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Cartographic And Petrographic Aspectof Central Area Ofthe Kibarianbelt(Katanga ;South-East Of D.R.Congo)

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Abstract: *The veins of quartz, pegmatite and greisens associated with the Mesoproterozoic Kibarian belt show two preferential directions, NE-SW and NW-SE. The most noticeable are those oriented NE-SW. They are contemporaneous with the second phase of deformation (D2) and belong to the category of fourth generation granites (G4). EW orientation veins at WNW-ESE are less observed and associated with the first deformation phase (D1) that affected Kibarian age groups.*

In its central part, most of the veins observed are oriented NE-SW, with a metamorphic enclosure which includes the micaschists, gneiss, phyllades and quartzites, intersected by the magmatic bodies generally of acid nature. The granite complex ofManono is in the form of a boulderintersected by veins of quartz andpegmatites of centimetric, decametric and rarely metric sizes. They show apreferential NE-SW direction anddevelop Greisenian bodies on theirshoulders.

This complex is alsoobserved in the Bukena area and itsvicinity where it is intersected by twoNE-SW and NW-SE vein networks. Thetwo families of veins are present in theterritory of Mitwaba and moreprecisely in Lula, Shombio andKalumengongo where they were setup in a micachistous enclosure.

Fourfacies were identified in this studyarea (central domain): leucograniticfacies, oriented biotite granite facies,gneiss facies, and facies associatedwith the veins complexes (pegmatite and quartz veins).

Leucogranitesgenerally consist of felsic minerals(quartz, feldspar) and rarely biotite.Unlike leucogranitic facies, biotite-oriented granites show a not-negligible proportion of hydratedminerals (biotites and amphiboles).

The quartz veins are made up of 90%of the quartz; Pegmatites of quartzand white micas (muscovite) whereasgreisens are dominated by muscovite.

Tourmaline, apatite, plagioclases,topaz, fluorite, zircon and garnets arethe most important accessoryminerals in the typical petrographicsfacies of the central area of theKibarianbelt. The metallics mineralsare those of the tin group, they aremuch more encountered in the quartz,pegmatite veins and in the greisensassociated with the G4 granites.

Keys words:*cartography – petrography – central area -kibarian belt*

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I. Introduction

The Kibarianbelt ofmesoproterozoic age, of preferential NE direction, extends about 600 km long and 100 to 300 km wide. It is bounded in the East by a mosaic of the continental blocks prior to the Kibarian orogeny, consisting essentially of the Archean craton of Tanzania and the Paleoproterozoic block of Bangweulu, whereas in the West the belt is limited by the Archean craton to Paleoproterozoic of Congo-Kasai (Fig1) (Delhal et al., 1975,Kokonyangi et al., 2006).

This belt is one of the major orogenic cycles of sub-Saharan Africa, and is represented by the series of orogenic belts including the Kibarianbelt (KB) in DR Congo, Uganda, Burundi, Rwanda and Tanzania, the Irumidesbelt IB) in Zambia and Malawi, Zambia's Choma-Kalomo (CK), the Mesoproterozoic basement of the Botswana northwest rift (NW), the rehoboth inlier (RI) and the Sinclair sequence of Namibia (SS) Namaqua in Namibia and the Republic of South Africa, Natal (NaB) of the RSA, Foreland of the Mozambican Lurio(LuB)belt, also called Proto-Lurio(Sacchi et al. Pinna et al., 1993).

Thishigh orogenic activity is globally recognized as associated with theGrenvillian, and has been linked to the possible amalgamation of the Rodinian Supercontinent (McMenaminet al., 1990; Hoffman, 1991).

The Kibarien is one of the few well preserved Mesoproterozoic belts in the world (Kampunzu, 2001). This channel is better represented in our study area (in its central part).

Nevertheless, the orogenic evolution of this belt is poorly constrained in D.R. Congo due to the lack of precisestructural, petrological, geochemical and geochronological data (Kokonyangi et al., 2006).

This beltis one of the largest in Central and Eastern Africa and extends over 2000 km in length for its segment from Katanga to Kivu in DR Congo and Burundi and then to the NW of Tanzania and SW of Uganda.

The branches of this belt in Rwanda and Burundi take the name Burundien,Karagwe-Angkolean in Tanzania and Uganda (Kipata, 2007). The Kibarien of Katanga is separated from the Irumides belt by cover formations and by the pluton-volcanic complex of the Marungu of Ubendian age (Lower Proterozoic). (Sacchi et al.,1984).Finally, the Luhule-Mabissio formations and the Cingandasupergroup in Kivu (DR Congo) are linked to the Kibarianbelt(Kampunzu et al., 1986, Kokonyangiet al., 2006).

