Extractive industries in Cameroon

A source book for teachers

Produced by Tiffany Fourment, 2012

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Mineral resources and Mining in Cameroon - Background

Cameroon is currently in the midst of a major shift in the nature of its extractive industries. It is important to be familiar with the history of how the nation’s extractive industries have developed, as well as the direction in which they are now going.

In the years leading up to and including World War II, there was significant industrial mining activity in Cameroon. Mining for gold, cassiterite and rutile contributed almost 12% of the Gross Domestic Product (GDP) of Cameroon in 1939. During World War II, it surpassed 20% of the GDP, but once the war was over, mining activity decreased until by 1950 it only contributed 2-3% of the GDP.

Since independence, the only mining that has taken place is small-scale, artisanal mining, most of which is concentrated in the East region of the country.

In 1977, companies began extracting oil, mostly offshore in the Rio del Rey area. The peak of oil production was in the 1980s, when Cameroon was producing 150,000-180,000 barrels of oil per day. For a number of years, oil production was critical to the national economy – it accounted for 25-50% of the national revenue, and over ½ of Cameroon’s total export. In the 1990s production was decreasing, and by 2000 less than 100,000 barrels per day were being produced. The decline in production continued, reaching record lows in 2009 and 2010 of 65,000-73,000 barrels per day. Now most of the major oil reserves are depleted, and the nation is looking for something to replace the revenue that oil production can no longer supply.

Cameroon is now hoping to develop mining as the industry to replace oil extraction. Currently there is exploration for possible industrial mining projects, for iron, bauxite, gold, uranium, diamond and other minerals, mostly in the South and East regions of the country. The mining projects bring both opportunities and risks to the communities in which they are located as well as the nation itself.

This document provides more details about the various minerals and mining projects that are developing in Cameroon, with a more detailed look at uranium.
Carte des Ressources Extractives du Cameroun

MINERAUX à potentiel évident ou reconnu:
- Argile
- Bauxite
- Calcaire
- Cobalt/Nickel
- Cuivre
- Diamant
- Disthène
- Étain
- Fer
- Marbre
- Or
- Pierre
- Pouzzolane
- Rutile
- Sable
- Saphir
- Saumure
- Syenite
- Uranium

PETROLE:
- Pétrole et gaz naturel
- Potential en pétrole
- Raffinerie
- Pipeline Tchad-Cameroun
- Terminal

Sources: Ministère des Mines, SNH, CAPAM
Cartographe: FOCARFE, Service National ‘Justice et Paix’

Réalisation: Coalition PWYP 2008
The opportunities and the risks of developing a mining sector

OPPORTUNITIES:
- **Job creation and opportunities for local companies:** Mining offers job opportunities for people of the region and beyond at different stages of the process: from construction of the infrastructure needed for mining, to the mining work itself. Construction of the mine, any necessary processing factories, or transportation infrastructure requires a lot of workers, both semi-skilled and highly-qualified.

Also, there is the potential for local businesses and individuals to profit from the presence of the mining project. Many sectors like catering, hotels, supply of materials, and security could have an increase in business related to the mining project. These businesses could also serve as partners, or as subcontractors in a mining project.

- **Infrastructure and social/community development:** The surrounding population is likely to benefit from the infrastructure that would be constructed for the transportation of ore (roads, railways, etc.). The Cameroon mining code provides potential for local development projects that will provide community benefits.

- **Financial income:** The State will collect much revenue from the mining companies, such as fees, land royalty, Ad Valorum tax, extraction tax, and others (see definitions at the end of the document). This income will be paid to the public treasury, and if correctly used, will improve the economy of the country, region, council and local communities around the project.

By law, 10% of revenue from Ad Valorum tax goes to the region in which mineral extraction takes place, 10% of extraction tax goes to the local population, and 15% goes to the council with territorial jurisdiction over the area.

RISKS:
In general, every mining project impacts the neighboring populations and environment in numerous ways:

- The process of mining destroys vast surfaces of land by removing vegetation and topsoil, and often blasting and drilling into the rock. This can mean the loss of forest resources, wildlife habitat, and/or agricultural cropland.

- There is a risk of pollution of land, water and/or air due to exhaust fumes, dust, discharge or spills of oils, metals, sediment or other contaminants accidentally or purposefully released into the environment.

