting samples and structures measurements, structural analysis combined with remote imaging (SRTM 30m and Landsat 7 ETM +), and laboratory analysis of petrographic thin sections and metallographic polished sections.

In addition to the field data collected in the study area, an interpretation of lineaments based on remote sensing image from SRTM 30m and Landsat 7 ETM + (Coulibaly, 1999, Akame & al., 2013) was performed in order to highlight large structures due to the lack of geophysical data *(Fig. 2)*.

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IV. Results

IV.1. Structural study

The Shuttle Radar Topography Mission (SRTM) 30m data displays a structural complexity framework in the area (Fig. 2). Rocks occurring in thrust slices were extremely deformed, forming tight, asymmetric and east–northeast-verging folds which contain a prominent axial-planar schistosity.

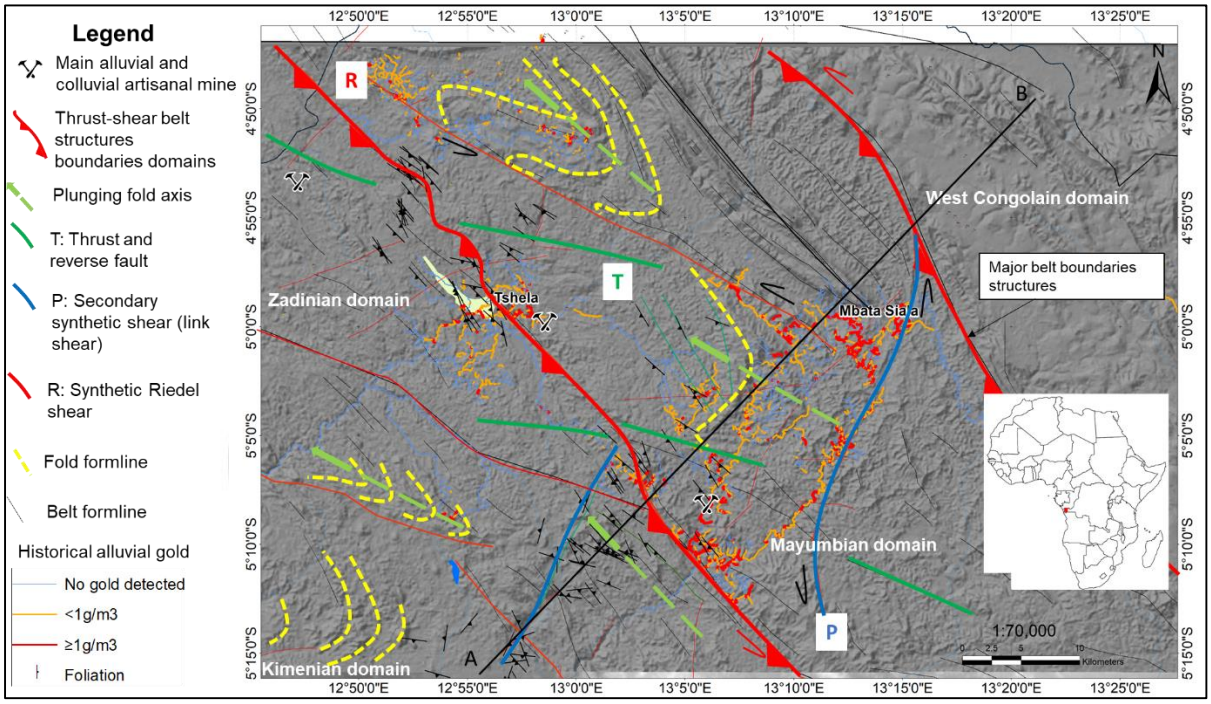

Figure 2. *Regional structural interpretation based on the SRTM 30m data hill shaded digital elevation model showing a complexity structural framework in this area including Thrust-Riedel shear belt.*

IV.1.1. Foliation

Field observation identified meta-clastic and meta-volcanic units displaying phyllosilicate foliation (S1) related to a greenschist facies metamorphism. This phyllosilicate foliation is mainly characterized by a NW-SE trending (S1) *(Fig. 2)*, moderately to steeply dipping towards SW that overprints primary bedding surfaces (S0). The identified foliation is more penetrative within the metasedimentary rocks and mainly sub-parallel to the bedding.

Poles to the foliation, measured throughout study area, shows a fold system including tightly to isoclinal folds (Fig. 3). The fold axis is parallel to the northwest plunging lineation with a vergence to the northeast. The foliation and fold axial planes within this schist dip steeply towards the SW, approximately parallel to the foliation in the adjacent carbonaceous shear.