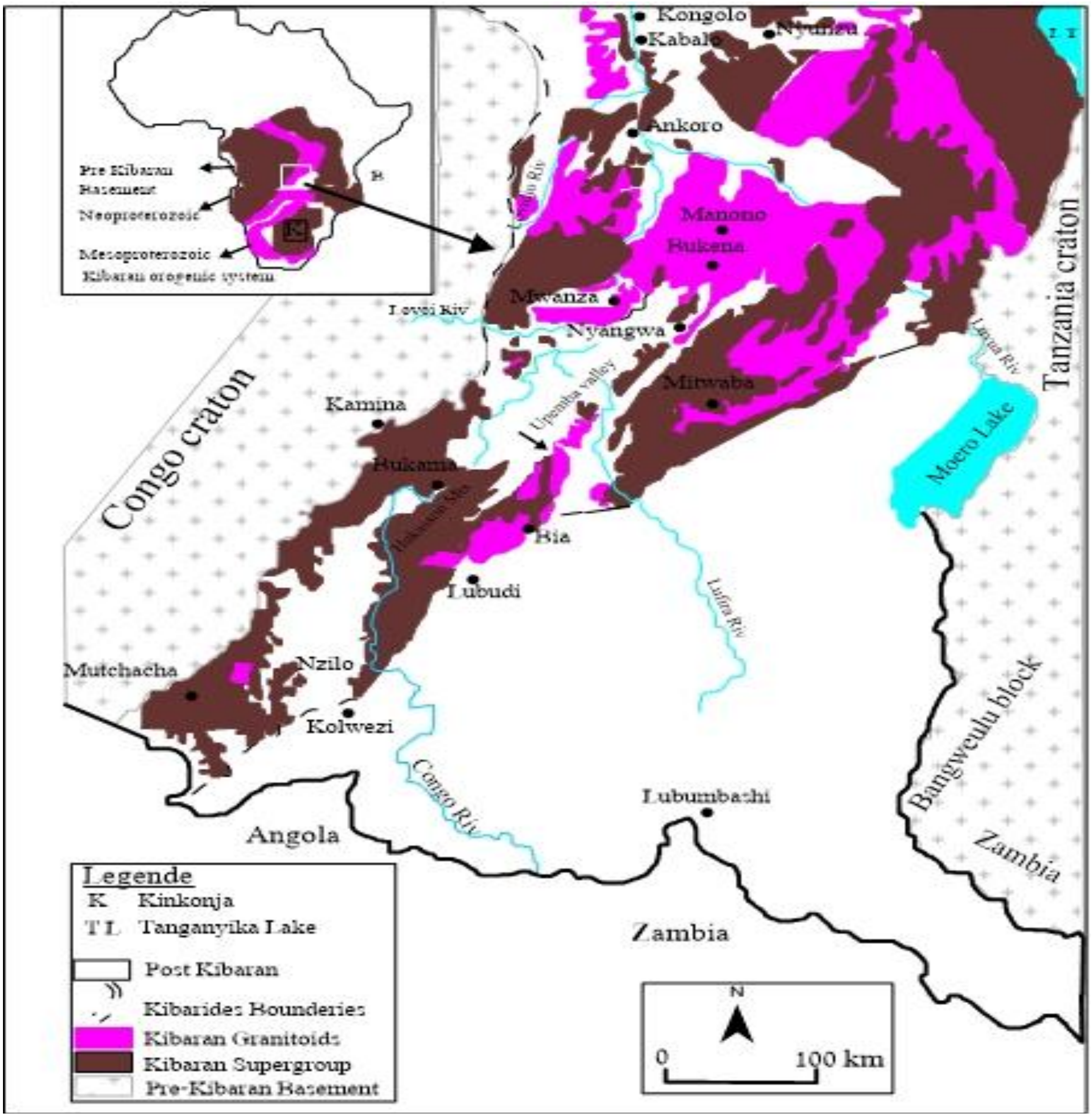

Fig.1.*KibarianBeltin thesouth-east partof DR Congo;showing the Kibarian Orogenic system distribution inSub-Equatorial Africa(Cahen, (1954) et Lepersonne (1974)).*

II. Regional geological context of theKibarianbelt

Most of the terrain encountered in theprovinces of Tanganyika and Lomami of medium Proterozoic age. Thesesame formations are also encounteredin the former Great Kivu, in Zambia(Irumides), in Burundi, in Rwanda andin Uganda. All these formations weredeformed during the Kibarianorogenesis between 1400-950Ma(Kampunzu et al., 1986) and between1600-970 Ma (Villeneuve et al., 2004, Kokonyangi et al., 2006 andBatumike, 2008).In Katanga, the Kibarian wereidentified for the first time in theKibara Mountains (De Magnée, 1934,Cahen 1954, Lepersonne, 1974), wherethey define a NE-SW oriented belt. InCentral and Southern Africa, this beltis about 3000 km long and 700 kmwide, where it changes its nameaccording to the region (Kipata, 2007).

The orogenic history of the greatKibarianbelt is well explained in the DRC. Structural, petrological, geochemical, and geochronologicaldata show that this belt was formedfollowing a collision of the Congocraton on the Tanzanian-Bangweulucratonic block, a collision that waspreceded by a subduction (Kampunzu and al., 1986; Kokonyangi, 2005).

Thisbelt represents one of the few wellpreserved Mesoproterozoic ages inthe world (Kampunzu et al., 2001).In Katanga, the KibarianMesoproterozoic range is between theKasai-Lomami (Congo Craton) Kasai-Lomami basement in the north-westand south-east by the CratonicTanzanian-Bangweulu block. In thispart of the DRC, this belt runs fromthe promontory of N'zilo to Kongolowhere it covers an area of about 600km in length and 100 to 300 km wide(Kokonyangi et al., 2006).

This belt consists of metasediments(Cahen et al., 1967 and 1984)intersected by supra-crustal graniticmarkers (Cahen, 1954, KlerkX et al.,1984, Kampunzu et al., 1986, 1998,Kokonyangi) With few carbonatesediments observed in the Lubudiregions. This Super Group ischaracterized by Mesoproterozoic (1.6Ga - 1.1 Ga) formations and isaffected by isoclinal folds of NE-SWstructural directions. The Kibarian isclassically subdivided into four groupsthat show in general lithostratigraphic,metamorphic and structural featuressurmounted by Katangian formationsthrough a conglomerate (Lepersonne,1974, Kokonyangi, 2005). It issubdivided as follows from top tobottom: the Lubudi Group (K4), theHakansson Group (K3), the N'ziloGroup (K2) and the Kiaora Group (K1).Studies in this belt have allowed proposing two models of thegeodynamic evolution of this belt. Thefirst model advocates the hypothesisthat the Kibarianbelt would haveevolved from the Rift system to acollision (Klerkx et al., 1987); (Kampunzu et al., 1986, Kokonyangi, 2006), the Kibariennebelt is said to have formed after a collision of the Congo craton with the Bangwelu-Tanzaniancratonic block.