- Development of a mine can lead to displacement of local people and wildlife, marginalization of indigenous groups, disputes over land rights and access, local price inflation due to the immigration of more people, problems linked to fair compensation for losses, and other social problems.
Iron

What is Iron?
Iron (Fe) is a metallic element. It composes about 5% of the Earth’s crust. Iron ore is the rock and material from which metallic iron can be extracted. Iron ores vary in color from dark grey to bright yellow to rusty red. Hematite is iron oxide (Fe2O3). Hematite is the main source of iron ore that is used to make steel. Itabirite is a formation of a number of different iron oxides that could include hematite and magnetite, as well as other minerals such as quartz.

What is it used for?
The main use of iron is for steel production. To make steel, iron is mixed with carbon, and sometimes other elements as well. This is called an alloy. Steel is used in many ways in our everyday life: in buildings and bridges, automobile parts, machinery, and railroad tracks, to name a few.

How is it mined/processed?
Iron ore is usually mined using an “open pit” (also called “open-sky”) technique. This technique is used when the ore is found relatively close to the surface. Open pit mining involves drilling, blasting, and removing large quantities of soil and sub-soil with heavy machinery, and then extracting the ore (the rock or material in which the iron is contained). After ore has been brought to the surface, it is crushed and sorted to separate the valuable part from the rest of the materials. Ore that has higher iron content, such as hematite, requires less beneficiation (further refining and processing to remove the various other materials and contaminants). Itabirite has lower iron content, so it requires more beneficiation to produce the concentrated iron ore. The ore is then shipped to a factory called a smelter for further processing and separation, using very high heat.

Where is it found in Cameroon, and how much?
Iron ore is found mainly in the East and South regions of Cameroon. In Mbalm, in the Haut Nyong division of the East region, there are reserves estimated at 215 million tons of hematite, and over 2 billion tons of itabirite. Another reserve in Mamelles, near Kribi in the South region, is estimated at 330 million tons.

What are the details of current projects to mine iron? (March, 2012)
There are a number of permits for exploration of potential iron ore mines in Cameroon, but for many of them, it is yet undetermined if they will proceed. There are 3 projects that look sure to proceed in the near future:
1) Sundance Resources Limited (Australia). The Cameroon subsidiary is CAMIRON. At the time of writing this project is expected to start very soon. It is based in Mbalam, in the Haut Nyong division of the East region of Cameroon. The project will include a mine, a transport corridor of approximately 500km, and a port facility located south of Kribi for shipping. Most of the iron mined here will be shipped to China for steel production. The mine is expected to produce 35 million tons of iron ore each year for the next 25 years. CAMIRON states that the estimated economic benefit to Cameroon based on the development terms they have proposed is estimated at more than 5 billion U.S. dollars over the life of the project. It is estimated that approximately 40 square kilometers of forest will be cleared in order to develop the mine site.

2) African Aura Mining, Inc. (England): This company split into two – one to explore gold mining and one to explore iron mining. The company exploring iron is called AFFERRO, and is working in Djoum and Nkout, South region, close to Mbalam.

3) SINOSTEEL (China): This company has an iron exploration project in Mamelles, 15 km from Kribi, South region where reserves are estimated at 330 million tons. There have been some difficulties in the exploration process because initially the company failed to communicate with the local population about the exploration activities, and this upset the community.
Bauxite

What is Bauxite?
Bauxite is an ore (rock and other material that contains valuable minerals) composed mainly of aluminum oxide and aluminum hydroxide minerals. It is reddish brown in color and can look like clay or soil. Bauxite ore is the main source of aluminum - over 99% of metallic aluminum comes from bauxite.

What is it used for?
Most bauxite mined worldwide is used to produce alumina, which is refined to produce aluminum metal. Aluminum is silver-white metal that is very light in weight and malleable (it can be molded and shaped, for instance drawn into thin wires or pressed into sheets of foil).
Aluminum is the second most-used metal, after steel. It is used in many ways, including parts for cars, motorcycles and airplanes, building and construction materials, electrical products such as light bulbs and power lines, and packaging such as cans for food and drinks, aluminum foil, and gum wrappers, as well as cooking pots.

How is it mined/processed?
Most bauxite is mined using an “open pit” (also called “open-sky”) technique. This technique is used when the ore is found relatively close to the surface. Open pit mining involves drilling, blasting, and removing large quantities of soil and sub-soil with heavy machinery, and then extracting the ore. Once the bauxite is loosened into manageable pieces it is loaded into trucks or railroad cars and transported to crushing or washing factories. Bauxite does not require complex processing because most of the bauxite mined is of an acceptable grade or can be refined by a relatively simple and inexpensive process of removing clay from the ore. For refining into aluminum, the ore is crushed and ground, and sent through a process of heating and combining with various chemicals in order to separate the alumina. Pure alumina is in the form of a white powder. The alumina is then sent to a smelter, where it gets made into metallic aluminum, through chemical reactions requiring high temperatures and electrical currents of very high voltage.

