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(RESEARCH ARTICLE)

Geological features of the Silakoro (Kintinian) gold deposit, SAG concession-Siguiri prefecture-Kankan-Guinea administrative region

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Abstract

The growth in the world's population sometimes leads to an increase in demand for useful minerals that are essential for the production of goods and services. The Siguiri area, which belongs to the Birimian, is highly mineralised with open-pit gold structures. For this reason, this study could be useful for anyone wishing to understand the geological features of the Silakoro gold deposit in the field, and could also serve as a guide for any subsequent geological study of a gold deposit.

A geological study is essential for understanding the technical parameters of any deposit. Consequently, the need to seek out new mineral concentrations remains useful for the entire nation. The aim of this research work is to carry out an in-depth geological study to determine mineral associations, the nature of the host rock and other factors for future work. To achieve this objective, we used a number of research methods, including field reconnaissance and macroscopic and lithological analyses of samples taken both on the surface and at depth.

The geological work carried out with Minéral Ressource Management (MRM) has enabled us to understand the emplacement and behaviour of the various formations studied, thanks to their petrographic, mineralogical and lithological characteristics. In addition, there are the folding and disjunctive structures responsible for the formation of the Silakoro deposit.

Keywords: Birimian; Resources; Silakoro; Meta-sediment; Disjunctive.

1. Introduction

Ever since man first appeared on earth, he has never ceased to be interested in mineral substances with a view to satisfying his needs, improving his living conditions and expanding his economy. The geological studies carried out have established that Guinea has been the privileged host of several complex geological factors that have created an environment favourable to the genesis and accumulation of a diversity of mineral resources, some of which have exceptional parameters **[1]**.

The Republic of Guinea is a mining country, and in 2019 will rank eighth among the largest gold producers in Africa and third in the world, with production of 27.5 tonnes/year. These deposits are mainly located in Upper Guinea. On a global scale, gold mining contributes to a country's economic development by creating jobs, but it also has a negative impact on the environment, notably by polluting water resources **[1] - [2]**.

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The concession held by Société AngloGold Ashanti de Guinée (SAG) is a subsidiary of AGA (AngloGold Ashanti). It was created on 15 April 1998 by a mining agreement between the Guinean state and the company's partners, covering a total area of 1,495 km^2 **[1]**.

Feasibility studies carried out in 1996 estimated reserves at 59.3 million tonnes with an average gold grade of 1.54 g/tonne. Mining began on 13 November 1997 and the first ingot was produced on 8 February 1998. The mine was officially inaugurated on 15 April 1998 by the then Guinean government. At the time, the mine was owned by Ashanti Goldfield, a company based in Ghana. It became AngloGold Ashanti (A.G.A) in April 2004 with the merger between Ashanti and AngloGold based in South Africa **[3]**.

In 2007, the Company produced 280,000 ounces, equivalent to 5% of the Group's A.G.A. at that date. The mine is an open-pit operation, and processing has been changed from Heap Leach to C.I.P. (Carbon In Pulp), which is more efficient than heap leach in terms of recovery **[2]**. This company (AGA) owns several mines around the world and is present in 10 countries (Guinea, Mali, Ghana, Tanzania, DRC, South Africa, Namibia, Australia, Brazil and Argentina) around the world **[3] - [4]**.

The Republic of Guinea is a country with exceptional mineral potential, with various deposits and showings. The potential of the Silakoro (Kintinian) gold deposit, which belongs geologically to the Siguiri sedimentary basin, has been a magnet since ancient times **[4]**.

1.1. Geographical context

The concession held by Société AngloGold Ashanti de Guinée (SAG), a subsidiary of AGA (AngloGold Ashanti), is located in the north-eastern part of the Republic of Guinea. It belongs to the Prefecture of Siguiri, bordered to the north and north-east by the Republic of Mali, to the north-west by the Prefecture of Dinguiraye, to the south by the administrative region of Kankan and to the south-west by the Prefecture of Kouroussa **[4] - [5]**.

According to **[4]**, the Sub-Prefecture of Kintinian, SAG's main mining site (fig.2), is one of the Sub-Prefectures of Siguiri located 25 km to the west and 887 km from the capital Conakry. It has a surface area of 15,500km2 and an estimated population of 724,631 (2016 census), giving an average density of 47 inhabitants per km2. (https://www.assemblée.gov.gn/siguiri, consulté le 14 Août 2022).