III. Presentation of the study area

The central area of the Mesoproterozoic belt (Fig.2) is between the meridians 26° and 29° E and the parallels 7° and 9°S and groups together the square degree of Mwanza between 26° and 27° east longitude and between 7° and° South latitude comprising the sites of Mwanza, Kakitengo, Kabango, Kabala, Kambeya, Kamose and Mputu; The square degree of Manono between 27° and 28° longitude E and between 7° and 8° latitude S including the sites of MuntuMpeke, Kanuka and Bukena; The square degree of Mitwaba situated between 27° and 28° longitude E and 7° and 8° latitude S including the sites of Lula, Kalumengongo and Shombio.

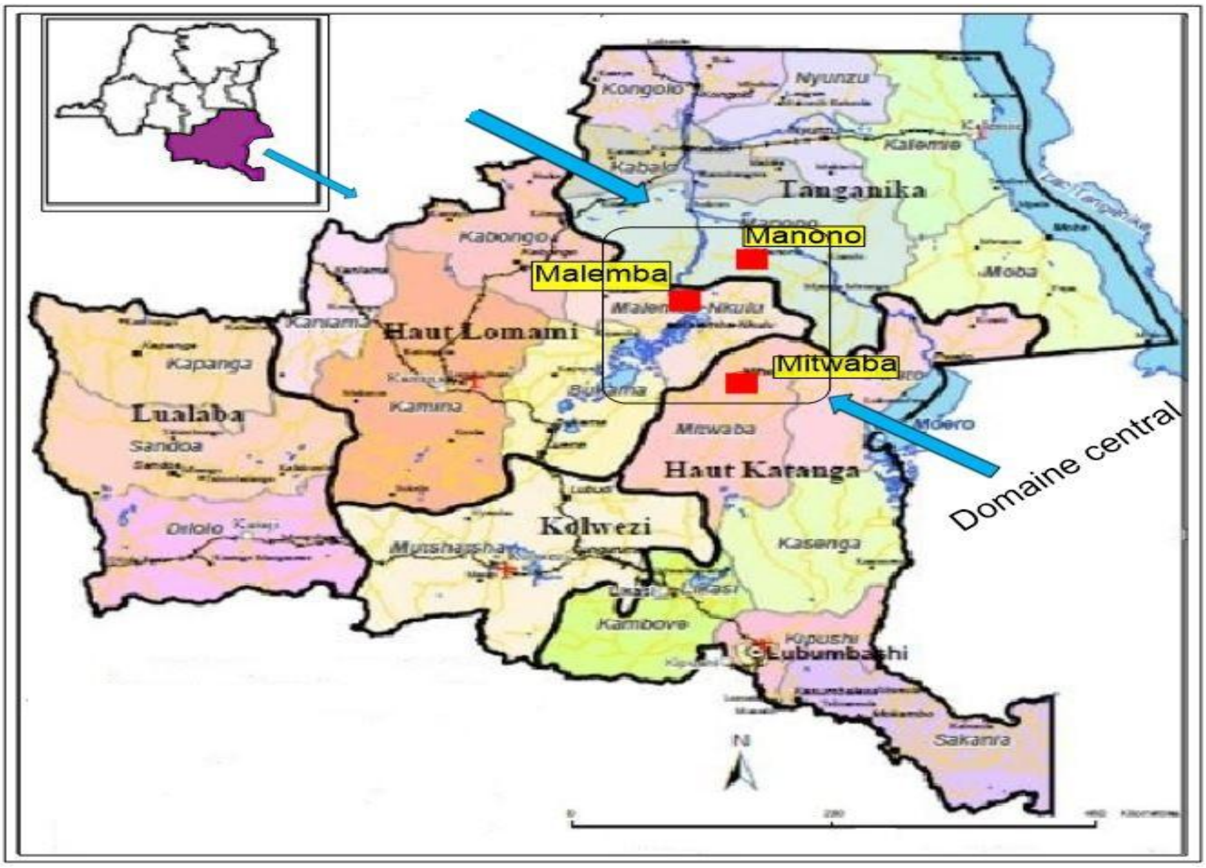

Fig2. Map showing the field of study.

IV. Field data

The main lithological units observed in the delineated area are, on the one hand, metamorphic rocks and on the other hand magmatic rocks. Metamorphites include gneisses, micaschists, quartzites, phyllades, amphibolites, metapelitesandmetaconglomerates.

The magmatics rocks are generally acidic and veined, represented by granitoids complexes with their vein cortege (pegmatites, aplites, quartz) and greisens. The presence of basic rocks in the form of enclaves in the granitoids is noted. The veins show two preferential directions NE-SW attached to phase D2 and NW-SE related to phase D1 (Kampunzu et al., 1986).

The following tables present the lithostratigraphic data collected in the following sites: Mwanza, Kakitengo, Kambeya, Kabala, Kamose, Kabango and Mputu.