Where is it found in Cameroon, and how much?
The bauxite reserves that are currently being explored are in the Adamawa region of Cameroon. The two reserves are projected to be about 550 million tons in total. There are a couple of other reserves estimated at about 65 million tons total, which are not currently being explored for mining.

What are the opportunities and risks of mining bauxite in Cameroon?
These are as described above for mining activity in general. With respect to aluminum processing in particular, there is concern about the electrolysis process that is used to convert alumina to aluminum. It is a highly energy-intensive process which uses an extremely large amount of electricity.

**What are the details of current projects to mine bauxite in Cameroon? (March 2012)**

The principal bauxite mining project currently planned in Cameroon is promoted by a joint venture mining company with headquarters in Yaounde, called Cameroon Alumina Ltd (CAL). The two sites for the project are Minim-Martap and Ngaoundal, both located in the Adamawa region of Cameroon. CAL is owned by a consortium of 3 companies: Dubai Aluminum Company of United Arab Emirates, HINDALCO of India, and Hydromine, Inc. of USA. The project, planned to begin in 2013, involves a bauxite mine expected to produce 8.5 million tons of bauxite per year over the next 25 years. The project also includes construction of an alumina refinery which will produce around 3 million tons of alumina per year. The construction of a railway link from Minim-Martap and Ngaoundal to the port city of Kribi and also port facilities for shipping from Kribi are also planned. CAL estimates that the project will lead to the creation of around 7000 direct and 6000-8000 indirect jobs during the peak of the execution building/development phase, and around 1500-2000 direct, and 4000 indirect jobs during the operation phase.

Cameroon already has an aluminum smelter, in Edea near Douala, owned by the company Rio Tinto, but since there is no bauxite currently being mined in Cameroon, it is shipped from Equatorial Guinea for smelting. Rio Tinto has future plans to build another aluminum smelter in Kribi.
Gold

What is Gold?
Gold is described and known as a precious metal. Scientifically speaking, gold is an element; a metal. Gold’s chemical symbol in the periodic table is Au.

What is it used for?
Most gold is used to make jewelry and other art items. Because it is chemically stable and conducts electricity so well, it is very important in electronics equipment such as computers, telephones and cellular phones. It is a very reflective metal, so it is used in aircraft and satellites to shield them from solar radiation. Gold has been used in various forms of financial exchange for thousands of years. In modern times, it is used as a reserve, to provide the “backup” value for every day currency that is earned or exchanged.

How is it mined/processed?
Artisanal and small-scale mining are mining activities that use rudimentary methods to extract and process minerals and metals on a small scale. Artisanal gold miners often use the simple method of “panning” for gold: using a pan to scoop silt and sand from a river bottom, and sift through it for bits containing gold. Often miners combine mercury (see the section on “Risks”) with silt that contains gold, to form a hardened amalgam that has collected most of the gold metal from the silt. The amalgam is later heated with blowtorches or over an open flame to evaporate the mercury, leaving small gold pieces.

On an industrial scale, gold that is located near the surface of the ground is mined using the “open-pit” (also called “open-sky”) technique. Open pit mining involves drilling, blasting, and removing large quantities of soil and sub-soil with heavy machinery, and then extracting the ore.

When the gold is located too far underground for an open-pit mine, an underground mine is used. Shafts are dug into the ground, with tunnels branching out, leading to the gold deposits. Once in the tunnels underground, miners drill holes in the rock and insert explosives in the holes. The rock blasts into pieces, and is then removed from the mine to sort the ore. Once the ore has been removed from the ground, the gold must be extracted from it. The ore is usually washed and filtered at the mine, then sent to a mill for further processing. At the mill, the ore is ground into smaller particles with water, then ground again into even finer particles. Then the gold must be separated from the ore. Most techniques for doing this involve the use of cyanide (see the section on “Risks”), as well as other chemicals and solutions, to separate the gold from the rest of the ore. One method involves putting the ground ore into
a tank with a cyanide solution that separates out the gold, then filtering it out. Another technique, called heap-leaching, involves piling the ore on an open-air pad, and repeatedly spraying the it with a cyanide solution, which soaks through and separates the gold.