This gold-bearing region generally belongs to the geological subdivision of the Siguiri sheet between coordinates 10°30' and 12°00' North and 8°00' and 10°00' West (**Figure1**) **[5]**. The study area is shown in **Figure 2.**

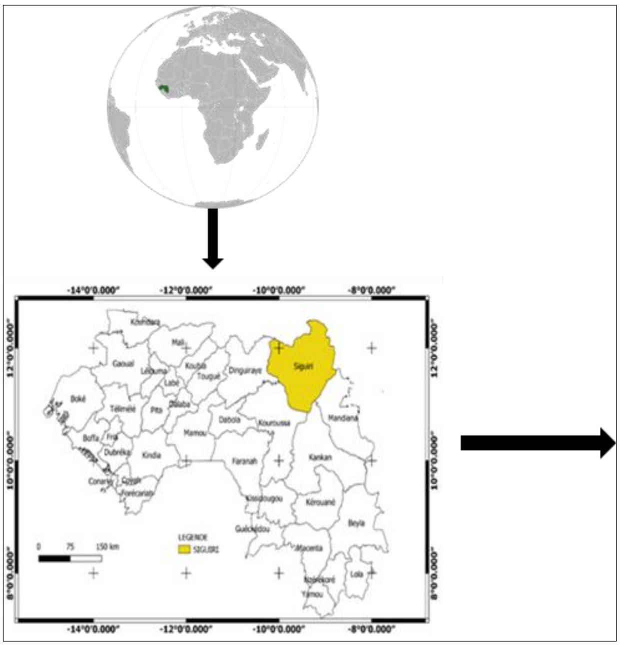

Figure 1 Administrative map of Guinea

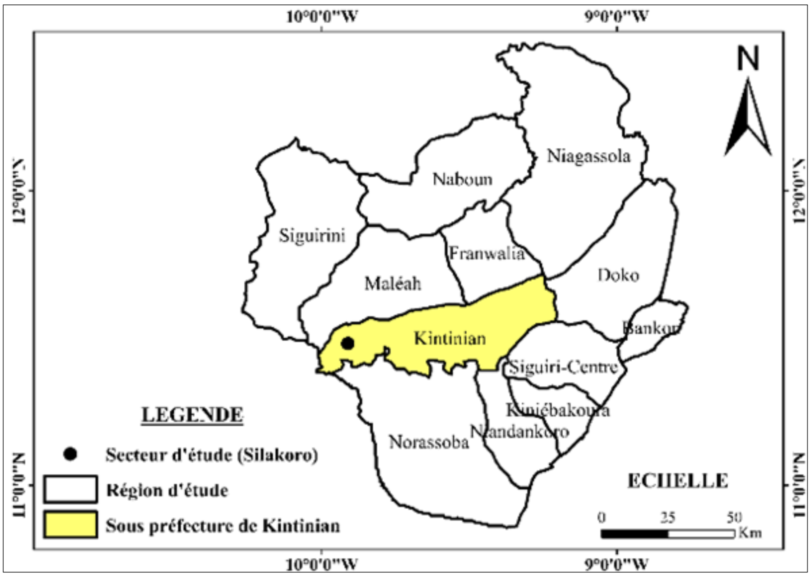

Figure 2 Location map of the study area

1.2. The West African Craton

Geologically, the study area is part of the Guinea Gold Province, known as a gold-producing province since the 12th century, and lies within the West African Craton (**Figure 3**). It comprises the Archean series of the Guineo-Liberian Shield and the Palaeoproterozoic formations of the Baoulé-Mossi Domain covering Ghana, Côte d'Ivoire, Guinea, southern Mali, Burkina Faso and western Niger,..... These Palaeoproterozoic formations are known as the Birimian **[6]**.

1.3. History of the geological study of the study area

The geological study of the Guinean territory had been carried out in a discontinuous manner and with little precision according to the immediate interests of metropolitan France. It was not until 1919 that H. Hubert drew up the first geological map of Guinea on a scale of 1:1.000.000 with a view to a systematic study. It was within this framework of general studies that the Siguiri region was the subject of geological studies **[6]**.

In 1927, the first major geological work was carried out in the north-east of the country following the work of A. Lenoble on the Kankan, Siguiri and Dabola circles. In the same year, R. Furon described the Niger and Milo valleys. From 1931 to 1934, R. Goloubinov carried out a geological survey on a scale of 1: 500.000 of the Kankan-Est sheet and described for the first time the outcrops of metamorphic schists at Kourouni (Siguiri), which he attributed to the Precambrian (metamorphic Birimian) **[5]** - **[6]**- **[7]**.

