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Lucien Antoine Zang<sup>\*</sup> and Pablo Higueras<sup>\*</sup>

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# Article Sustainable Mining in Cameroon

# Lucien Antoine Zang Mengue \* and Pablo Léon Higueras Higueras

Instituto de Geología Aplicada, Universidad de Castilla-La Mancha. Pl. Manuel Meca 1, 13400 Almadén (Ciudad Real)

\* Correspondence: lucien.zang@yahoo.fr

Abstract: Considering the differences between the European and African continents concerning the management of the mining production sector, we decided to carry out this study with the main objective of demonstrating that, in Africa, mining can positively change the quality of life of the populations where it develops and, at the same time, it is possible to respect the environment, which is our main wealth. To achieve these objectives, it is necessary to present the mining activity of the continent, emphasizing both the negative aspects and its strong points. The most important thing is to make a good diagnosis of the situation, which will allow us to cure our "patient", that is, African mining production.

Keywords: cameroon; mining; small scale mining; sustainable development; Betare Oya

# 1. Introduction

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Cameroon is generally considered as Africa in miniature, due to the multiplicity of its climate and its diverse geology. The north is dominated by the Sahara Desert, meanwhile in the south, the equatorial forest and a mountain range including Mount Cameroon, which is the tenth highest peak in Africa, are the characteristic features. Between the two we have a savannah and plateaus, which make the transition between the two referred major geological and climatic spaces of the country. Cameroon is also a multicultural country, with more than a hundred languages. The population includes 27.2 million inhabitants for an area of 475,442 km<sup>2</sup>, implying 57 inhabitants per km<sup>2</sup>, higher than average population density for Africa (37 hab/km<sup>2</sup>). The country's economy is highly dependent on its oil and agricultural exports. These not managing to generate enough employment, a parallel so-called informal economy has been created, which has a very great social importance. Concerning the mining activity, which is at the heart of our work, it represents less than one percent of the GDP, remaining embryonic despite its great potential. The mining activity developed here is essentially artisanal, and is mainly present in the eastern region, where it does not really contribute to the improvement of the living conditions of the populations. We are therefore committed to proposing solutions for a mining activity that is more respectful of human rights, of the environment, or simply sustainable. It will therefore be up to first present the country's mineral wealth, their importance, the problems linked to its development and finally to propose solutions for a more responsible and friendly mining activity.

# 2. Cameroon in the context of central Africa

Cameroon is located just above the equator and extends in latitude between 1° 40' and 13° 50' (north) and in longitude between 8° 30' and 16° 10' (west). Cameroon has 590 km of highly irregular coastline along the Atlantic Ocean and shares borders with six countries: in the north and northeast with Chad and Lake Chad; to the east, with the Central African Republic (CAR); to the west with Nigeria (it shares a border with the two English-speaking provinces) and with the Atlantic Ocean; while in the south it borders three countries: Gabon, the Democratic Republic of Congo (DRC) and Equatorial Guinea (DeLancey, 2023). Compared to other countries of the economic community of central Africa, it is less dependent on its oil and mining exports, because its economy is much more diversified. Angola, DRC and Gabon are totally dependent on oil, meanwhile the DRC and the CAR are highly dependent on mining (Gershon, 2019). In fact, more than 82% of the DRC's public treasury revenues come from the mining industry (ITIE DRC, 2019). The DRC has the largest workforce in the world in artisanal mining, estimated at two million people and with some 12 million people