Where is gold found in Cameroon, and how much?
Currently, gold is being mined mainly in the east region of Cameroon and the eastern portion of the Adamawa region also. There are proven reserves of about 4,500 tons of gold in Cameroon.

What are the specific opportunities or risks of mining gold in Cameroon?
RISKS - With respect to gold mining in particular, there are concerns around the use of toxic chemicals such as cyanide and mercury. Cyanide is highly toxic, and can cause poisoning and even death to humans and animals through inhaling it in the air, ingesting it, or coming into bodily contact with it. Therefore, it must be dealt with very carefully and contained thoroughly and completely. There is a history of cyanide spills at gold mines around the world, which have led to poisoning and contamination of people, wildlife and water sources. Mercury, a “heavy metal” like lead, arsenic and others, is also poisonous to both humans and the environment. Mercury poisoning in humans causes neurological damage and can lead to problems with vision, hearing, speech and muscle movement, and more. Small-scale gold mining is the second-worst source of mercury pollution in the world, after the burning of fossil fuels.

What are the details of current projects to mine gold in Cameroon? (March 2012)
Currently in Cameroon, the only gold mining operations are artisanal or small-scale operations. There are a number of companies involved in exploration of gold mining on an industrial scale, but it is too soon to know the details of how that will develop.
Gold is currently sold and traded almost entirely on an individual level – it has not yet entered the larger formal trade sector. In 2003 the Cameroon government created the Support and Promotion Framework of Mining Activities Organization (CAPAM) to facilitate, assist and promote small scale gold mining, with the hope of making gold production more formal and thereby collect some for the nation’s central bank reserves.
Diamonds

What are diamonds?
Diamonds are an allotrope of carbon. An allotrope is a pure form of an element that exists in varying molecular structures. For instance, graphite is a different allotrope of carbon.

Largely due to strong covalent bonding (the stable balance of attractive and repulsive forces between atoms when they share electrons), diamond has the highest hardness (it is the hardest mineral known to man) and thermal conductivity of any bulk material.

What are they used for?

There are two distinct categories of diamonds: gem-grade and industrial-grade. Industrial diamonds are valued mostly for their hardness and heat conductivity. Because it is the hardest substance known, diamond will cut through any material. Consequently, the dominant industrial use of diamond is as an abrasive and in cutting, drilling, grinding, and polishing applications. Industrial diamonds are embedded in large steel drill bits to drill into rock for wells to find water, oil, and natural gas. They are also used in machinery for drilling and cutting metal machine parts. Gem-grade diamonds are stones with high-quality color and clarity that make them suitable for jewelry or investment use. These stones are especially rare and make up a minor portion of worldwide diamond production.

How are they mined/processed?

There are two main methods for mining diamond:

Pipe Mining: Pipe mining refers to the extraction of diamonds from volcanic pipes (these are not man-made pipes, they are natural pipes in the ground).

In most countries, a diamond pipe mine is composed of kimberlite. Initially kimberlite is dug from the surface of the pipes in open pit mining. Once the surface deposits have been exhausted, shafts are sunk into the ground at the edge of the pipes, and tunnels are driven into the deeper parts of the pipes. After the diamond-bearing rock is brought to the surface, it is then transported to a screening plant where the diamonds are separated from the host rock.

Typically, a very large area has to be mined to collect just a small amount of diamond. An average of 250 tons of ore must be mined in order to produce a one-carat (0.2 gram) gem-quality polished diamond.

Alluvial Mining: This process involves the extraction of diamonds from riverbeds or ocean beaches.

Walls are built to hold back the water and the sand on the bank or beach is moved with a bulldozer until the level of earth that diamonds can be found in is reached. In order to extract these diamonds from beaches, a wall is built to hold back the surf. Up to 25 meters of sand is bulldozed aside to reach the
diamond-bearing level. Once reached, the diamond-bearing earth is removed and transported to screening plants.

**Where are they found in Cameroon, and in what quantity?**

Diamond reserves are found mainly in the east region of Cameroon. Reserves in the current project in Mobilong (see below) are estimated at 18 million carats. One carat weighs 0.2 grams, so 18 million carats is approximately 3.5 tons.