According to **[8]**, it was in 1938 that R. Goloubinov took up and completed A. Lenoble's study of the Kankan, Siguiri and Dabola circle on a scale of 1: 500,000. The Archean plutonic terrains of Upper Guinea were initially described by Obermuller (1941) and Roques (1948) **[8]**.

In 1977, Bessoles showed that these formations have petrographic characteristics and lithological associations comparable to the Leonian and Liberian of Sierra Leone, Liberia and Côte d'Ivoire. The 1:200,000 scale mapping programme carried out by teams of Soviet and Guinean geologists made a major contribution to the characterisation of these plutonic formations **[9]**.

Finally, the compilation, geo-traverses and radiometric dating carried out by the Pagem project (1998) took stock of our knowledge and clarified the age of the Archaean terrain (**Figure3**) **[10]**.

1.4. Geological make-up of the study area

1.4.1. Stratigraphy

According to **[11]**, the stratigraphic study is based on the geological chronology of the different formations crossed from bottom to top, according to the results of the mission reports. This stratigraphy is presented by priority in the study area as follows:

- Lower Proterozoic: represented by the Birimian and outcrops over almost the entire study area except for the north-western part.
- The Birimian Serie: it has been subdivided into two layers: a lower sedimentary layer, made up of phyllites, green shales, etc...... and an upper effusive layer made up of magmatic lavas and volcanic tuffs. The geological map of the Birimian basin is shown in (**Figure 3**).
- Upper Proterozoic (PR3): this formation is widely exposed in the north-western part of the region, where it is intercalated between the Birimian basement and the basic rocks of the Mesozoic (gabbros and dolerites). The Upper Proterozoic sandstones and conglomerates form the subhorizontal formations bounded by cliffs that are clearly visible in the landscape and form the first step of the plateaux developing towards the Republic of Mali **[11] - [12]**.
- The Palaeozoic: this contains the Ordovician series, which outcrops in the northern part of our study area and overlies granites of Upper Proterozoic age. At the base of this series lies a layer of coarsely bedded quartz conglomerate, a few tens of centimetres thick.
- The Cenozoic: the Cenozoic formations are made up of the weathering crust and recent deposits of alluvium from the terraces and river beds. The Middle Quaternary is characterised by sandy and clayey deposits 4-8m thick. The Upper Quaternary contains more widespread deposits than the Middle Quaternary. It is represented by sandy and clayey deposits varying in thickness from 5-7 m (**Figure 3**) **[12]**.

1.4.2. Metamorphism

It is characterized by a low intensity (green schists) with multiple trends. The first model considers that this is essentially thermal metamorphism linked to the rise of magmatic solutions and the burial of terrains by gravity tectonics. The second model attributes the metamorphism (in terms of pressure) to the burial of terrains linked to tectonics (**Figure 3**) **[13]**.

1.4.3. Magmatism

According to **[14]** our study area is characterized by two magmatic complexes:

- The Lower Proterozoic magmatic complex (PR1)

Made up of plutonic magmatic rocks (monzogranites and granodiorites)

  - Monzogranites (^{2}⍰2-3) : outcrops in the Maléah area in the north-west of the region, and is partially covered by Upper Proterozoic sediments and Mesozoic dolerites.
  - Granodiorites (T⍰4) : these rocks outcrop to the west of the study area, on the right bank of the Tinkisso river. They are also medium-grained granodiorites, rich in systematically zoned automorphic plagioclase (albite-oligoclase).

- The Mesozoic magmatic complex (MZ).

It is represented by basic intrusions (doleritic and gabroic) in the form of sills and dykes. Petrographically, these rocks are compact, hard and grey-green in colour, with a massive texture and amphibolitic structure. They are essentially composed of feldspars and pyroxene, with hypersthene predominating over augite (**Figure 3**) **[15] - [16]**.

1.4.4. Tectonic

According to [16], the study region belongs to the Guineo-Liberian shield of the African platform.

There are two (2) structural stages:

- The upper structural stage;
- The lower structural stage.
- Upper structural floor or roof: In the study area, as throughout the Guineo-Liberian Shield, this stage is essentially made up of subhorizontal sedimentary rocks of the Upper Proterozoic resting in clear angular unconformity on the basement. The rocks of this stage are weakly folded and metamorphosed compared with those of the basement, and include sandstones, terrigenous deposits and river alluvium.
- Lower structural floor or plinth: The study region consists of Lower Proterozoic formations that are deeply folded and metamorphosed as a result of tectonic movements and granitisation. The granites pierce the Birimian formations, which are violently folded in a north-south direction (**Figure 3**).