The Field data relative to different sites are announcedin the tableI

Table1.*Cartographic data collectedin Mwanza, Kakitengo, Kambeya, Kabala, Kamose, Kabango andMputu.*

Square degrees	Sites	Metamorphic rocks	Magmatic Rocks	Observations
Mwanza	Mwanza	gneiss, micaschists et quartzites	granite, pegmatite, greisen, Quartz veins and basic enclaves	At Mwanza, the Quartz veinsare oriented NE-SW.
	Kakitengo, Kambeya, Kabala, Kamose et Kabango.		granitoïds, pegmatites, Quartz veins and basic enclaves smalls veins	The Quartz and pegmatite veins are showing two preferential directions (NE-SW et NW-SE With an average dip from 80o to NW respectively towards the SW. The NW-SE oriented veins are considered as 1st generation shifts oriented NE-SW. The pegmatites are intrusive in the granitoids and quartz veins in the pegmatite.
	Mputu	micaschists et gneiss	granite, pegmatite, aplite, greisen, Quartz veins and gabbro.	The basic enclaves are flush with the SE of the sector, they are oriented NE-SW and contagious in the granitoids. NW-SE- oriented quartz veins contain stanniferous mineralization and develop beyond the granite body

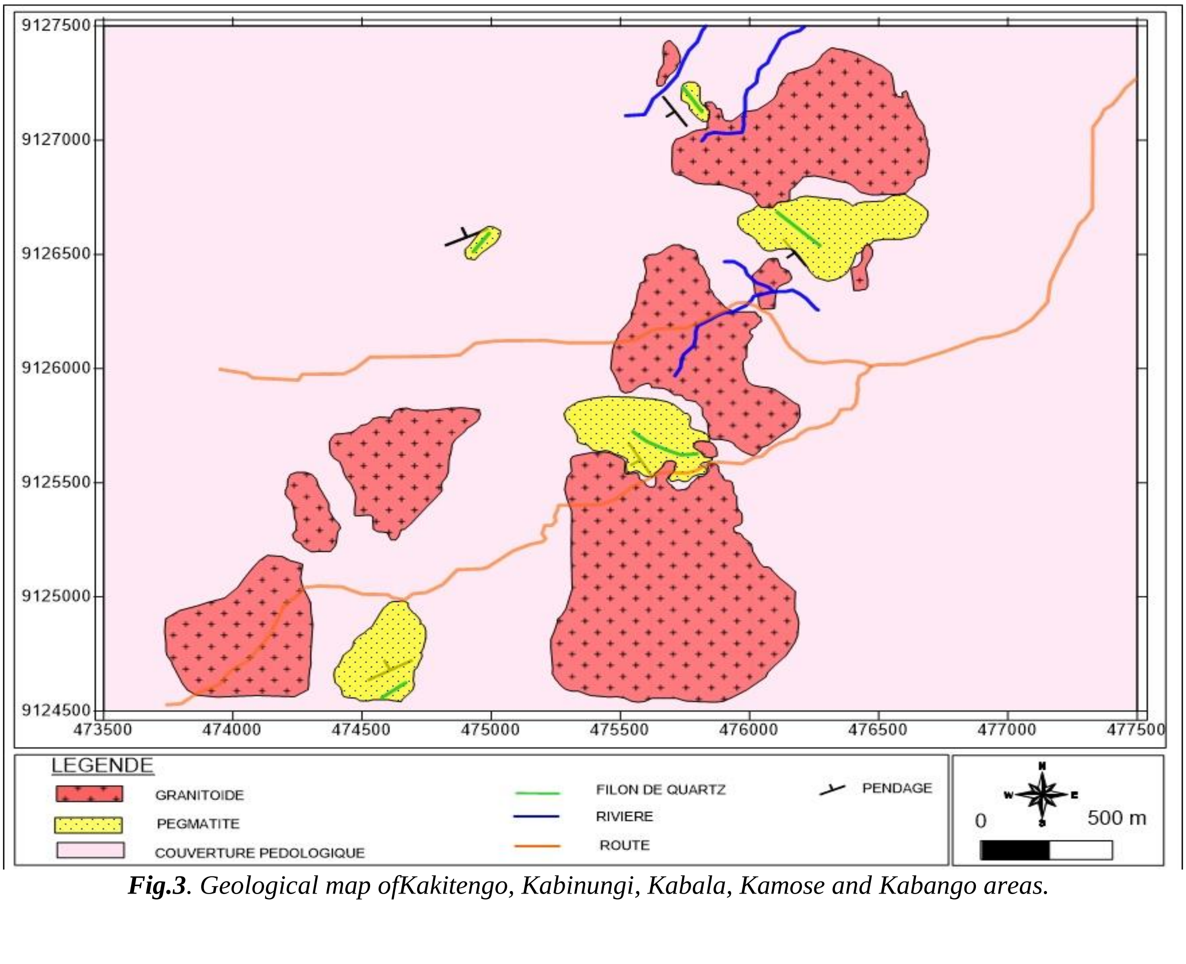

Fig.3*. Geological map ofKakitengo, Kabinungi, Kabala, Kamose and Kabango areas.*

The field data relative to***MuntuMpeke -Kanuka andBukena***are announced in the table 2

Table2.*Cartographic data collected at MuntuMpeke-Kanuka andBukena.*

Square degrees	Sites	Metamorphic rocks	Magmaticrocks	Observations
Manono	MuntuMpeke-Kanuka	gneiss, micaschists and quartzites.	granite, amphibolite, phonolite, pegmatite and Quartz veins.	The main part of the complex consists of granites flushing in the form of a gigantic highly eroded batholith. The quartz and pegmatite veins are centimetric, decimetric and metric, NW-SE and intrusive in the granites. The pegmatites are thicker and contain the stanniferous and colombo- tantaliferous mineralization
	Bukena	orthogneiss and quartzites	granite, pegmatites and quartz veins granulites.	The geological formations in the Bukena area are mainly granites traversed by veins of quartz and oriented greisens NE-SW and NW- SE