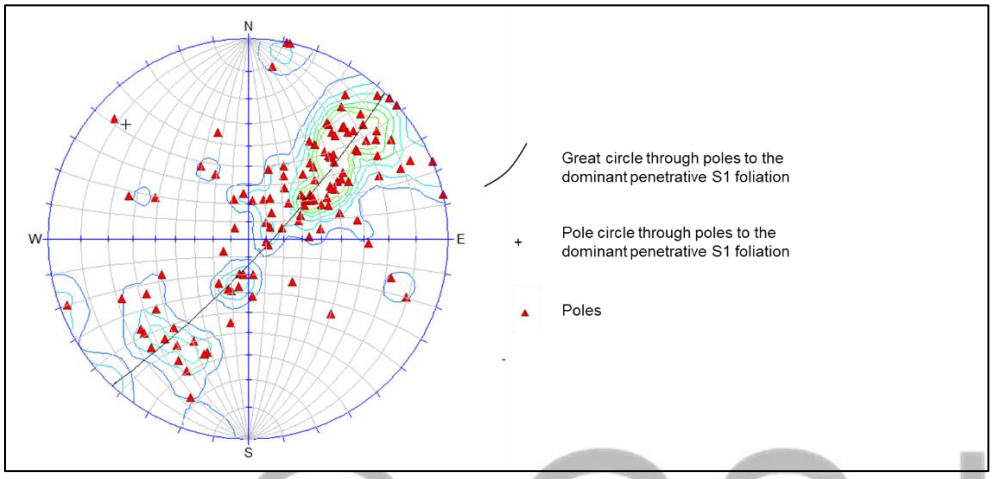

Figure 3. *Equal area, lower-hemisphere stereographic projections of structural data from the study area. Poles to the dominant S1 foliation scatter along a great circle whose axis coincides with the regional tight fold.*

IV.1.2. Crenulation

A fine crenulation cleavage (Sn) generally trending WNW and steeply dipping towards NNE, shows symmetric and asymmetric cm-scale folds (Fig. 4). The later are specifically well developed in finer grained lithologies. Therefore, these folds are denoted Fn and their related axial planar crenulation cleavage is Sn.

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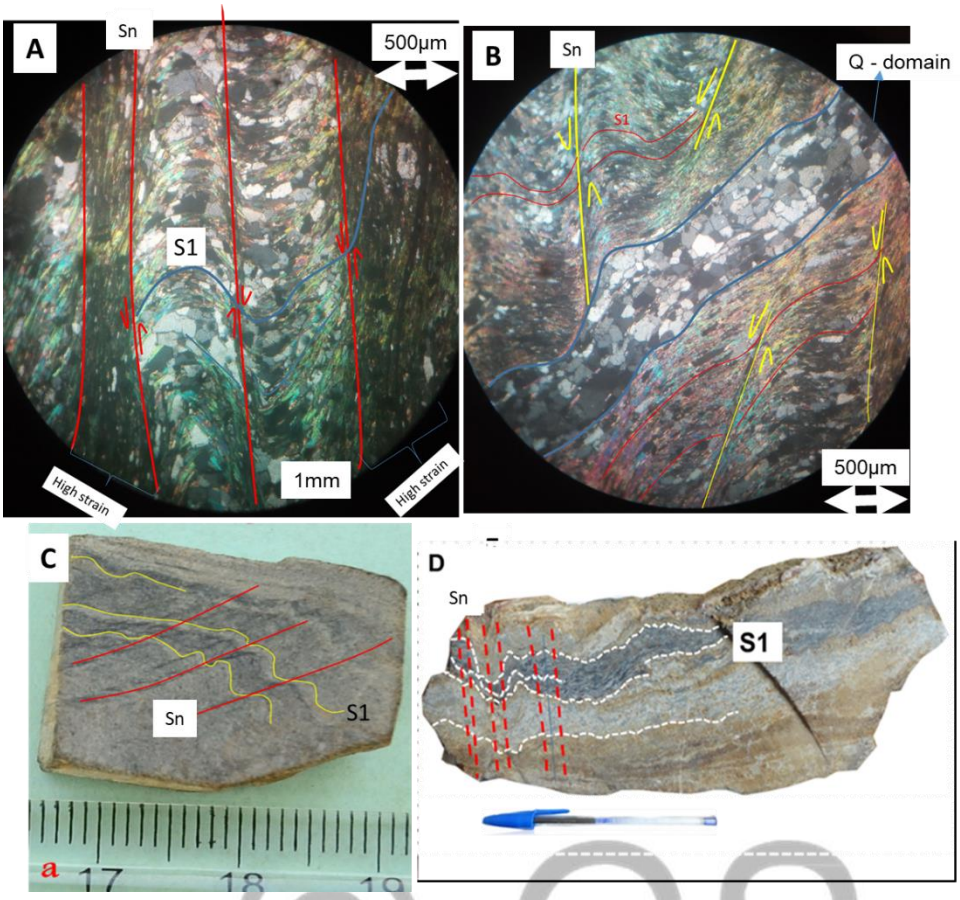