1.4.5. Mineralization

According to **[17]**, research in the study area has revealed two types of mineralization: primary and secondary.

- Primary Mineralization

For this type of mineralisation, SAG's work has highlighted 3 types :

  - Primary in-situ mineralisation, mainly associated with quartz veins, veinlets and stock-werks, identical to that found around the village of Kintinian;
  - Mineralisation associated with a volcanic breccia where gold-bearing quartz and sulphides fill fissures within the volcanic vent;
  - Paleo-placers, currently at a higher level than the watercourses, which make up 70% of the deposit's reserves **[17] - [18]**.
- Secondary mineralisation

These are alluvial deposits on the current river beds and terraces. They are also found in the Kintinian and Fatoya regions.

- Useful minerals

According to previous research, there are two types of useful minerals.

- Metalliferous useful minerals

The study region (Siguiri) is the centre of gold mining in Guinea. It supplies 90% of the country's primary and secondary gold production, and is currently the only metalliferous mineral.

- Useful non-metalliferous minerals

these are represented by building materials such as limestone, granite, clay, laterite, sand, sandstone, dolerite, ... (**Figure3**) **[18]**.

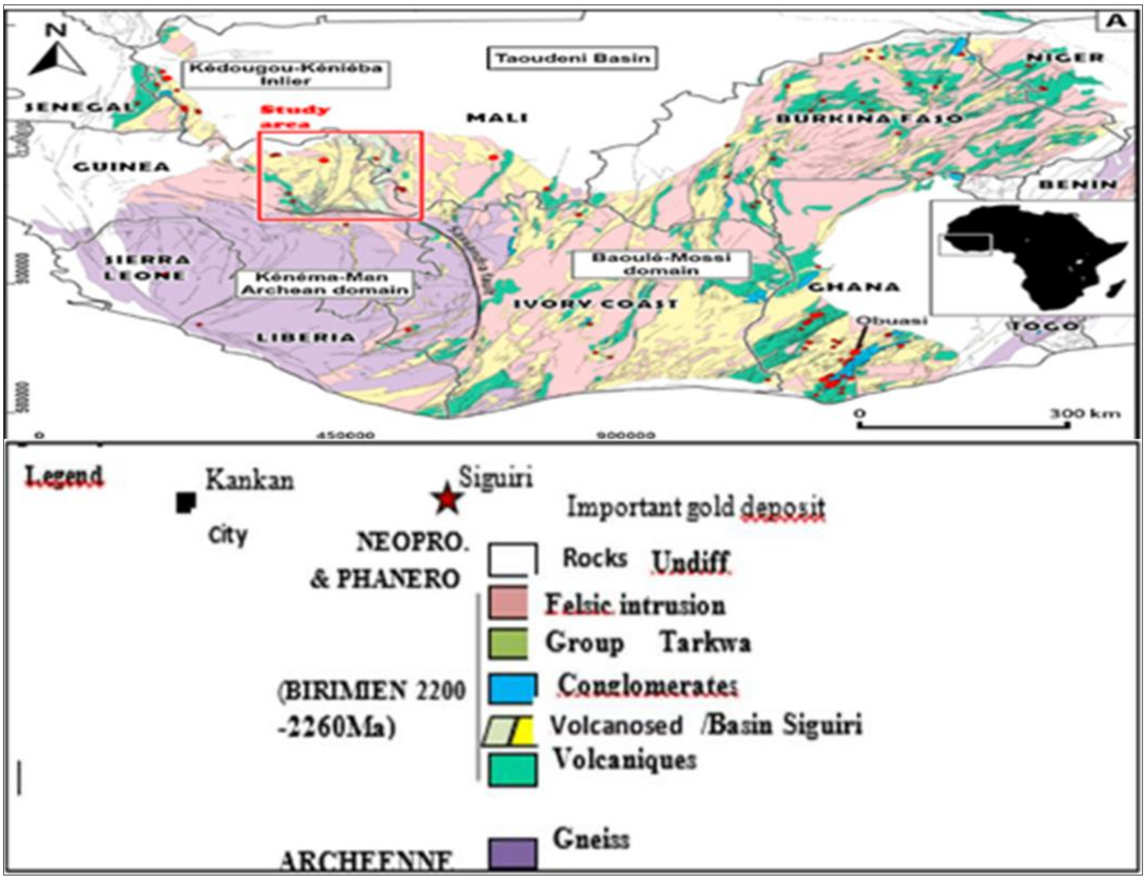

Figure 3 Geological map of the Birimian basin of the West African craton

2. Material and methods

Generally speaking, gold is one of the precious or noble metals whose content in the earth's crust is very low, around 5.10-7% or 0.005 ppm. It can be found in its native state or associated with other minerals (**Table 1**) **[19] - [20]**.