**What are the risks and opportunities of mining diamonds?**

**RISKS** - In some of the more politically unstable central and west African countries, diamond mining has been controversial because in the recent past revolutionary groups have taken control of diamond mines, and used the proceeds from diamond sales to finance their operations. Diamonds sold through this process are known as *conflict diamonds* or *blood diamonds*. Some Diamond traders are considered to be funding and fueling the political conflicts by doing business with the armed groups. In response to public concerns that their diamond purchases were contributing to war and human rights abuses in central and western Africa, the United Nations, the diamond industry and diamond-trading nations introduced the Kimberley Process in 2002. The Kimberley Process aims to ensure that conflict diamonds do not become intermixed with the diamonds not controlled by such rebel groups. This is done by requiring diamond-producing countries to provide proof that the money they make from selling the diamonds is not used to fund criminal or revolutionary activities. Although the Kimberley Process has been moderately successful in limiting the number of conflict diamonds entering the market, some still find their way in. Cameroon has stated the intention to join the Kimberley process.

**What are the details of current projects to mine diamonds in Cameroon? (March 2012)**

Diamond mining in Cameroon was for a long time conducted by artisan (small-scale, individual) miners in east region. Presently, development is underway for an industrial mining project of diamond deposits, in east region. The C&K Company was created by Korean based C&C and CAPAM in Cameroon. The main project it is developing is the Mobilong diamond mining project in the Boumba and Ngoko divisions. The deposit is estimated at 18 million carats (approximately 3.5 tons). C&K has obtained an operating permit for Mobilong and they are planning to start in 2012. The company claims that the project will provide approximately 115 direct and indirect jobs in the area.
URANIUM IN CAMEROON

1. Energy, and the role of uranium

Energy is the locomotive of modern life: transportation, industry and communication all need it to work and satisfy the burgeoning needs of our society. With the increase in population and urbanization, our energy needs will increase in the future: Studies show that the global demand for primary energy (crude oil, petrol, natural gas, solid mineral fuels, solar energy, hydroelectricity, etc.) will double by 2030. The energy consumption of so-called “emerging” countries, in particular, is expected to rise, demand for domestic energy will increase, as well as increases in industrial and commercial energy consumption. Petroleum, gas and coal are still the most important sources of energy today. But since petroleum, coal and gas deposits are becoming scarce, their renewal takes millions of years, and their use is believed to contribute to climate change, many countries are trying to access other types of energy. Many in Europe are investing a lot of money to develop renewable sources of energy like biomass (wood, plant waste, and manure), water, and wind, geothermal or solar energy that can be substituted for non-renewables.

Nuclear energy is another alternative. In Africa uranium, which is used to produce nuclear energy, is already being mined in Niger, Malawi, Namibia and South Africa. In the future, new deposits in the continent will probably be opened for mining. Research is ongoing in Chad, Botswana, Tanzania, Central African Republic, Democratic Republic of Congo and Gabon. In Cameroon, several uranium reserves are in the exploration phase.

What is uranium? How, exactly, is uranium used to produce energy? Does it have other uses? How is it mined? Is it dangerous? What will the Cameroon government benefit from mining it and what will it lose? This section offers some answers to these questions.

2. What is uranium?

Uranium is a heavy metal found in different layers of the earth’s crust. It does not exist in a pure state, it is always combined with other elements (granite, phosphate, etc.). It shows many combined characteristics: it is at the same time radioactive, chemical and toxic. Uranium is above all an important strategic natural resource found everywhere in nature: in rock and water.
3. What is Radioactivity?
Uranium is an unstable chemical element which, over time, breaks down into 13 different elements. When it breaks down, it emits alpha, beta and gamma rays. This is known as radioactivity. The rays emitted are invisible and odorless, yet they can cause many health problems for people, such as damage to body cells, deformities, burns, cancer, even death. These health risks depend not only on the intensity of the radiation and the duration of exposure, but also on the type of tissue that is exposed to it (also chapter 10).

4. What is uranium used for?
Uranium is mainly used for generating electricity, also for weapons, medical and industrial uses.

Generating electricity at nuclear stations
In the 1960s, nuclear fission, a reaction during which the nucleus of uranium is split into lighter particles, started to be used to generate electricity, the process takes place in "nuclear reactors", housed in nuclear power stations. Today, 17% of world electricity is produced in this way. The reactors use uranium as fuel to boil water. The vapor produced turns turbines to generate electricity.

Military
The first military use of uranium in the history of weapons was by the United States, to make the bombs dropped on Hiroshima and Nagasaki during the Second World War. The uranium used in making these bombs was from Africa (Democratic Republic of Congo) and Canada. Today, there are other uses of uranium by the military. It is used in the manufacture of tanks, tank shells, ammunition, planes and missiles.

