Chad

A supplement to Mining Journal

Chad plans for the future

Chad's mining minister outlines the government's plans and aspirations

ON MARCH 23, 2009, the government of Chad set up the Ministry of Mines and Geology.

The central objective of the ministry is to allow the development of mining in Chad and aid the economic development of our country.

With the help of donors, the government is investing CFA500 million a year in mining exploration. However, given the potential of the territory and the economic benefits that might result from the exploitation of these resources, double this investment is needed.

The lack of infrastructure is a major obstacle to exploration. To ensure the development of resources, infrastructure planning should take into account the occurrences of potentially profitable minerals.

Mining in Chad is underdeveloped. The only metal currently being exploited is gold in southwest Chad, and even this is being extracted using artisanal-mining methods.

The recent discovery of several instances of poly-metallic mineral deposits could change this. These discoveries demonstrate the potential importance of gold to the country.

Under the Mining Code (Law No 011/PR) of June, 1995, companies are protected in their exploration and development of minerals.

Enterprises that acquire productive assets get a discount of 40% through tax credits. In addition, the costs of accommodation, training and infrastructure are discounted from start-up costs and amortised over five years.

To take into account the stage of political and economic, environmental and mining development, and the state of the world economy, the mining code will undergo an overhaul in order to render it more appropriate, flexible and attractive.

The development of mineral resources is needed to stimulate national economic growth. Indeed, a rational exploitation coupled with the modernisation of techniques for extracting and processing minerals will increase employment nationally and regionally.

However, the development of minerals resources requires not only considerable expenditure, but also a skilled and experienced staff. In this regard, Chad still lacks a sufficient number of technicians and managers.

The training of locals is vital.

The promotion of mining is one of the priorities of government policy. The focus on the sector stems from the hope that the mining sector will play a full role in the development of Chad.

To make mining one of the main components of the economy, extraordinary measures must be taken to solve the financial, infrastructure and human resources problems.

The government intends a programme of intensive geological exploration – both geophysical and geochemical – to gather information that could provide the basis for further exploration and development by the local government and private companies.

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History

The area around Lake Chad has been inhabited since at least 500 BC. In the 8th century AD, Berbers began migrating to the area. Islam arrived in 1085, and by the 16th century a trio of rival kingdoms flourished: the Kanem-Bornu, Baguirmi and Ouaddaï. During the years 1883-1893, all three kingdoms came under the rule of the Sudanese conqueror Rabih al-Zubayr.

In 1900, Rabih was overthrown by the French, who absorbed these kingdoms into the colony of French Equatorial Africa, as part of Ubangi-Shari (now the Central African Republic). In 1946, the territory now known as Chad became an autonomous republic within the French Community.

An independence movement led by the first premier and president, François (later Ngarta) Tombalbaye, achieved complete independence on August 11, 1960.

President Tombalbaye was killed in the 1975 coup and was succeeded by General Félix Malloum, who faced a Libyan-financed civil war throughout his tenure in office. In 1977, Libya seized a strip of Chadian land and launched an invasion two years later.

In March 1979, nine rival groups agreed to form a provisional government headed by Goukouni Oueddei, a former rebel leader. Fighting broke out again in Chad in March 1980, when Defense Minister Hissen Habré challenged Goukouni and seized the capital. In January 1981, Libyan president Muammar al-Qaddafi proposed a merger of Chad with Libya.

The Libyan proposal was rejected and Libyan troops withdrew from Chad that year, but in 1983 they poured back into the northern part of the country in support of Goukouni. France, in turn, sent troops into southern Chad in support of Habré. Government troops launched an offensive in early 1987 that drove the Libyans out of most of the country.

President Idriss Déby

In 1990, Idriss Déby, a former defence minister, and head of the Patriotic Salvation Movement, overthrew Habré, suspended the constitution, and dissolved the legislature. In 1994, a new constitution was drafted and an amnesty for political prisoners was declared.