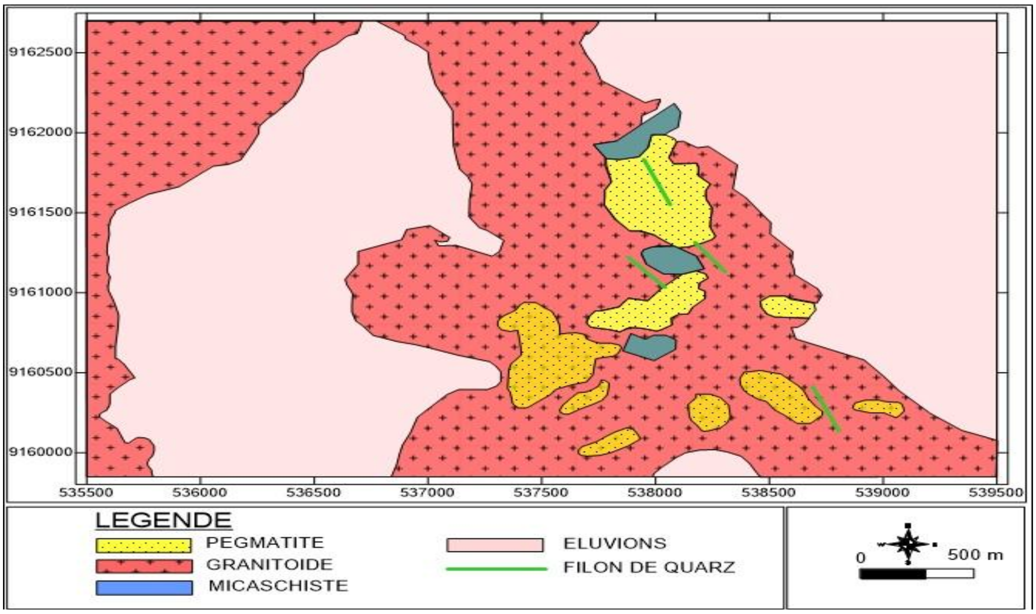

Fig.4.*Geological map ofMuntuMpeke area.*

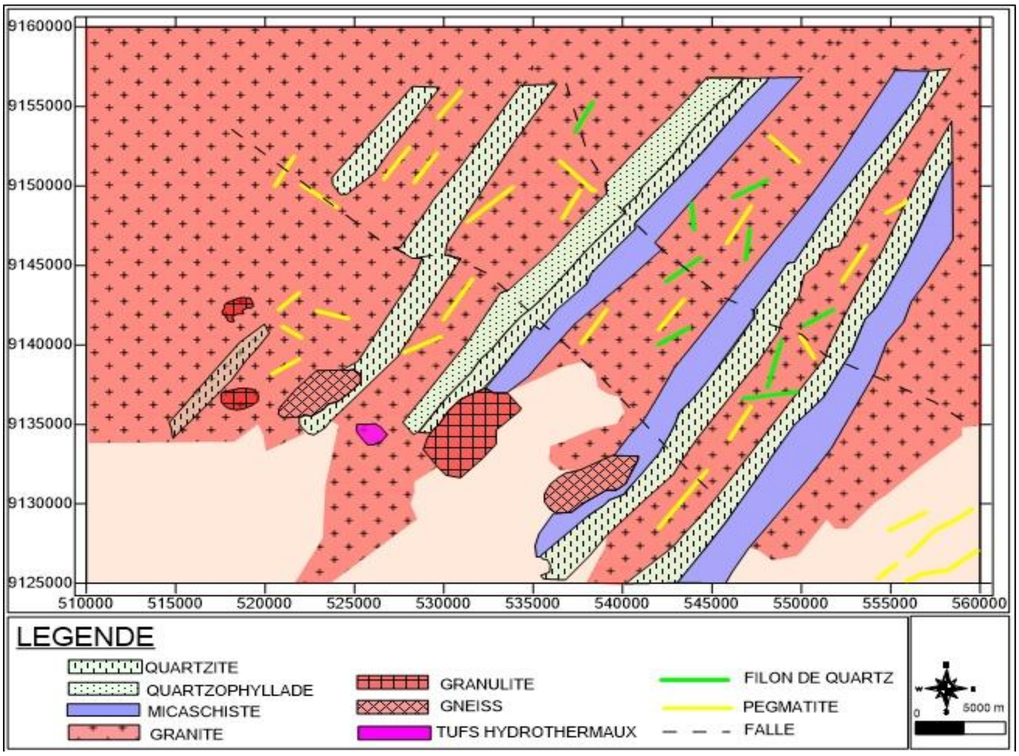

Fig.5.*Geological map ofBukena area and its surrounding.*

***Tableau 3.**Cartographic Data collectedin square degrees ofMitwaba (Kokonyangi et al., 2004).*

Square degrees	Sites	Metamorphic rocks	Magmatic rocks	Observations
Mitwaba	Lula, Shombio, , Kalumengongo.	micaschists, phyllades and quartzites.	Quartz veins, greisens and granite.	Greisens veins, of quartz and of pegmatites present in Lula area, Kalumengongo andShombioare showingthree general directions; they are either oriented NE-SW, either E-W or NW-SE and present a sub-vertical dip to the SW. They are intrusive vein,the micaschistsorin thephylladesand rarely in the granitoïds.