Medical uses
Radiation therapy is a modern medical technique, it uses nuclear radiation to destroy cancer cells. Products from the disintegration of uranium are also used in the diagnosis and treatment of certain diseases.

Industrial uses
Uranium can also be used to produce artificial radioactive substances called "radioisotopes" for industrial and medical uses, and for scientific research. Industrial irradiation helps in the process of
fabricating resistant and light materials, it has for example numerous applications in producing lighter prosthesis for medicine use, and resistant electric cables for industry. These radioactive isotopes can also be fabricated in special devices called "accelerators", which do not need uranium.

5. How is uranium mined?

There are many ways to mine a uranium deposit.

**Open Pit Mining**

Also called open sky, "open pit mining" involves removing large quantities of soil and sub-soil, and then extracting the ore (the rock or material in which the uranium is contained). Open pit mining is done when the ore is found relatively close to the surface. The rock is loosened by drilling and blasting, it is dug out and then loaded on dump trucks that carry it to plants for processing. About one in three mines uses open pit mining.
galleries are used for transporting miners, equipment and carrying the ore to the surface, for air circulation, evacuation of water etc. This method of mining is the most commonly used.

**Heap leaching (lixiviation)**

This technique may use many methods, but the underlying principle is to spray chemicals onto the substrate in order to separate the uranium from the rocks and other impurities in which it is found. Lixiviate is the liquid obtained at the end of the operation, it is processed to extract the dissolved substances. 6. How is uranium processed?

Once the uranium ore is extracted from the substrate, using one of the mining methods described in the previous chapter, it is transported to a factory where it undergoes the concentration process to extract the uranium from the ore. The factory is usually located at the mine site, because to transport the large amount of ore somewhere else would be too expensive. At the factory, the ore is crushed into fine powder and then chemically treated to extract the uranium from the solution. This process produces a yellow-colored uranium powder concentrate called “yellow cake”. Normally, one ton of uranium ore will produce about 500g of yellowcake. The powder, in sealed barrels, is then transported by truck or train to a sea port, where it is exported to the country that ordered it.
7. Where is uranium found in Cameroon and in what quantity?
There is uranium in different parts of Cameroon, sometimes as indicators and at other times as deposits. Currently (2012), there are no projects extracting uranium in Cameroon. However, there are companies in the process of researching or prospecting. It is therefore difficult to estimate the uranium reserves, since research is still underway.

For the moment, there are two main uranium projects, in Kitongo (North) and Lolodorf (South), whose potential reserves are estimated at:
- Kitongo: 13,125 tons
- Lolodorf: 11,000 tons

The minimum content of the deposit is 0.1%. The concentration in known uranium mines worldwide varies between 0.05 and 0.5%.
(Source: Ministry of Mines 2009)

8. Which companies are researching uranium mining in Cameroon?

Many foreign companies have obtained permits from the Cameroon government to prospect for uranium ore in the country. Most of them are small Western companies.

Table: Companies researching on uranium in Cameroon.

<table>
<thead>
<tr>
<th>N°</th>
<th>Compagnies</th>
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<th>Minéraux recherchés</th>
<th>Type de permis</th>
<th>Pays d'origine</th>
</tr>
</thead>
<tbody>
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(Source: Ministry of Mines, 2009)
9. What are the opportunities and the risks of Uranium mining?

In addition to the opportunities and risks outlined above, in relation to the mining sector in general there are specific and very serious potential risks for the population and the environment resulting from the development of a uranium mine and from toxic and radioactive industrial waste.

**Chemical pollution:** processing uranium requires the use of toxic chemicals including ammonia, hydrochloric acid, kerosene and oxygenated water. If these substances leak into nature they can seriously pollute the environment.

**Air pollution by radon:** radon is a natural, colorless, odorless and radioactive gas emitted during the natural radioactive splitting of uranium. From the uranium mine, it can spread through the atmosphere and reach people and animals by inhalation. The health effects of exposure to radon are serious as it causes lung cancer.