depending directly or indirectly on this sector (Hruschka, 2011). Unfortunately, most of this mass of workers remains in the informal circuit and does not benefit from the repercussions of their work; only some 110,500 are considered workers by the national labour office, thus representing 10.87% of the country's payroll. The situation is similar in CAR, but, on the other hand, in Cameroon the mining sector represents less than one percent of the country's exports and does not generate many jobs. Cameroon, compared to countries like the DRC and CAR, has a minor mining history. The main minerals that have been exploited industrially are non-metallic, mainly limestone and pozzolan for cement manufacturing, and industrial rocks for construction (Szczesniak, 2021). In 2020, 1,737 carats of diamonds and 341,054 grams of gold were formally extracted in the country. This production is very low as compared to DRC and CAR: the same year the RCA in instability produced 62,000 carats of diamonds and 401, 147,000 grams of gold, and the DRC, for its part, produced 12,743,000 carats of diamonds and 31,501,000 grams of gold (Statista, 2023). Compared to the country of its sub-region, Cameroon has not yet experienced the exploitation of its metallic and precious minerals on an industrial scale. The exploitation in Cameroon of its various deposits of world size importance should boost the national economy and generate many jobs in the cities of the east of the country where the unemployment rate is one of the highest in the country (Voundi, 2021).

#### 3. Mining potential of Cameroon

Geology is what determines the mineral wealth of a country, and so, which determines that Cameroon has a wide variety of mineral resources associated with its geology.

#### 3.1. General geology of Cameroon

Cameroon is underlain by Precambrian rocks, Cretaceous sediments, and Cenozoic sedimentary and volcanic formations. Much of the Precambrian is undifferentiated gneisses and migmatites. Meso- and Neoproterozoic rocks are exposed in the southeast of the country. Cretaceous sediments almost completely cover the Precambrian basement (Belinga, 2001). In northern Cameroon the Cretaceous sedimentary facies is mainly continental, while the Cretaceous in the coastal zone is mainly marine. A recent volcanic zone crosses Cameroon in a north-easterly direction. This line probably follows an important ancient structural zone. Finally, in the south of the country we have the Ntem group, which is the only area where archaic rocks are found, the most important being granites, gneisses and charnockites (Schluter, 2006).

#### 3.2. Ore resources of Cameroon

The ore minerals present in the country are mainly: gold, diamond, bauxite, kyanite and rutile, tin, and cobalt. Gold deposits are found throughout the country, especially in the crystalline basement and epimetamorphic sequences. The highest concentrations are found in the east of the country, essentially along the borders with the Central African Republic and Chad. In this area, its association with the process of microcline formation with the base rock has been observed (Kamga, 2018). The same occurs for the extreme south, the north (Poli series) and the center (Lom series), based on the Congolese region, formed by a volcanic-sedimentary environment, and, finally in the west of the country, where rocks are found as mostly intrusive. The diamonds are associated with the Cretaceous fluviolacustrine formations of the "Series de Carnot", near the border with the Central African Republic and exploited using artisanal methods, although they are also associated with gold alluvium (Bakia, 2014). The Carnot series is composed of sandstones of Mesozoic age and fluvial origin that, in more recent deposit environments, could also have included lacustrine and marsh deposits from one end to the other (Delpomdor, 2015). Consequently, the Carnot sandstone includes various evolutionary levels of agglomerates, sandstone, argillite, and siltstones. The geomorphology of the present landscape is an important factor in the location and quality of diamond deposits that are exposed due to erosion (Chirico, 2010). Cassiterite occurs in a small deposit at Mayo Darlé in the northwest, near the Nigerian border. The mineralization occurs as porphyry-type stockwork veinlets with grades up to 0.3% SnO<sub>2</sub> and as vertical and horizontal high-grade (2–20% SnO<sub>2</sub>) greisen veins within host alkali biotite granites, it is defined as alluvial cassiterite (Nwamba, 2023). Economic concentration of nickel and cobalt appear in the east of the country, near Lomie in a small town called Nkamouna. The ore are associated with laterites and serpentine type rocks (Lambiv Dzemua, 2012). The feasibility report for the Nkamouna project has been submitted in

2011 by SRK Consulting, Knight Piésold, but to date no facility infrastructure are build (Africa Intelligence,2022).Rutile is found in economical quantities at Akonolinga and is associated with micabearing schists, it depends of the Yaoundé seriesThe occurrence of rutile in the region east of Yaoundé (Nanga-Eboko and Akonolinga) and west of Yaoundé (Eseka-Pouma) is known in alluvial, eluvial and residual deposits since the last century . The rutile was exploited between 1935 and 1955 with a total production of 15,000 tons The rutile is of high quality (>95% TiO<sub>2</sub>) and occurs in various sizes (up to 5 cm of diameter) (Stendal, 2006).