Figure 4. *Crenulation cleavages showing in microscopic and macroscopic features. A. Symmetrical crenulation cleavages in the mica-quartz-rich schist whose limbs of fold define domains rich in mica and poor quartz-feldspar (high strain) and the hinge areas are rich in quartz-feldspar and poor in mica (low strain). B. Asymmetrical crenulation in the mica-quartz-rich schist with micro quartz-feldspar veins weakly (Q-domain) affected by that crenulation and is anterior to crenulation. C. Cm-scale of asymmetrical crenulation in the mica-quartz-rich schist. D. Cm-scale of crenulation in the hand specimen.*

IV.1.3. Folds

Regional interpretation using the STRM 30m data shows a km-scale fold *(Fig. 2)* near the regional thrust- Riedel shear structures. Old Belgium data highlight main alluvial gold mining activities in hinge zones of folds which could be hosting mineralization in the country rock. Field structural data recorded show a folding system which are upright-tight to open related to the F1. The antiformal fold axis is generally trending

N310 and plunging moderately to shallow toward NW. The described fold structures may suggest a good trap for mineralization fluids. The F1 was also affected by the Fn sheared crenulation event.

IV.1.4. Shear zone, thrust and faults

Riedel shear structures, defining this area, developed during a transpression thrust-fault-fold belt and could be associated with the mineralization fluid event. The structural analysis at regional scale highlights the framework of the defined Riedel shear *(Fig. 2&3).* Structural features close to the major structures in that zone are characterized by the development of a mylonitic fabric and contains well-developed mineral-stretching lineation plunging toward SW, developed along the contact between the Zadinian – Mayumbian – West Congolian terranes. The orientation of shear is indicated by strain shadows which suggest a major sinistral sense of shear related to the antithetic and synthetic sense *(Fig. 5).*

Tack et al. (2001) defined a fold-thrust belt in this zone, with east-verging, gently-dipping and imbricated thrust slices. The faults are interpreted from STRM 30m images combined by outcrop features recorded in the field mapping *(Fig. 2)*.

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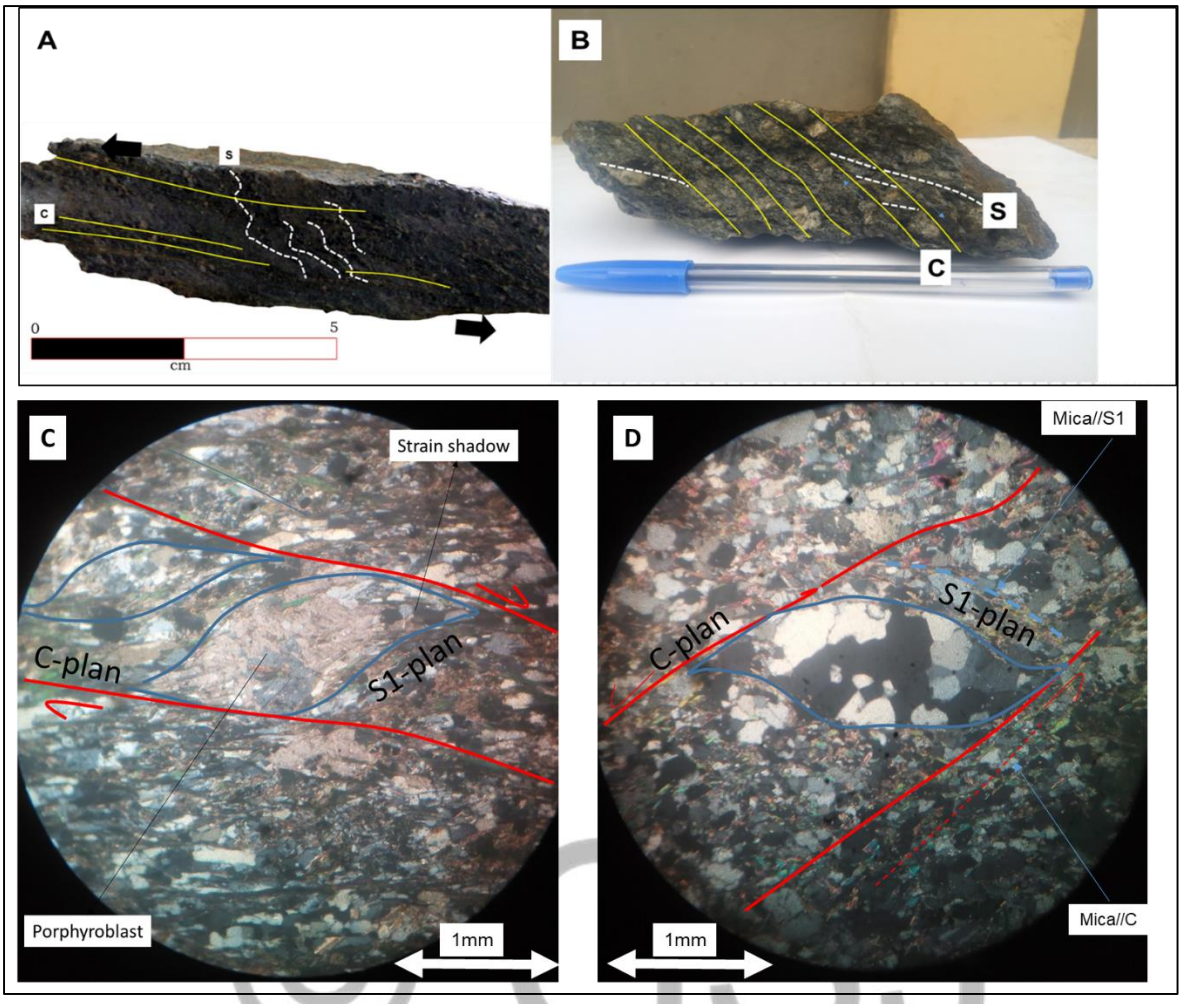