**Production of and pollution by radioactive residue:** most uranium residue left on rocks is not processed because it contains very little uranium. Nevertheless, it is still radioactive. If it is not properly blocked away, it emits radon and radioactive ash, which is then spread by the wind and can affect the health of people in the area. These wastes could also reach underground water after rainwater soaks through them. Heaps of waste can also contain toxic chemicals: acid, arsenic, nitrates and heavy metals. The drainage water from the drilling and the rainwater flowing inside the mine is also a risk. Water pollution comes from the contamination of the underground water table, which in some instances swells the layers of uranium. Other sources may mix with the uranium, which can cause irreversible pollution.

**Uranium projects are very demanding of energy and water:** The large amount of water required to produce the “yellow cake” is usually drawn on the spot, which can decrease the water table.

**Health risks in the population:** The effects of uranium radiation on the human body are quite variable depending on the amount received, the time and mode of exposure, and the radio element involved. However radioactive materials and radon gas, constitute a serious hazard for the population, one that enters the body through inhalation or ingestion, and can lead to gene mutations, birth defects, cancers, leukemia, reproductive problems, etc.

**Occupational health hazards in a uranium mine:** workers regularly exposed to radioactive and toxic products face serious health risks. There are many examples of miners around the world, who many years after the end of mining, suffer from severe and deadly diseases because of exposure to radioactivity.

**Green house gases** are emitted in significant quantities during Uranium production. To produce one ton of uranium takes the equivalent of 9.7 tons of petrol.
Examples from uranium mines around the world show that in the short term, it is chemical pollution that causes most serious damages. Threats from radiation are of a very subtle nature and appear only over a very long period of time. It is even after the closure of the mine that many health and environmental problems emerge.

10. What is the law on uranium and uranium mining?

Law No. 2001 of 16 April 2001 on the mining Code restricts the mining of uranium. Among other laws applicable to uranium mines, we could cite Law No. 95/08 on radioprotection adopted on 30 January 1995, the framework law on the environment of 1996 and the order of 2005 on environmental impact studies.

10.1 Main articulation of the mining Code

The mining code and its decree of application organize mining activities and promote investment in the mining sector throughout Cameroon. While the mining code opens the sector to all moral persons without distinction of nationality, it also sets conditions of eligibility such as an obligation of residency for all applicants.

There are three main types of mining permits: reconnaissance permits (Section 32), prospection permits (Section 37) and exploitation permits (Section 45). According to the law, the Minister of Mines is in charge of issuing reconnaissance and prospection permits, while only the President of the Republic can issue a mining permit.

The permit to prospect for uranium is delivered for an initial period of 3 years maximum, renewable 4 times for a duration not exceeding 2 years each time (See Sections 38 (1)(2)) of the Mining Code of 2001). As for the mining permit, it does not exceed 25 years and can only be renewed under certain
conditions outlined in Section 48 (2) of the Mining Code. Once the permit has been issued by the president of the Republic, it is the duty of the holder of the permit, pursuant to Section 52 of the mining Code, to inform the Minister of Mines of the progress of his activities. Mining can be done in zones close to housing, protected areas or sacred sites, under condition that the applicant obtains the appropriate permit. It means that even though a uranium mine is dangerous to humans because of its radioactivity, it could be authorized near a built-up area.

**Major articulations of the Decree of application of the Mining Code:**
The Decree of application of the Mining Code No 2002/846/PM/ of 26 March 2002 : obliges the holder of the prospection permit for uranium or other substances to pay a caution equal to the operator's quarterly expenses on the project. For the mining permit, this caution is set in the Mining convention at 2.5% of the total investment of the operator before the first commercial production. The operator of the mine settles his financial obligations towards the public treasury. Mining royalties paid by the operator are divided as follows: 25% to local communities affected by the mine (10% for the communities and 15% for the councils), 25% for agents from the department of mines to monitor the activities and 50% for the public treasury. Other specific fiscal arrangements which are applied to the mining sector, including uranium, like the payment of company tax and custom duty are indicated in the Tax Code and the investment Charter.

**10.2 The law on radioprotection**
In 1995, Cameroon adopted Law No 95/08 of 30 January 1995 on radioprotection. This law protects man and the environment against activities emitting radioactivity. Article 3 of this law regulates mining of uranium and other minerals like thorium, and nuclear activities: owners of a uranium mine in Cameroon have to take adequate measures to protect people and their property against exposure to radioactivity. Exposure of humans and the environment to radiation is a crime proscribed by the said law (Article 7 and 8) and the Penal Code with sentences ranging from imprisonment from 5 to 10 years and fines varying between FCFA 200,000 to 20,000,000