Table 1 Economic gold minerals (Petrulian et al., 1973)

Name	**Formula**	**% Au**	**Density g/cm3**	**Color**
Gold	Au	100	15-19,5	Golden yellow
Electrum	Au,Ag	55-80	12,5-15,5	Pale yellow
Maldonite	Au_2Bi	65	15,5	Orange-white
Calaverite	$(Au, Ag)Te_2$	39,5-44	9-9,5	Bronze-yellow
Krennerite	$(Au, Ag)Te_2$	39,5	8,35	Yellowish white
Sylvanite	$(Au, Ag)Te_4$	24,5	7,9-8,3	Steel-grey
Petzite	$(Au, Ag)_2Te$	12-25	8,7-9	Grey-black
Hagyagite	$Au_2Pb_{14}Sb_3Te_7S_{17}$	6-13	7	Lead-grey

2.1. Description of the object of study

2.1.1. Properties

Gold has the chemical symbol Au and occupies the 79^e place in the periodic table. It belongs to group 11 which includes copper, silver, atomic mass 196.97 and density 19.3 g/cm 3 having a melting point of 1064°C and a boiling point 2960°C.Gold is the most ductile of metals, it can be rolled into sheet up to 0.0001mm thick. It is a good conductor of heat and electricity. It is second only to silver) (www.Joaillerie-david.com>propriété-or, accessed 15 August 2022).

Gold is a metal that does not oxidise easily and is very resistant chemically; it is not attacked by oxygen or strong acids; it dissolves in aqua regia and cyanide; it is soluble in mercury (amalgamation). (www.joaillerie-david.com-propriété-or, consulté le 15 Août 2022).

2.1.2. Uses

Gold is a mineral substance with industrial applications, but it is above all the object of hoarding and speculation. Nowadays, it is used in a number of fields, such as jewellery, coinage, the manufacture of medals, dental surgery, technical industry, etc....While gold's companions are enormous, including copper, lead, zinc, arsenic, antimony and bismuth, they are constant companions of gold. They are found in all types of deposits in the form of sulphides and sulphosalts **[20]**.

The same is true of iron, which is expressed in sulphide form as well as in carbonate or oxidised form. Silicon (quartz), boron (tourmaline-axinite), calcium (calcite-ankerite-dolomite), sodium and potassium (albite-orthose-andular), and magnesium (talc-chlorite-serpentine) are also faithful companions of gold. Tungsten (scheelite) is fairly common, while cobalt, nickel, tin, molybdenum and chromium are sometimes associated with it **[19]**.

Manganese, tellurium, fluorine and mercury appear in a few mineralogical associations. Broadly speaking, two types of carbonate are associated with gold deposits: ferriferous and magnesian carbonates, sometimes manganesiferous, and calcic, magnesian and/or ferriferous, non-magnesian carbonates **[20]**.

2.2. Description of the Equipment used

According to **[21]** - **[22]**, in the majority of cases, the main equipment used during fieldwork is as follows:

- GARMIN 64S GPS: used to locate sampling points;
- The ESTWING geologist's hammer: used to take samples from the surface;
- ACHROMAT type mineralogical magnifying glass: with a diameter of around 10-20 mm, it is used to analyse samples macroscopically.
- The structural compass: used to measure the structure of geological formations.
- The drill : This is a CR-10 machine designed to drill holes to obtain samples for analysis. A photo of the drill is shown in (**Figure 4**). **Figure 5** shows an excavator in the working position.

Figure 4 CR-10 type drill (This work)

Figure 5 Excavator in operation

In order to obtain the results relating to our study topic, we used various methods, including geological field reconnaissance, the geophysical method and the lithological and stratigraphic approach.

2.3. Used Methods

2.3.1. Geological fieldwork

This method focuses on identifying the realities and collecting data in the field.

2.3.2. Geophysical method

This consists of studying the subsoil by processing its physical properties. It uses the following methods: gravimetry, radiometry, magnetic prospecting, electrical prospecting and seismic prospecting. The method used at SAG is electrical prospecting.

2.3.3. Litho-stratigraphic approach

This approach involves describing the nature of the rocks, which depends on external factors and the depositional environment (local factors). This activity always begins with fieldwork and continues with petrographic, mineralogical and sedimentological characterisation, followed by a study of the horizontal and vertical organisation of the strata (**Figure 6**) **[22]**.