Figure 5. *Shear structural features recorded on the field mapping and microphotography under polarized light. A. Shearing illustrated by S-C plane within the mylonite B. Shearing within the protomylonite rock showing the porphyroblast mineral with sigmoid shape associated with S-C plane C. µm-scale of mica-quartz rich rock showing a shearing S-C plane within the sigma porphyroclast quartz-feldspar with kinematic analysis indicate the dextral movement associate by pressure shadow D. µm-scale of mica-quartz rich rock showing a shearing S-C plane within the sigma porphyroclast quartz-feldspar with kinematic analysis indicate the sinistral movement.*

IV.2. Alteration and mineralisation

The visual observation and petrographic analysis of the alteration is characterized by a combination of chlorite-feldspar-carbonate-sericite-silica-magnetite-pyrite mainly observed in metabasalts and weakly in metarhyolites. The metasediments shows a weak alteration in silica and sericite-chlorite. The sulphides observed are essentially

fine to coarse grained mainly pyrite with trace chalcopyrite and pyrrhotite (Fig. 6). Sulphides are also found in quartz veins with the wall rocks appearing un-mineralized. However, the gold associated by hydrothermal alteration in this zone has not yet been deeply investigated by geochemical studies and it is not known if the observed alteration is linked to a hydrothermal activity associated with the emplacement of the mineralization or if it is simply related to an earlier metamorphism.