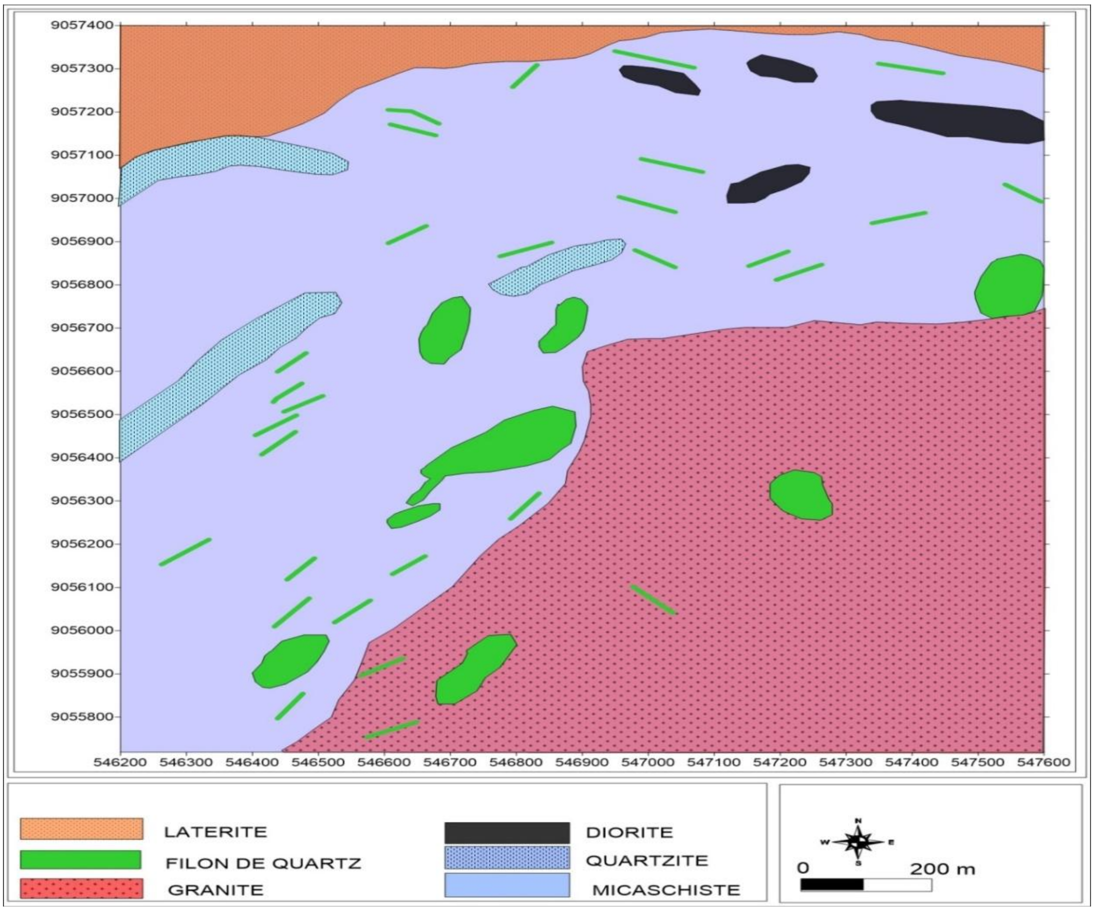

***Fig.6.**Geological mapof Shombio area*

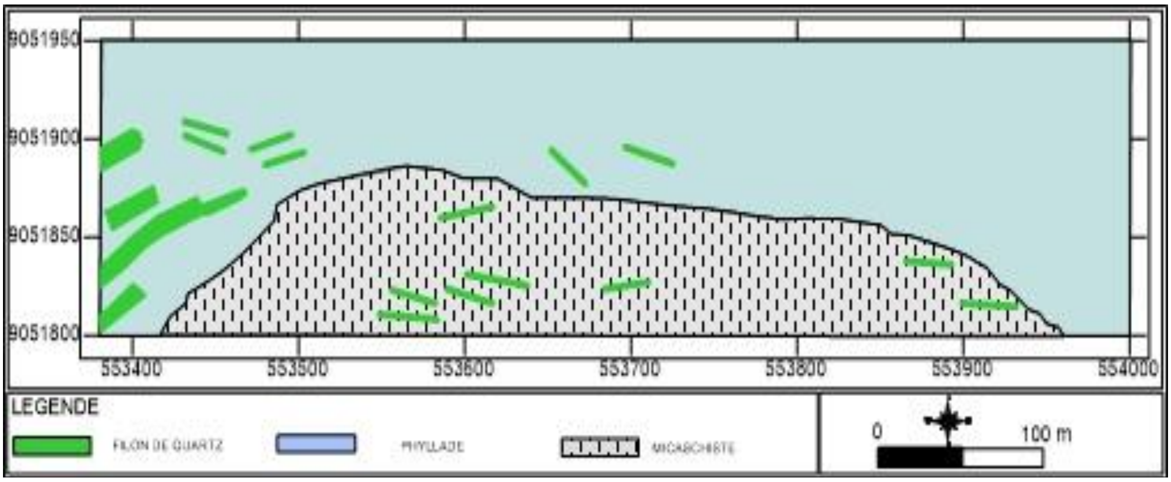

Fig.7. Geological map ofKalumengongo area.