Figure 6 Panoramic view of the Silakoro mine (S. Bangoura, et,al,.2012)

3. Results

In spite of the documentary research linked to this geological work on the gold mineralisation of Silakoro (Kintinian), based on the assigned objectives, we were able to take and analyse a few samples, which enabled us to obtain satisfactory results. These results enabled us to retrace the geological chronology of the formations traversed and the genetic link that is the source of the mineralisation in the study area.

3.1. Lithological and petrographic results of the deposit

3.1.1. Lithological results

The deposit is made up of the following formations: The topsoil, cuirasses (indurated laterite, gravels) laterite, a mottled zone, saprolite sapok (transition zone) and bedrock.

Observations of the different sections obtained from these air-core drilling data reveal three main distinct formations, from top to bottom: laterite, saprolite and source rock (sediments).

- Laterite LT 100 and LT 200: reddish to brownish-red soil, rich in iron hydroxide, most often characterised by the presence of pisolites.
- The mottled zone (WMZ): characterised by the disappearance of most of the primary textures and by the development of centimetre-sized patches of iron oxides and hydroxides within the clay matrix.
- Saprolite: highly weathered (rotten) rock in which the structure and primary texture of the parent rock have been preserved. It includes:
- Upper saprolite: water-saturated zone marked by the predominance of secondary minerals in the process of alteration.
- The lower saprolite: a formation dominated by the nature of the parent rock, with rock fragments and primary minerals in separate grains (**Figure 7**).

Figure 7 Saprolite

- Saprock: this is the transition zone between saprolite and sound rock; it is generally compact and slightly altered..
- Source rocks: these are sedimentary rocks (sillstones, sandstones), characterized by a sandstone faces with a fine and coarse grain size, with various colours due to alteration. **Figure 8** shows different layers and types of alteration.

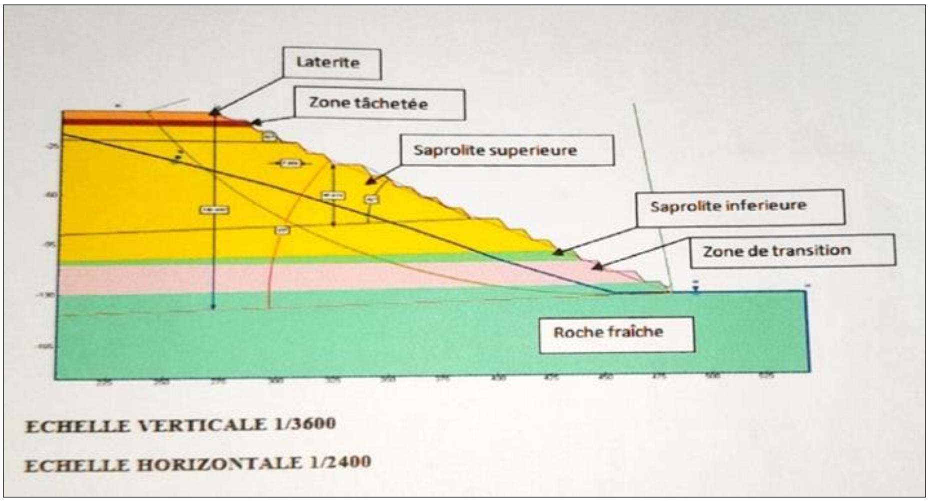

Figure 8 Different layers and types of alteration on the Based on the lithological section and borehole data from top to bottom

we can represent the Blue = water level Red = angles Green = probable quarry slide line Black = height between two main safety benches. The above formations are summarised in **Table 2**.

Table 2 Summary table of facies descriptions

Sign	Lithology	Oxidation	Hardness
LT 200	Ferruginous dolomite	6	5
LT 100	Lateritic gravel	6	5
WMZ	Mottled zone	5	4
Upper sap	Upper Saprolite	4	2
Lower sap	Lower Saprolite	2	3
Saprock	Transition zone	1	4
RM	Parent rock	0	5

The results shown in Table 2 indicate that the degree of oxidation decreases with increasing distance from the ground (from top to bottom). The same is true for hardness, which decreases with increasing depth, right down to the parent rock, which is the hardest of all the formations.