Figure 1. Location of the most important deposits in Cameroon (modified from https://www.actualitix.com/carte-cameroun.html).

Bauxite constitutes two very important deposits, in the Ngaoundal and Minim-Martap Complex in the north of the country and near Fongo-Tongo in the west. Two iron deposits with 30-40% Fe contents are known in Cameroon, in the southwest at Mbalam and offshore at Kribi. Lastly, we have non-metallic limestone deposits in Figuil, Marble in Bidzar, and pozzolan in Djoungo and Njombe-Penja (SOFRECO, 2012). Mining is essentially artisanal and semi-mechanized (Hilson, 2022). The main deposits are in the east of the country (Figure 1).

## 4. Importance of the Cameroonian minerals in the energetic transition

Since the 2009 Copenhagen conference on climate change (https://unfccc.int/conference/copenhagen-climate-change-conference-december-2009), during which all the countries present agreed to put in writing precise figures for their emissions reductions by 2015, many countries have embarked on ambitious programs to reduce the use of gasoline-powered cars and maximize the use of electric vehicles with the aim of drastically reducing greenhouse gas emissions (Slowick, 2020). Due to these programs developed and carried out

especially by northern European countries, an increase in the demand for electric cars and, by extension, in their production, has been noted (Hedegaard, 2012). What makes the specificity of the electric car is its battery, which consists mainly of cobalt and lithium. This use of cobalt in refillable batteries has caused a significant increase in the demand for this element (Hauet, 2019).



Figure 2. Evolution of world cobalt production from 2005 to 2015 (BRG 2017).

The evolution of demand has in turn led to an increase in production and prices as can be seen in figures 1 and 2.



Figure 3. Cobalt price evolution from 2014 to 2023. Source : https://tradingeconomics.com/commodity/cobalt

To maintain the production of electric cars and achieve the goal of zero thermal engine cars by 2035 in the European Union, it will be necessary to produce even more cobalt and nickel for batteries. In this context, Cameroon, which has world-class reserves, should be playing a major role.

#### 5. Problems of mining in the east Cameroon

Mining activity in eastern Cameroon is essentially artisanal, as mentioned above. Most of the artisanal miners in this region of the country are engaged in gold mining, but there are also a significant number of them that exploit alluvial diamonds and other precious stones (Hilson, 2021). The last census taken estimated that 79% of the 44,000 miners who worked in artisanal mining in Cameroon in 2014 are dedicated to gold mining (Seccatore, 2014). The sector contributes significantly to the social and economic development of the region, thanks to taxes and the arrival of new people, who inject their profits into the local economy. However, this boom does not directly benefit to the entire population: of course, the eastern province continues to be one of the poorest, with a very low literacy and nutrition rate compared to regions such as the south and west (Nguepjouo, 2017). In the last ten years a new development model has emerged in eastern Cameroon: privately operated artisanal and small-scale mining (ASM), largely financed by Chinese actors (Weng, 2022). Artisanal exploitation is restricted to areas of less than one hectare, and to depths of less than 30 m (Tetsopgang, 2007). Between 2010 and 2012, 280 artisanal exploitation permits were granted, of which more than a third are in the eastern region, demonstrating that it is the area with the greatest mining potential in the country (CIMEC, 2013). Of these new permits, a large number have been issued to small Chinese