**10.3 Protection of the Environment**
The 2001 Mining Code and its decree of application of 2002, alongside the 1996 framework law on the environment and the Prime ministerial order on environmental impact studies transfers a certain number of responsibilities to the mining companies: they have to ensure that mining activities respect the protection of the environment and the general public. The 1996 framework law on the environment guarantees every citizen’s right to a healthy environment and information on the negative impacts of all noxious activities on man, the environment and health, as
well as the measures taken for the protection or the compensation for these effects (See sections 5 and 7(1)). It also integrates the following fundamental principles:

**The principle of precaution**: Measures must be taken when there are enough reasons to believe that an activity or product risks causing severe and irreversible damage to the environment. These measures could include:

- if it concerns an activity, limiting or ending that activity or,
- if it is a product, banning the product, even if the formal proof of a cause/effect relation between the activity or product and the dreaded consequences could not be established beyond reasonable doubt.

**Principle of rectification at source**: This principle shows that it is cheaper and easier to remove a source of pollution before it becomes a problem, or take steps to avoid the danger, instead of taking corrective measures to clean up or repair damage after an accident.

**The public participation principle**: This principle shows that the participation of everybody in sustainable development is essential. Sustainable development requires behavior change, sensitization of each person, and the participation of all in decision making through participative democracy.

**The principle of responsibility** means that we are responsible for the consequences of our actions, even the unforeseen ones, and the principle of precaution has to be applied to prevent these disturbing consequences.

**The polluter-pays principle** means charges for preventive measures, reducing and avoiding pollution must be paid for by the polluter. This principle is one of the essential principles for drawing up environmental principles.

**Environmental impact assessments** must by law be carried out, by all promoters or holders of mining projects with potential to impact the environment. The EIA should describe the project and its impact, as well as the measures to be taken by the
company to mitigate or lessen the impact. Concerning the waste, the law stipulates that anyone who produces or keeps waste must take the necessary measures to eliminate or recycle it.

11. Questions
At the end of this overview of uranium mining, many questions arise about the mining of uranium in Cameroon. Most of these touch on the question of whether or not to mine uranium, and are addressed to the Cameroon government, which should consider the mining of this resource very carefully, in order to make a decision which represents the best interests of the people.

11.1 Uranium and its uses
- Is Cameroon planning to build nuclear infrastructure to satisfy its energy needs?
- Which countries will import Cameroon’s uranium and for what use?
- Which potential countries or companies are interested in Cameroon’s uranium? How will it be transported?
- Will Cameroon use its uranium for making nuclear bombs?

11.2. Uranium and public interest
What will Cameroon benefit, financially, from mining uranium? This calculation must consider all options, that is, what will the country gain from mining uranium and what will it lose?
How will people, especially those in the extraction region, benefit from the mining of uranium?
How shall the royalties from local mines be managed?
What laws or rates will be used for the payment of compensations?
What capabilities does government have in monitoring companies mining uranium? The local administration sometimes finds itself completely powerless and incapable to monitor the different projects decided by the central administration. Will further training and additional means be given to these administrations to build their capacities to monitor the mining of uranium?

11.3. Health and environmental risks from uranium extraction
What health risks do workers and neighboring communities face from the extraction of uranium and what are the measures taken by the mining company and the government to mitigate risks?
How will the resource be transported? What safety measures will be put in place to avoid disastrous accidents during transportation? What plan is in place to handle such accidents should they occur?
What danger does nuclear wastes have for people, animals, the environment? How will these be managed?

What capabilities does Cameroon have to handle wastes? Are they sufficient? All over the world, the management and safe storage of mining wastes has always been a problem.

Who are the regulating authorities?

Are they independent from the industry?

What are the long term effects of mining uranium?

After comparing the benefits of a uranium project with the negative impacts, are the risks of insecurity too high? Should this resource be mined, or should it be left in the soil? Research some more, and form your own opinion.
SOME DEFINITIONS - Government revenues from mining.

Flat fee: A fee paid to the Public Treasury for the attribution, renewal or transfer of a permit, mining or quarry title relative to the research or the exploitation of mined minerals.

Land royalty: Tax paid by the holders of reconnaissance, research and exploitation permits. This royalty is fixed by regulation on an annual basis and is paid in advance from the date of attribution of the title.

Ad Valorum tax: Minerals extracted from the soil or under the ground within the national territory for exploitation or research are subject to a proportional tax on the value of product extracted, known as ad valorem tax.

Extraction tax: Tax paid on every extraction of materials, proportionate to the volume of materials extracted.