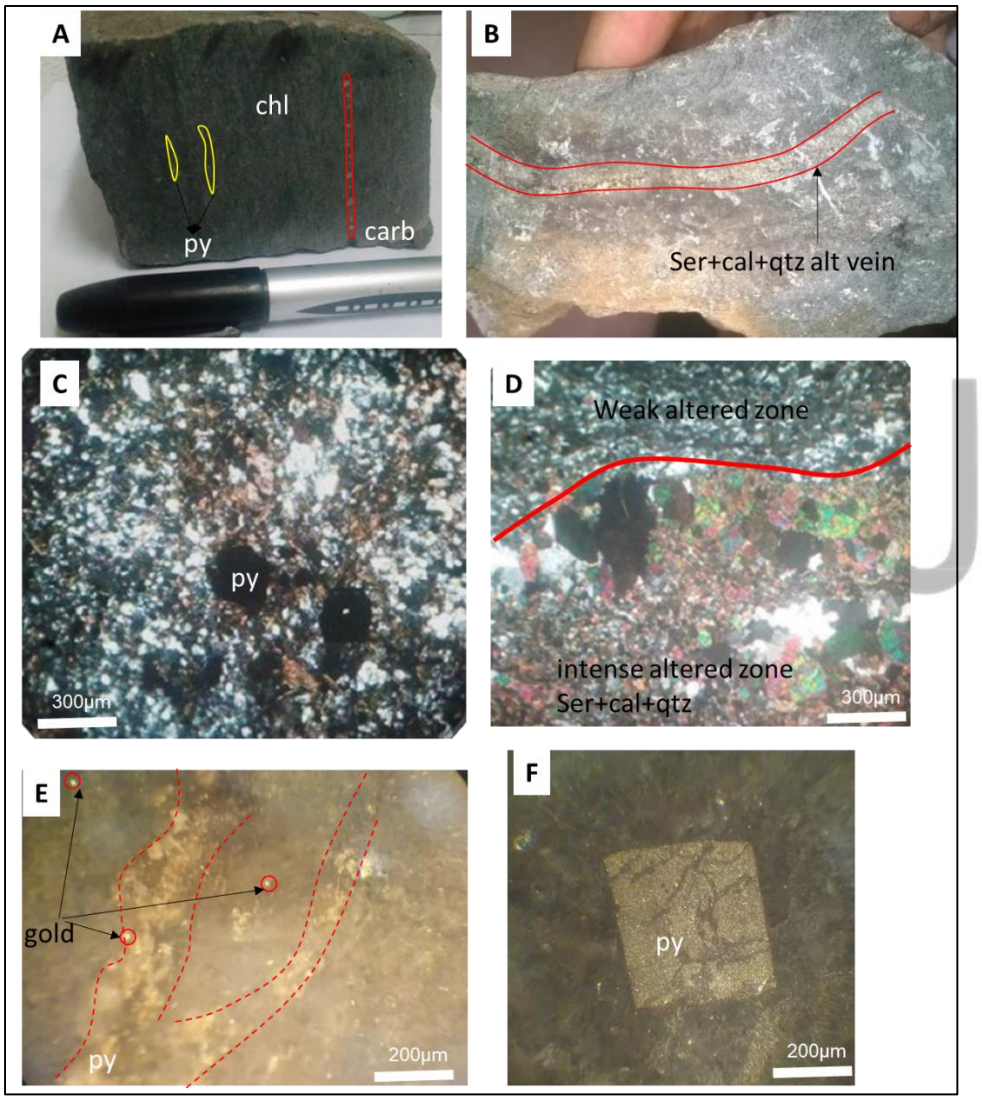

Figure 6. *Alteration and mineralisation features. A. Hand specimen cm-scale showing the chlorite (chl) and carbonate (carb) pervasive alteration associated with disseminated patchy of pyrite (py) and carbonate along a foliation in the Metabasalt. B. Hand specimen cm-scale showing an alteration of sericite (ser) and chlorite (chl) with alteration vein of sericite, calcite (cal) and quartz (qtz). C.*

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Photomicrographs polarized light thin section showing an euhedral pyrite associated with quartz-feldspar-carbonate-chlorite-mica alteration within the metabasalt. D. Photomicrographs polarized light thin section two differentiated zone characterized by weak alteration and intense alteration associated by sericite-calcite-quartz. E. Reflected light photomicrographs on the polished section of fine pyrite along a fracture and fine-grained gold disseminated. F. Reflected light photomicrographs of coarse grained fracture euhedral pyrite.

V. Discussions

The structural complexity observed on the Shuttle Radar Topography Mission (SRTM) 30m data such as folding and shearing is the evidence of the orogenic events occurred in late Proterozoic to Paleozoic. The NW-SE trending moderately to steeply dipping Phyllosilicate-folia, Riedel shear and close spaced crenulation cleavages indicate that they were developed during phases of deformation identified in this study area caused by multiple Pan-African deformation events as illustrated largely by *Tack & al., (2001)* and *Alkim & al., (2006)*.

The folding system was confirmed by the poles to the foliation measured in this study are, crenulations and the interpretation of the SRTM 30m map is interpreted as a trust-fold belt as illustrated on the SW-NE cross-section (Fig. 7) of the West Congo belt (Tack et al., 2001).

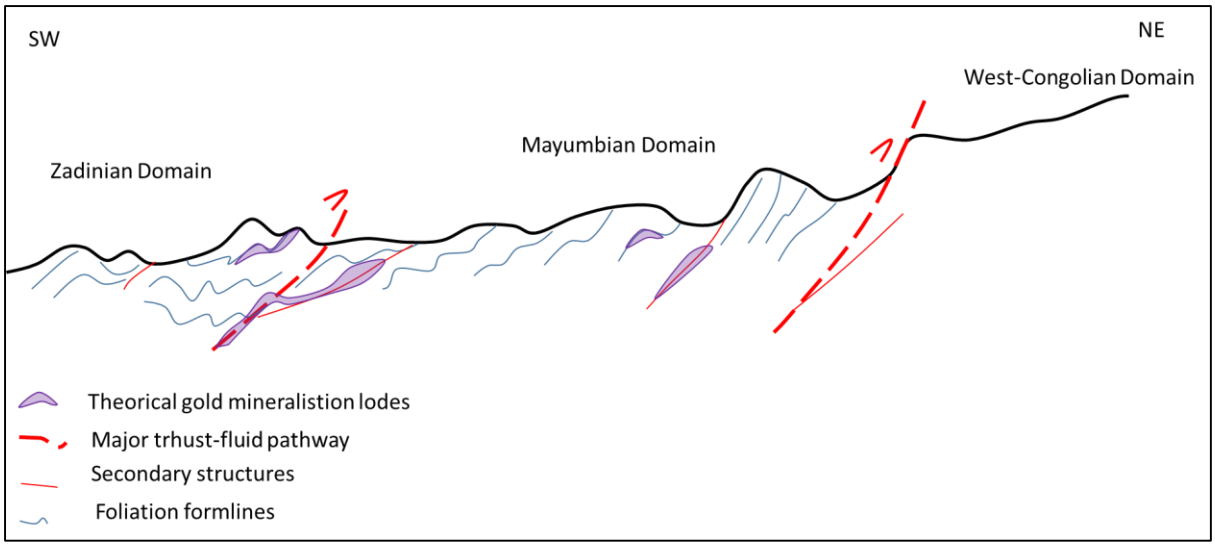

Figure 7. *SW-NE cross-section of the study area in the West Congo belt showing the potential gold-bearing related to the major thrust as a fluid pathway.*