groups, leading to a recent expansion of privately operated small-scale mining in eastern Cameroon, especially at Betare-Oya, Batouri, Yokadouma and Garoua. Boulai (Tetsopgang, 2007). These junior companies are mechanized and use modern extraction technologies, characteristics that do not strictly correspond to descriptions of artisanal mining or 'small-scale mining', as provided by law (Weng, 2022). This hyper-mechanization of artisanal mining is a source of unfair competition, because small local artisanal miners do not have the financial means to do so. It is also a source of many conflicts, the pinnacle of which was reached on November 15 of 2017 in the locality of Mali, about fifteen km. away from the town of Bétaré-Oya, which was the site of clashes between local communities and Chinese operators. The report mentions two dead (a Chinese and a local resident) and four injured, including three Chinese (Agency Ecofin, 2017). The other major problem is that of non-compliance with the conventions, these companies exceed the limits of their operating area, destroy the forests and in the process contaminate the soils and the rivers on which the populations depend for their food.

No.	Location	Nationality of	Expat	Cameroon	Start Date
		Investors			
1	Bétaré Oya	Korea	3	34	12/2011
2	G. Boulai	Korea	4	32	2012
3	<u>Bétaré</u> Oya	Cameroon	0	70	2011
4	<u>Bétaré</u> Oya	Korea	7	44	1/2011
5	<u>Bétaré</u> Oya	China	8	122	11/2011
6	<mark>Bétaré</mark> Oya	China	6	14	4/2012
7	Bétaré Oya	Korea	14	27	6/2013
8	Bétaré Oya	China	5	12	11/2012
9	Bétaré Oya	Cameroon	0	25	5/2012
10	Bétaré Oya	France	2	12	2012
11	Malewa	China	6	8	2011
12	Bétaré Oya	China	6	8	2012
13	Gboyo	China	6	8	2013
14	Bétaré Oya	Saudi Arabia	10	59	08/2012
15	Colomine	Saudi Arabia	10	59	2013
16	Batouri	Greece			2012
17	Bétaré Oya	China	6	10	1/2013
18	Bétaré Oya	China	4	7	2013
19	Bétaré Oya	China	6	16	2/2013
20	Dokayo	Cameroon	1	10	2013
21	Bétaré Oya	South Africa	4	6	11/2013
22	Bétaré Oya	China	2	17	4/2013
23	Bétaré Oya	Cameroon	0	8	2013
24	Bétaré Oya	China	8	17	6/2013
25	Bétaré Oya	China	2	12	5/2013
26	Bétaré Oya	China	10	18	3/2013
27	Bétaré Oya	Germany	5	107	6/2013
28	Bétaré Ova	China	0	25	9/2013
29	Bétaré Oya	China	2	28	9/2013
30	Bétaré Ova	China	15	27	6/2013

 Table 1. Mining companies exploiting gold on a small scale in a mechanized way in eastern Cameroon, source:

 Cameroon ministry of industries, mines and technological development; 2017.



Figure 4. map representing the main gold deposits along the Lom River source: Weng et al; 2015.

Figure 4 shows the concentration of mining sites on the banks of the Lom River, whose turbidity and concentration of heavy metals (mainly Fe, Mn, Pb, Cd and Cr were identified as the predominant pollutants in surface water) has increased significantly since 2010 (Rakotondrabe et al., 2018).