3.1.2. Petrographic results of the deposit

The lithological and stratigraphic studies carried out in Block 1 revealed the presence of the following formations (from bottom to top), SAG concession (Siguiri):

- The Balato formation : this formation is still poorly understood due to its large extent in a mine that is either in operation or already in operation in the region. The interpretation of aerial photographic images was used to study this formation in the Sintroko mine.
- The Fatoya formation : the Fatoya formation is represented by a turbid sequence of sandstone-greywackes interstrates, silstones, black shales and layers of breccia-conglomerates. It contains clasts of silicates, carbonates and feldspars.
- The Kintinian formation : the Kintinian formation is made up of shales of varying thicknesses and may contain small intercalations of sandstone-greywackes and sillstones intercalated between the large shale beddings. The Kintinian shales are easily distinguished from the other shales in the region by their dark green colour, their great thickness with carbonated quartz veins and disseminations of sulphides (cubic pyrite) in the matrix of the rock.

In view of the characteristics of the various units studied above, here are a few facies never encountered or studied in one of the Block 1 mines that caught my attention at Silakoro:

- From chert to dolomitic quartzite : These are purely siliceous rocks containing 95% silica and 5% other rocks with a conchoidal fracture and no stratification. Dolomitic quartzites are dolomites that have been solidified and are dark in colour but have a very high degree of silicification and are very hard (**Figure 9**).
- Quartzites : These rocks contain 100% silica and are light in colour and very hard to the touch. Several facies have been encountered, including fine-grained and coarse-grained quartzites. Quartzite formation is attested on the (**Figure 10**).
- Carbonated dolomitic quartzite : this rock contains around 90% silica, with carbonate clasts and levels of very siliceous dolomitic rock. The appearance of this rock has led some geologists to describe it as quartz-bearing conglomerates (**Figure 11**).
- Black shale : this is a black, foliated rock. It feels black to the touch because of its graphite composition (**Figure 12**).

3.2. Mineralogical results of the deposit

From a mineralogical point of view, several minerals are encountered in the Siguiri region and in particular in the Silakoro deposit, which gives it mineralisations linked to the phenomenon of supergene (meteoric) or endogenous (hydrothermal) alteration.

3.2.1. Meteoritic or supergene alteration

This plays the most important role, infiltrating through the pores and fractures in the rocks and desaggregating them.

It is important to remember that most soil materials come from this destruction, which takes place at the surface and affects magmatic, metamorphic and sedimentary rocks alike.

Purely mechanical action produces fragments of identical composition to the parent rock. As for chemical phenomena, they produce leaching solutions that are exported or that provide elements that form the new soil (neo-formation). The supergene alteration mantle is made up of eroded rock. The contribution made by organisms to this layer in the form of humus results in the formation of soil, the nature and thickness of which varies according to the climate (**Figure 13**).

Observations and analyses show that most of the minerals encountered are the result of chemical weathering due to exogenous agents (water, temperature, etc....). This process is also responsible for modifying the physico-chemical properties of formations exposed to continental conditions.

3.2.2. Hydrothermal or endogenous alteration

Concentrations of minerals of hydrothermal origin are the result of precipitation of mineral masses in rock cavities in the form of substitution for them (metasomatosis). In other words, they are hot gas-liquid solutions resulting from the formation of ortho magmatic deposits. Hydrothermal deposits are formed under the influence of these solutions. The host rocks of these deposits are generally altered by these solutions. The alteration process depends on the nature of the original rock, the nature of the hydrothermal fluid, the temperature and the pressure.

This phenomenon manifests itself at depth and moves towards the surface. It is of great importance in the search for and prospecting of useful mineral deposits.

The transformations in the host rocks are physical and/or chemical in nature, involving changes in permeability, hardness, elasticity, etc.... (**Figure 14**).

Figure 9, 10, 11, 12, 13, 14 Quartzites

NB: For more information and understanding of the above figures, please read page 11.

Under the effect of hydrothermal alteration, the above transformations result in a very wide range of minerals:

- Chloritisation : This is an operation that leads to the formation of chlorite from the degradation of biotite during late hydrothermal phenomena. It is responsible for the green colouring of rocks, particularly meta-sediment.
- Silicification : This is the impregnation of silica into pre-existing rocks, making them hard with a smooth sheen. It is linked to magmatic and hydrothermal phenomena that lead to the precipitation of silica in sedimentary rocks or to the migration of silica in certain metamorphic rocks.
- Sericitisation : This is the result of the degradation of plagioclases and micas following atmospheric and hydrothermal phenomena. Its main characteristic is its violet-blue colour.
- Haematization : This consists of the enrichment of rocks in iron oxide, often with a red colour.
- Kaolinisation : This is an alteration during which calcite is formed, generally with epidote and chlorite. It is characterised by a whitish colour.
- All these phenomena lead to a rich and varied mineralisation marked by sulphides, including arsenopyrite (a satellite mineral of gold). The main minerals are:
- Arsenopyrite : This is a gold indicator mineral. Its chemical formula is $FeAsS$ and it has a bright white, silvery lustre. It is this characteristic, which it retains whatever its orientation in relation to light, that differentiates it from sericite. Gold exists in free form around arsenopyrite crystals.
- Chalcopyrite : This is the most common economic copper mineral. It is formed from double sulphides (copper-iron, $CuFeS2$) and has an irregular formation and a lustre that varies according to its position in relation to the light. Its colour is brassy yellow to gold with red and blue irritations.
- Pyrite : With the chemical formula $FeS2$, this is the most common iron sulphide in mineral form. It occurs in the form of well-defined crystals as well as amorphous masses and crystallises in the cubic system.
- Pyrrhotite : Composed essentially of iron and sulphur, this magnetic mineral is usually found in massive form. Its hardness varies between 3.5 and 4.5 and its density between 4.58 and 4.64. It is derived from the high-

temperature transformation of pyrite and has a bronze-yellow to reddish colour with a metallic lustre, and crystallises in the hexagonal system. It is found in metasomatic sediments.

4. Discussion

Mining, agricultural inputs and domestic waste are the main sources of pollution of water resources. However, the current challenge facing the mining sector is to strike a balance between preserving the quality of the environment (groundwater and surface water) and reducing greenhouse gas emissions [10].

The study area is made up of: the LT 100 and LT 200 laterite; the mottled zone (WMZ); the saprolite subdivided into upper saprolite and lower saprolite; the saprock and the sillstones and sandstones that make up the parent rock. The geophysical method used at SAG is electrical prospecting [13]. This involves induced polarisation (IP), the aim of which is to identify anomalous zones. The lithogeochemical method is used for prospecting purposes. It involves processing and analysing samples taken systematically from rocks likely to contain accumulations of useful mineral substances.

The lithological and stratigraphic studies carried out in the study area reveal lithological formations identical to those of SAG's other concessions (Balato, Fatoya and Kintinian) [13]- [22].

The results shown in Table 2 indicate that the degree of oxidation decreases with increasing distance from the ground (from top to bottom). The same is true for hardness, which decreases with increasing depth, right down to the parent rock, which is the hardest of all the formations [19].

In addition, purely mechanical actions produce fragments of identical composition to the parent rock. As for chemical phenomena, they produce leaching solutions which are exported or which provide elements forming the new soil (neoformation). The supergene alteration mantle is made up of rocks eroded in the Silakoro area. The contribution of organisms to this layer in the form of humus results in the formation of a soil whose nature and thickness vary according to the climate [21].

5. Conclusion

The study area is part of the gold province of Guinea, designated as a gold-producing province since the 12th century with the presence of the Palaeoproterozoic formations of the Baoulé-Mossi domain known as the Birimian. For this reason, geological studies of gold mineralisation in the study area, based on samples taken from boreholes and at the surface, enabled us to address the problems of this research and obtain results for interpretation. These results gave us some ideas about the geological formations encountered, based on geological chronology, source rocks and other formations.

This has enabled us to come to a conclusion not only about the origin of the gold, but also about the zonation of mineralization, with a view to guiding future work. In Guinea, gold mining provides a source of income for the population, although it is also a source of chemical pollution of water resources.

Despite the documentary research linked to this geological work on gold mineralisation at Silakoro (Kintinian), based on the assigned objectives, we were able to take and analyse a number of samples on site and outside Guinea with satisfactory results.

Observations of the different sections obtained through these air-core drilling data reveal three main distinct formations, from top to bottom: laterite, saprolite and source rocks (sediments).

Based on our observations and analyses, we can see that most of the minerals encountered are the result of chemical alteration due to exogenous agents (water, temperature, etc....). This process is also responsible for modifying the physico-chemical properties of the formations, both at the surface and at depth.

In view of the characteristics of the various units studied above, a number of faces that have never been encountered or studied in any of the mines in Block 1 caught the Company's attention, including: dolomitic quartzite, quartzites, carbonated dolomitic quartzite and black shale.

As a result of our petrographic observations of the various samples collected in the field (chip-tray) combined with other results, we have identified the meta-sediments as host rocks represented by schists, quartzites and many others emplaced under favorable conditions.

Compliance with ethical standards

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Disclosure of conflict of interest

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