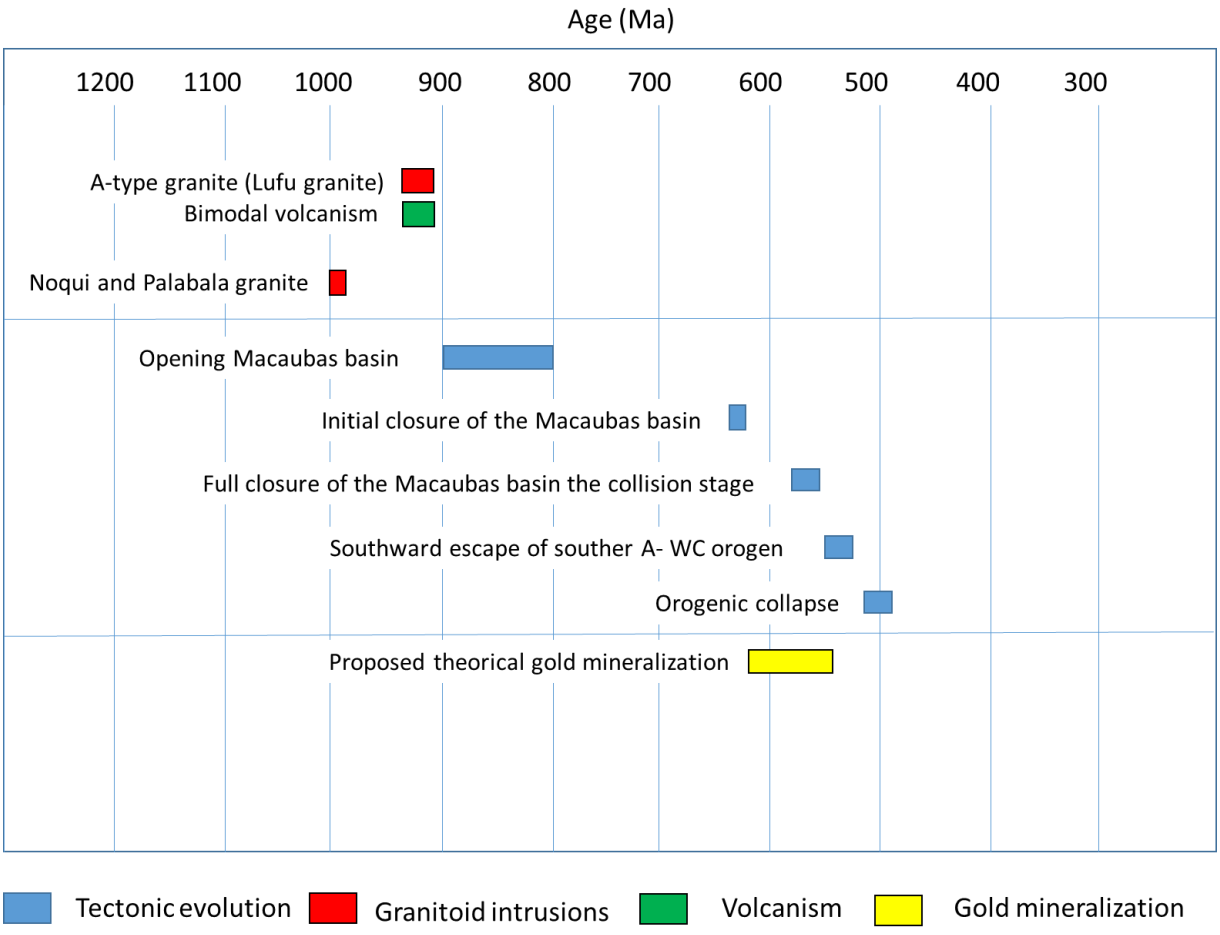

Figure 8. *West Congo Belt illustrated the geochronology data events (Alkmim et al., 2006; Tack et al., 2001) including theorical gold mineralization in the Pan African Orogen.*

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The Pan-African deformation history of the West Congo Belt was more complex with a rheological contrast creating different strain ranging from ductile to brittle deformation, related to thrust-shearing along the contact between the stratigraphic groups of the belt, which possibly controlled the distribution of gold (Fig. 8). This style of deformation is similar in many Pan-African Belt-hosted orogenic gold deposits and shear systems (Goldfarb et al., 2001; Weinberg & al., ND).