#### 5.1. Involvement of Chinese companies in small-scale mining

The first foreign small-scale gold mining company was registered at Betare Oya in 2006 and the following year saw the arrival of 20 more companies (Weng, 2013). These largely Chinese companies, owned by Chinese-based investors, are much better capitalized than local artisanal miners. They are equipped with imported bulldozers, scrapers, screens and separators, and work in partnership with local Cameroonians to acquire mining permits. The financial capital for the extraction comes mostly from money collected from friends and relatives in the same village in China, mainly in Guangxi, Fujian and Zhejiang provinces. The number of people employed by these companies varies between 6 and 20 (Margules, 2022). Small Chinese companies invest at least US\$500,000 or more in mechanized material for small-scale exploitation. According to the records of the Ministry of Mines, there are thirty companies operating in the Bertoua area, on which Betare-Oya depends, but in the countryside, it is something else, there are many more companies operating in complete freedom and impunity (Sayer, 2022). The mode of operation and organization of Chinese companies operating in the area is the same throughout sub-Saharan Africa. Company number 5 in the table is parented by a Beijingbased trading institution. It is primarily an export-import business, with only limited involvement in mining. This company is engaged in open pit mining and dredging and has invested more capital than other Chinese companies. The parent company of number 6 is a private resource recycling company based in France. This company has several investments in the African continent. Number 8 is a typical Chinese family business with a parent company based in Gabon. It is also involved in the timber, shipping and mineral trade between China and Africa. Finally, number 11 is a joint venture between a private Chinese company and a company owned by the Chinese government (Levang, 2022). The panorama of Chinese companies exploiting gold minerals in eastern Cameroon reveals that they are companies not specialized in mining that have capital and associate with nationals to be able to exploit already known deposits.

#### 5.3. Employee Profile

Foreign workers are the ones who usually occupy the technical and most qualified positions, relegating nationals to rudimentary jobs, although there are many Cameroonians trained to work in

mining. These workers oversee prospecting for gold deposits and operating machinery such as excavators and bulldozers. International employees are also responsible for human and financial resources, management and consultation with the local government. Some of the Cameroonian workers have received training in operating machines, basic knowledge of geology and gold mining (Weng, 2022). All Korean and Chinese companies employ workers from their own countries; these people have higher salaries than Cameroonians. Foreign workers have very little interaction with local populations and their own national colleagues. In fact, very few speak English, French or any other local language, relying on Cameroonian interpreters for their limited interactions with the local population (Endamana, 2022). In Betare-Oya, mining companies have created few employment opportunities for the local population. Compared to the traditional artisanal mining activity that operates completely manually and engages in activities that provide more employment opportunities, foreign investor companies operate with mechanical equipment, which requires less labor than manual mining. Most of the employees in the local communities' work as drivers, excavator operators, custodians, and occasionally as geology technicians. Small businesses, being mechanized due to cultural and language differences, prefer to employ workers from their home countries, such as China (Levang, 2022).

#### 5.4. Legal framework and mining justice

Since their independence, many African states have believed that the mining industry would be the driving force behind their countries' development. Unfortunately, fifty years later there are countries within easy reach that have benefited from its mineral wealth. Nevertheless, it is important to emphasize that Under the leadership of international organizations, in order to attract new investors and generate more revenue from the booming mining sector in the early 2000s, many African countries launched work to modify and improve the mining codes. At the end, new laws were promulgated, considering the protection of the environment, the rights of workers and the organization of the artisanal mining activity that is a source of income for the populations that live near the mining sites. Moreover, it was expected effectiveness and transparency of regulatory frameworks; Transparency and accountability; Governance and citizen participation; Impacts and benefits at an environmental, economic, social and health level; Added value, research and development and technological information; Building human and institutional capacity. Unfortunately, the dynamic is quite different on the ground. Cases of non-compliance with the mining code are legion on the African continent. This is mainly due to the laxity of the states that do not exercise their control and, in turn, do not protect the interests of the populations. Unscrupulous Chinese mining companies, which invest massively in small mines and compete with small artisanal miners, happily benefit from this lack of control and sanctions.

As for Cameroon, we can cite two examples that are not isolated. First, the deadly collapse of Ngoengoe, in the department of Lom-et-Djérem. It occurred on the night of December 29-30 of 2018 and killed nine people. The tragedy occurred at a site that had just been abandoned in violation of the mining code by the Chinese mining company "Lu and Lang". The law requires mining operators to "rehabilitate" and "close mining sites." Specifically, this means that after having exploited the site, the company "Lu and Lang" that owns the mine was obliged to leave it in an "acceptable" state, so that it is not dangerous for the populations, filling in the gaps. In this case, the company and the state that has been lax can be accused. Secondly, we have the contract signed between the Cameroonian State and the company Sinosteel Cam SA, which is very opaque and has aroused much criticism from civil society, which considers it leonine.