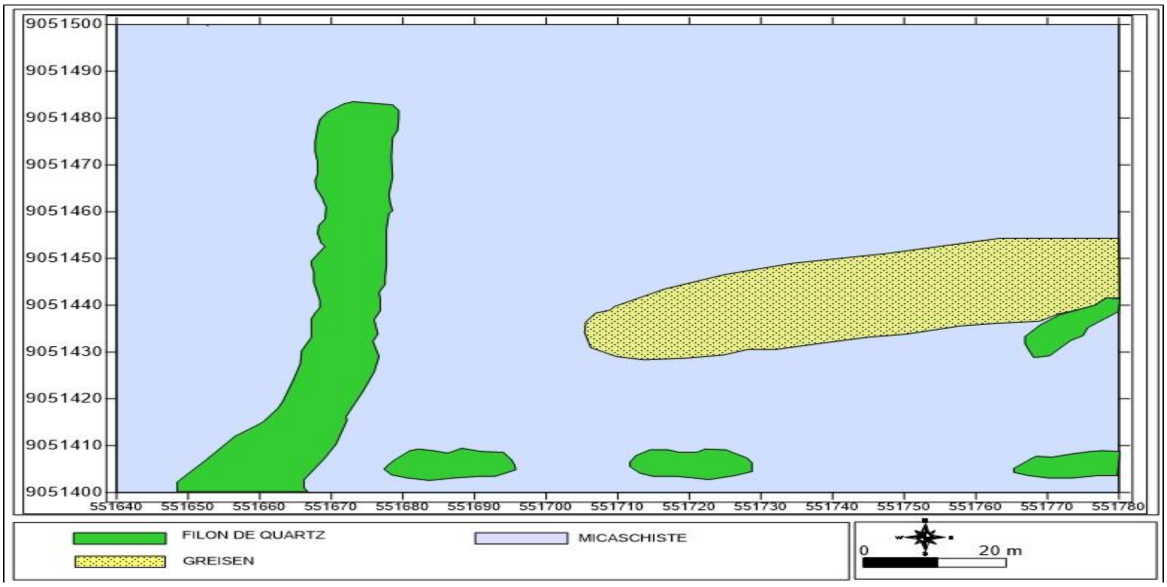

***Fig.8**. Geological map of theShombio area.*

V. Petrographic And Mineralogical Data

Petrographic and mineralogical data the center of the Kibarien consists essentially of magmatic rocks, represented by granitoid, intersected by veins of pegmatites and quartz. The latter contain stanniferous mineralization.Different facies of magmatic rocks have been revealed in this part of the belt, among others the Leucogranitic facies, Granite facies oriented to biotites, gneissic facies and facies with complex vein (pegmatites, quartz veins, basic enclaves, aplites, etc. .).

The petrographic and mineralogical data of the various sectors studied in the central domain are shown in Tables 4, 5, 6, 7 and 8.

***Table4.** Synthesis ofpetrographic and mineralogicalobservations of magmatic rocksKabango, Kakitengo, Kamose andKambeya area.*

Petrographic Types	**Textures**	**Minerals**		**Metallics minerals**
		Essential	**Accessory**	
Leucogranites	Grainy	Quartz, feldspar K, biotite, plagioclase		Goethite and hematite
Granites oriented to biotite	Grainy	Biotite, quartz and feldspar	Muscovite	Bornite, covelline and goethite
Basic enclaves	Grainy	Biotite and amphiboles	Quartz, feldspar and muscovite	
Quartz veins	Grainy	Quartz		Cassiterite
Pegmatite veins	Graphic	Quartz, feldspar and muscovite	Biotite and tourmaline	Cassiterite and hematite
Greisens	Spherolitic	Muscovite and quartz		Cassiterite et goethite

***Tableau 5.** Petrographic Facies of the formations cropping outin the MuntuMpeke area.*

LithologicalTypes	**Petrographics Types**	**Minerals**		**Metallics Minerals**
		Essential	**Accessory**	
Metamorphics rocks	Gneiss	Quartz, feldspar K, muscovite and Biotite		Hematite, goethite chalcopyrite and pyrite
	Micaschist	Biotite and quartz		Hematite, goethite and pyrite
Magmatics rocks	Pegmatite	Quartz, feldspar K, plagioclase and muscovite	Biotite and apatite	Goethite and hematite
	Aplite	Quartz, muscovite and feldspar K		Goethite and hematite
	Granite	Quartz, feldspar K, muscovite and biotite	Plagioclases	Goethite and hematite
	Quartz veins	Quartz		Goethite, pyrite and cassiterite

	Greisen	Quartz and muscovite	Topaz, tourmaline, fluorine and apatite	Hematite, cassiterite and chalcopyrite
	Gabbro	Hornblende, plagioclase and pyroxenes		Pyrite and goethite

Table6. *Petrographic Facies of the formations cropping out in the Mitwaba area.*

Petrographic Types	**Textures**	**Minerals**		**MetallicMinerals**
		Essential	**Accessory**	
Granite	Grainy	Quartz, feldspar K, biotite and muscovite	Tourmaline	Cassiterite, goethite and haematite
Foliate Granite	Granolepido-blastic	Quartz, microcline, biotite, muscovite and plagioclase	Zircon and tourmaline	
Greisen	Lepidoblastic	Quartz and muscovite	Tourmaline	Cassiterite, chalcopyrite and goethite
Quartz veins	Grainy	Quartz		Cassitérite and goethite
Tourmalinite		Tourmaline		Chalcopyrite, goethite and hematite
Diorite(Greenstone)	Granophyric	Amphibole, plagioclase, quartzand biotite	Epidote	

Table 7. *Petrographic and mineralogical faciesin MuntuMpeke,Bukena,Kalumengongo and Kabinungi.*

Lithological Types	**Petrographic Types**	**Minerals**		**Metallicminerals**
		Essential	**Accessory**	
Metamorphics rocks	Quartzite	Quartz, plagioclase, Phyllites		Hématite, goethite, chalcopyrite et oxydes noirs.
	Gneiss	Quartz, feldspar K, biotite		
	Micaschist	Quartz, biotite, muscovite and feldspar	Tourmaline andandalousite	
	Phyllade	Quartz and muscovite	Biotite and amphibole	
Magmatics rocks	Granite to both mica	Quartz, feldspar K, biotite, and muscovite		Pyrite, chalcopyrite, goethite, hématite et chalcosine.
	Granite to muscovite	Quartz, feldspar K, biotite, muscovite	Amphibole, plagioclase	Goethite, hematite and cassiterite.
	Granite to orientedbiotite	Quartz, feldsparK, biotite	Amphibole and plagioclase	Goethite, hematite, chalcopyrite and cassiterite, columbo-tantalite.
	Pegmatites	Quartz, feldspar K, muscovite, biotite	*garnets*and plagioclases	Pyrite, goethite, chalcosine, hematite, chalcopyrite.
	Granite	Quartz, feldspar K, biotite, muscovite		Goethite, hematite, chalcopyrite and cassiterite.
	Pegmatite	Quartz, feldspar K, muscovite, biotite		Hematite, chalcopyrite and goethite, cassiterite andcolumbo-tantalite.
	Greisen	Lépidolite and quartz	Plagioclase	Goethite and chalcopyrite.
	Quartz veins	Quartz	Tourmaline	Cassiterite