The kinematic indicators observed in different scales demonstrate a sinistral shear related to transpression – transtension with the Riedel sense indicating a sinistral movement (Figure 7). The thrust-shear contact zone between Zadinian, Mayumbian and West Congolian Groups is more prospective for gold exploration because of the competency contrast during the shearing which increased the permeability of surrounding rocks and allows for a pathway of mineralizing fluid.

The presence of sulphides and graphitic schist suggests a reduced environment while the presence of magnetite alteration attests to an oxidized environment. No temporal relationship has been highlighted to explain their implementation and their association with the gold. We can, however, hypothesize that the alteration in magnetite could pre-date the alteration associated with pyrite and gold. Neumayr et al. (2004) shows that the combination of oxidation-reduction zones is an important factor in the precipitation of gold.

Structural complexity found in outcrops of the study area requires a deeper analysis to better understand the link it has with gold mineralization. A detailed geological, geochronological and geochemical evaluation of this area is recommended to give answers to the remaining questions.

VI. Conclusion

Structural analysis in the Neoproterozoic Wet Congo Belt have identified complexity structural fabrics including schistosity, crenulation, fault, shearing system characterized by mylonite fabrics related to the thrust-fold and associated with hydrothermal alteration and sulphides mineralization formed during a Pan-African deformation events provide a favorable environment of gold deposit incliding the lithology of host rocks and their metal association.

The Thrust-Fold Riedel sinistral shear contact zone between Zadinian, Mayumbian and West Congolian Groups associated folding deformation event are more prospective for gold exploration in the study area. Competency contrast during the shearing increased the permeability in dilatational zone and provided a well system for gold deposition with the major structures as pathway of mineralizing fluid.

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References

Akame, J. M., Mvondo, O. J., Olinga, J. B., Esseno, J. & Mbih, P. K., 2013. Utilisation des modèles numériques de terrain (MNT) SRTM pour la cartographie des linéaments structuraux: Application à l'Archéen de Mezesse à l'est de Sangmélima (Sud-Cameroun). Geo-Eco-Trop., 37, 1: 71-80.

Corresponding author: e-mail, : yannwaku1@gmail.com, +243812056179

Alkmim, F.F., Stephen, M., Antonio, C.P.S., Guilherme, G.P., Simone, C.P.C. & Alan, W., **2006.** Kinematic evolution of the Aracuaı-West Congo orogen in Brazil and Africa: Nutcracker tectonics during the Neoproterozoic assembly of Gondwana, Precambrian Research, 149, 43–64.

Cahen L., 1954. Géologie du Congo-Belge, Vaillant- Carmanne, Liège, 576p.

Cailteux J.L.H., Delpomdor F.R.A., Ndobani J.P. N., 2015. The Neoproterozoic West-Congo "Schisto-Calcaire" sedimentary succession from the Bas-Congo region (Democratic Republic of the Congo) in the frame of regional tentative correlations. Geologica belgica (2015) 18/2-4: 126-146

Cornet J., 1906. Notes sur la géologie du Mayombe occidental, Mons, Soc. des Sciences, des Arts et des Lettres du Hainaut, t. IX, pp.16-17.

Coulibaly, L., 1999. Interprétation structural des linéaments par traitement d'images satellitaires: cas des sous-provinces d'Abitibi et d'Opatica (Quebec). Mémoire de maitrise, Département de géographie et télédétection, Université de Sherbrooke, Québec, Canada, 117p.

Forminière, 1945. Exploitation aurifère du Bas-Congo, Unpublished report.

Forminière, 1948. Rapport technique (Bas-Congo), Unpublished report.

Goldfarb R.J. & Groves D.I., **2015.** Orogenic gold: Common or evolving fluid and metal sources through time, Lithos 233, 2–26.

Groves, D.I., Goldfarb, R.J., Gebre-Mariam, M., Hagemann, S.G. & Robert, F., 1998. Orogenic gold deposits: A proposed classification in the context of their crustal distribution and relationship to other gold deposit, types Ore Geology Reviews 13. 7–27.

Groves, D.I., Goldfarb R.J., Robert F. & Hart C.J. R., 2003. Gold Deposits in Metamorphic Belts: Overview of Current Understanding, Outstanding Problems, Future Research, and Exploration Significance Economic Geology. Vol. 98, pp. 1–29.

Hanson, R.E., 2003. Proterozoic geochronology and tectonic evolution of southern Africa. In: Yoshida, M., Windley, B.F., Dasgupta, S., (eds), Proterozoic East Gondwana: Supercontinent assembly and breakup. Geological Society of London Special Publication 206, 427-463.

Kröner, A. & Stern, R.J., 2004. AFRICA/Pan-African Orogeny. Encyclopedia of Geology, vol. 1, Elsevier, Amsterdam.