#### 6. Purpose to make mining sustainable in Cameroon

The mining activity being essentially artisanal to date, we will propose short-term solutions to improve the conditions of the thousands of workers in this sector and by extension those of their families. If the living conditions of artisanal miners are improved, a large part of the social problems will be solved. In order to achieve this objective, private's companies and state agencies must create a competitive official market (Wamsley, 2010). Large mining companies should contribute to improving the safety and productivity of artisanal mines, helping mining artisans to form cooperatives that will be able to access legal title to property, sharing their experience in health and safety, and introducing new technologies (Africa Progress Panel, 2013). The other need today is to

involve the indigenous populations as much as possible in all decisions related to the exploitation of the mines, because everything that is done for you and without you is against you. For this, state agents must ensure that the technical information transmitted to them is accessible so that they can make decisions with full knowledge of the facts (Zang, 2019). Based on this, it is up to states to implement bold environmental policies, create research centers in environmental sciences, and create independent environmental agencies that have experts well trained. Not only is it necessary to create these centers, but it is essential to provide them with sufficient means and authority so that they have the capacity to control mining companies that only think about profit (Systex, 2021). Finally, it is necessary to think about the complete rehabilitation of mining sites. The environmental protection organizations and governmental agencies must mainly control the evolution of mining operations, ensure that during the exploration phase all the holes that are generated are filled, that areas where the operation will not be carried out are reforested and, above all, that the remediation action plans that are drawn up are realistic because companies always try to minimize environmental risks. In the same way, these plans should be backed by economic guarantees, which guarantee that the planned restoration is carried out in the expected time and manner. Another very important topic is the rehabilitation of mining sites, which consists of the remodelling of the mining site, including waste piles, but also in the monitoring and prevention of residual risks. The main objective is to ensure the landscape integration of the mining deposit in its environment. In a world where reputation constitutes an added value for companies and an important variable of adjustment in the stock market, a sort of "mining friendly certificate" might be a good incentive. Companies that comply with the specifications for the rehabilitation of mining sites would receive it as an acknowledge of their efforts, and they could have more opportunities to be considered for future contracts.

Based on such premises, mining industry in Cameroon should be ready to face a future more focused on the environment and on the social and economic needs of its population.

#### 7. Conclusions

The purpose of this article is to analyse the social and environmental problems caused by the small-scale mining industry in eastern Cameroon. we presented the Cameroonian mining industry, after demonstrating that this activity has negative consequences on populations and nature. In the end, proposals were made to arrive at a much healthier activity that improves the living conditions of the populations. Due to this study, we were able to highlight the important role that Cameroon could play in the energy transition through to its strategic minerals still not exploited. This work has also made it possible to demonstrate that China, which should invest only in industrial and semiindustrial activity, is insidiously establishing itself in artisanal mining. These Chinese investments create unfair competition because the Cameroonian small-scale miners do not receive any subsidy or protection from the state. This situation accentuates the pauperization of the populations who lose on the one hand their land, and on the other hand the income from the mining activity. The fact that mining activity is poorly controlled causes significant contamination of rivers such as the Lom, but also social conflicts that have resulted in the death of men. To solve these problems listed during this work we have proposed solutions which could if they are put into practice improve the living conditions of the populations. Small-scale mining has more potential to be widely accepted in the conditions of post-conflict and in transition economy settings, but for social sustainability it needs to prove its positive contribution to societal development in many identified dimensions. We firmly believe that the artisanal mining activity in the eastern zone of Cameroon could be a driving force for economic development and job creation if the state provides technical and financial support to experienced mining craftsmen.

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