Table 8.*Petrographic and Mineralogical types cropping out in Bukenaand its surrounding.*

Lithological Types	**Petrographic Types**	**Textures**	**Essential and accessoryMinerals**	**MetallicMinerals**
Metamorphics rocks	Gneiss	Grainy	Quartz, biotite, muscovite, orthose, sillimanite, topaz, and disthene	Cassiterite, pyrite, wolframite, hematite and goethite
	Quartzite	Isogranular	Quartz, biotite, feldspar, chlorite and sericite	Goethite and chalcopyrite
	Micaschist	Grano-lepidoblastic	Calcite, quartz oiled, minerals argileux et biotite	Pyrite, chalcopyrite, hematite and goethite
Magmatics rocks	Granite	Grainy	Quartz, microcline and biotite	Cassiterite, pyrite, chalcopyrite, hematite and goethite
	Pegmatite	Granular	Quartz, orthose, plagioclase et biotite	Cassiterite, pyrite and chalcopyrite,

VI. Discutions and Conclusions

Remainingconscious that the simplerecognition of the spatial distribution of lithologicals units represents only a part of the knowledge of the geological evolution of a region and the precise lithological identification. However, the present study presents a detailed lithostratigraphic knowledge of the central domain of the mesoproterozoic Kibarianbelt.

Indeed, this study proposes axes of research that can be carried out in the future in this belt of high orogenic activity, with a view to perfect geological knowledge of this important belt which contains abundant and varied mineralization. In this central part of the Kibarian, the pegmatitic veins collect the stanniferous mineralization. The latter are accompanied by niobium, tantalum and tungsten.

In the degree of Mwanza, the formations of the enclosure are constituted of gneiss and granitoids, intersected by NE-SW oriented pegmatite veins concentrated much more in the NW part of the sector. These formations are strongly altered in some sites and have given rise to a granite arena.

In the SE section of the Mwanza square, mineralized formations (pegmatites and quartz veins) shows two preferential directions (NE-SW and NW-SE); they are intrusive in the granitoids. In the south-east, we encounter in the granitoids, the filaments of basic enclaves of about 25 to 40 cm oriented NE-SW. The first network of NW-SE oriented quartz veins contains very powerful veins 6 to 7 m wide. They contain stanniferous mineralization and develop beyond the granite body; On the other hand the second network is weakly mineralized and consists of less developed veins located mainly in the apical parts of granitoid. Structurally, NE-SW oriented veins contemporaneous with the second deformation phase (D2) are highly mineralized in contrast to those oriented NW-SE.

The mineralization is encased in veinsof quartz, greisen and generally inpegmatite. The latter is in the form ofNE-SW oriented veins and is widelyexposed in the northwest part of theMwanza square degree.The structural markers observed inthe Muntu-Mpeke region show thepresence of two phases ofdeformation, one of which is plastic,and is marked by the presence of N78o E oriented magmatic fluidity; Theother is rigid, marked by the existenceof several networks of N-S or E-Woriented breaks, some of which arefilled and constitute the veins ofpegmatites.

The bulk of the complexconsists of granites flushing in theform of a gigantic highly erodedbatholith. The rock is leucocrate to mesocrate.

The rock has a grainystructure and is mainly composed ofquartz, feldspars and micas (biotiteand muscovite). In Bukena and itssurroundings metamorphic rocks(quartzite, gneiss, quartzophyllades, schists and micaschists) areobserved oriented NE-SW directionand shifted by two large NW-SEoriented faults.

The geological formations flush in thisregion are mainly granites intersectedby veins of pegmatites, quartz andgreisens. Acid formations includepegmatite, which appears to be thebest exposed rock at the outcrop, twomicas granite, lithiniferous granite,greisen and aplite. On the hills ofNgulu and Kalimulembe,the eluvium shows the presence ofnumerous crystals of Wolframitewhose edges are generally rounded.

Quartz veins and greisens constitutethe most heavily mineralized bodies atLula, Shombio and Kalumengongo.They contain cassiterite and aremainly oriented NE-SW, rarely NW-SEand are intrusive in the micaschists orin phyllades.

The various petrographics types encountered in the study areaare characterized by a lepidoblastictexture (for mica-schists and phyllades), oiled (for gneiss) andgrained to granoblastic (for quartzitesand gneisses). They contain thefollowing cardinal minerals: quartz,muscovite, alkaline feldspars,phyllites, plagioclases, biotite, sericite, and chlorite; But also tourmaline,andalusite, sillimanite, disthene,orthose and topaz as accessoryminerals. Metallics minerals are foundthere but in very small proportions.

The presence of quartz, muscovite,biotite, orthose, andalusite, distheneand sillimamite; Allows us to classify these metamorphites on the one handin the series of facies with andalusite-sillimanite (Aboukuma type) and on the other hand in that of disthene-sillimanite (Barrow type).

The majority of magmatic formationsare plutonic (acids and intermediates)and show textures greeted with the naked eye and under the microscope. Theserocks contain the mineral speciesmost commonly encountered in acidics rocks (quartz, K feldspar, muscoviteand biotite); there is an assortment ofvaluable and semi-precious mineralssuch as: tourmaline, topaz, fluorite,zircon, monazite, apatite, etc.

Theseminerals are much more noticeable inquartz and pegmatite veins. Most ofthe metallic minerals pinned in theprevious tables are enclosed in themagmatics rocks. The presence ofcopper-bearing minerals (malachite,azurite and covelline) is reported inBukena and more specifically inMuzozwe.

Finally, in the central domain, theenclosure is generally metamorphic,intersected by veins of pegmatites andveins of quartz. Mineralized rocks(pegmatite and quartz vein) show twopreferential directions (NE-SW and NW-SE) and are associated with Granitoids.

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