Lepersonne, J., 1974. Carte géologique du Zaïre au 1 :2.000.000 et notice explicative. – République du Zaïre, Département des Mines, Direction de la Géologie, 66 p.

Maarten J. de Wit, Francois Guillocheau, Michiel C.J. de Wit, 2015. Geology and Resource Potential of the Congo Basin. Springer Heidelberg New York Dordrecht London, 445p.

Maurin, J.-C., 1993. La chaîne panafricaine ouest-congolienne : corrélation avec le domaine est-brésilien et hypothèse géodynamique. Bulletin de la Société Géologique de France 164, 51–60.

Milesi J.P., Toteu S.F., Deschamps Y., Feybesse J.L., Lerouge C., Cocherie A., Penaye J., Tchameni R., Moloto-A-Kenguemba G., Kampunzu H.A.B., Nicol N., Duguey E., Leistel J.M., Saint-Martin M., Ralay F., Heinry C., Bouchot V., Doumnang Mbaigane J.C., Kanda Kula V., Chene F., Monthel J., Boutin P. & Cailteux J., 2006. An overview of the geology and major ore deposits of Central Africa: Explanatory note for the 1:4,000,000 map ‘‘Geology and major ore deposits of Central Africa’’. Journal of African Earth Sciences 44, 571–595.

Corresponding author: e-mail, : yannwaku1@gmail.com, +243812056179

Mpaka W. Y. and Kandolo M. J., 2015. Contribution à l'étude lithostructurale et modélisation spatiale des linéaments extraits des images satellitaires de Tshela (kongo central), Université de Kinshasa, 93p, Unpublished memor.

Neumayr P., Walshe L. J., Horn L., Petersen K., Deyell C., Moran K., Howe D., Connors K., Stolz N., Morrison R. S., Hagemann S. G., 2004. Hydrothermal alteration footprints and gold mineralization in the St Ives gold camp. predictive mineral discovery CRC Conference, Barossa Valley, 165-170.

Pedrosa, S.A.C., Noce, C.M., Wiedemann, C.M. & Pinto, C.P., 2001. The Araçua – West-Congo Orogen in Brazil: an overview of a confined orogen formed during Gondwanaland assembly. – Precambrian Research, 110, 307-323.

Schermerhorn L.J.G., 1982. The age of the Vista alegre pluton and the unity of the west Congo sequence, annals de la socété géologique de Belgique, T. 105, pp.87-95.

Schwartz, D. & Lanfranchi, R., 1990. L'origine des gisements d'or du Mayon1be central (Congo) ; Quelques hypothèses. Geodynamique de la surface, pp. 155-160.

Steven, N.M., Badenhorst, F.P. & Petzel, V.F.W. 1994. A review of gold occurrences in the Northern and Central Zones of the Damara Orogen and the underlying mid-Proterozoic basement, central Namibia, Communs geol. Surv. Namibia, 9, 63-78

Tack L., 1975b. Etude pétrochimique de la Formation des Roches vertes de Gangila, Bas – Zaïre, Annales de la Société géologique de Belgique, 98, 229-249.

Tack L., 1979a. Etude pétrochimique du Mayumbien au Bas - Zaïre : une séquence volcano-plutonique acide précambrienne, Annales du Musée Royal de l'Afrique Centrale, Tervuren, Belgique, 8, Sciences, Géologiques, 84, 56p.

Tack L., 1979c. Données pétrochimiques concernant des roches vertes affleurant dans la région de Bibuanga au Mayumbe, Bas-Zaïre, Annales de la Société géologique de Belgique, 102, 185-187.

Tack L., 1983. Extension du Mayumbien au Bas-Zaïre : le problème de sa délimitation cartographique et implications sur les concepts du cadre géologique général du Precambrien du Bas – Zaïre, Rapport Annuel, 1981-1982 du Département de Géologie et Minéralogie, Musée Royal de l'Afrique Centrale, Tervuren, Belgique, 127-133.

Tack L. & Fernandez-Alonso M., 1998. The West Congolian Belt: a critical assessment of available time constra ints during the Neoproterozoic and Palaeozoic amalgamation of Gondwana, Special Abstracts Issue, Gondwana 10: Event Stratigraphy of Gondwana, Journal of African Earth Sciences 2 7, p. 193.

Tack L., Wingate M.T.D., Liégeois J.-P., Fernandez-Alonso M. & Deblond A., 2001. Early Neoproterozoic magmatism (1000–910 Ma) of the Zadinian and Mayumbian Groups (Bas-Congo): onset of Rodinia rifting at the western edge of the Congo craton, Precambrian Research 110, 277–306.

Weinberg, R.F., Groves, D.I., Hodkiewicz, P. & van der Borgh, P., ND. Controls on Gold Endowment: Shear Zone Comparison, Hydrothermal Systems, Giant Ore Deposits, Yilgarn Atlas Volume III UWA Gold Module, Part 1, AMIRA Project P511.

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