President Déby won multiparty elections in 1996 and was re-elected in 2001.

Source: From www.infoplease.com

Untapped resources

The mineral resources of Chad remain largely unexplored but the African country is tempting investors with tax and import concessions

CHAD has had very little exploration or development of its mineral wealth. However, studies conducted by the United Nations Development Programme and the Chad Direction de Recherches Géologiques et Minières (DRGM) have outlined several areas that are highly prospective for gold, bauxite, uranium, silver and alluvial diamonds. Since 1995, Chad has had a Mining Code designed to lure foreign investment to the country.

Greenstone belts have been identified in the southwest of the country, and include the Mayo Kebbi belt (containing the Lere, Mourbame and Pala areas). Gold mineralisation has also been found in the Ouaddai region (including the Am Ouchar, Ade, Ardelik and Goz Beida areas). These regions have been likened to the gold-bearing Birimian rocks of West Africa.

Alluvial gold is mined, particularly along the Mayo N'Dala river (where a substantial alluvial deposit exists, estimated at hosting several tonnes of gold). South Korea's Afko has opened Chad's first gold mine at Pala, some 300km south of the capital, N'Djamena.

The mine is also proximal to the major Doba oilfield development, currently being undertaken by Exxon, Petronas and Chevron.

Due to the extremely arid nature of the Sahara region, conventional stream sediment sampling is made very difficult. However, alluvial diamonds have been reported from the Ouaddai, Biltine, Guera and Baibokoum areas.

Bauxite reserves have been identified at Koro, northeast of Moundou in the south of Chad. Ore resources are estimated at 7Mt grading at 57% Al_2O_3. Other commodities include silver (at Ofoni), wolframite (at the Yedri Massif in Tibesti), uranium (at Mayo Kebbi and Tibesti) and titanium (at Guera Massif).

MINERAL LEGISLATION

The mining sector in Chad is under the responsibility of the Ministry of Mines, Energy and Petroleum, which has several divisions, and of various companies under the control of the state.
The ministry that oversees minerals activities is the General Direction, which itself has three components:

- **Petroleum:** Direction du Pétrole;
- **Energy:** Direction des Energies; and
- **Mining and geology:** Direction des Mines et de la Géologie.

The Direction des Mines et de la Géologie (DMG) has a multifunctional role: it manages and implements Chad's mineral resources policy, manages the mining sector, oversees the exploration and mining activities, and develops strategies for the development of the mining sector.

DMG has four departments (Services):

- **Geology:** Service Geological;
- **Mines:** Service of Mines; and
- **Laboratory:** Laboratoire d'Analyses Géochimiques.
- **Documentation division**

The DMG also serves as a host organisations for partners, whether they are private or represent international aid organisations or national co-operation organisations.

Thanks to the support of UNDP, the DMG also serves as an intermediary for investors. At present, it is well equipped in vehicles and logistics support, a drill rig, geochemical analytical laboratory (for soil and rocks), a petrography laboratory, and a modern documentation and mapping department. Its personnel are trained in field prospecting and exploration techniques, and in data collection, processing and interpretation, which gives them the tools required to fulfil their mandate.

LEGAL FRAMEWORK

In Chad, the mining legal framework is the same as that for the industrial sector in general, which falls under the following laws:

- Investment Code (Ministry of Commerce and Industrial Promotion);
- General Tax Code (Ministry of Finance)
- Customs Code (Ministry of Finance and Information);
- Labour Code (Ministry of Public Service and Labour); and the
- Environmental Code (Ministry of the Environment and Tourism).

In addition, to be consistent with changes that have occurred in the international mining industry and with the firm intent of involving foreign investors in the development of the country's mining sector, Chad aims at developing this economic sector.

A new mining code for Chad was drafted in June 1995 to replace the 1970 code. This legal framework sought to encourage development of a competitive mining sector by attracting foreign investors.

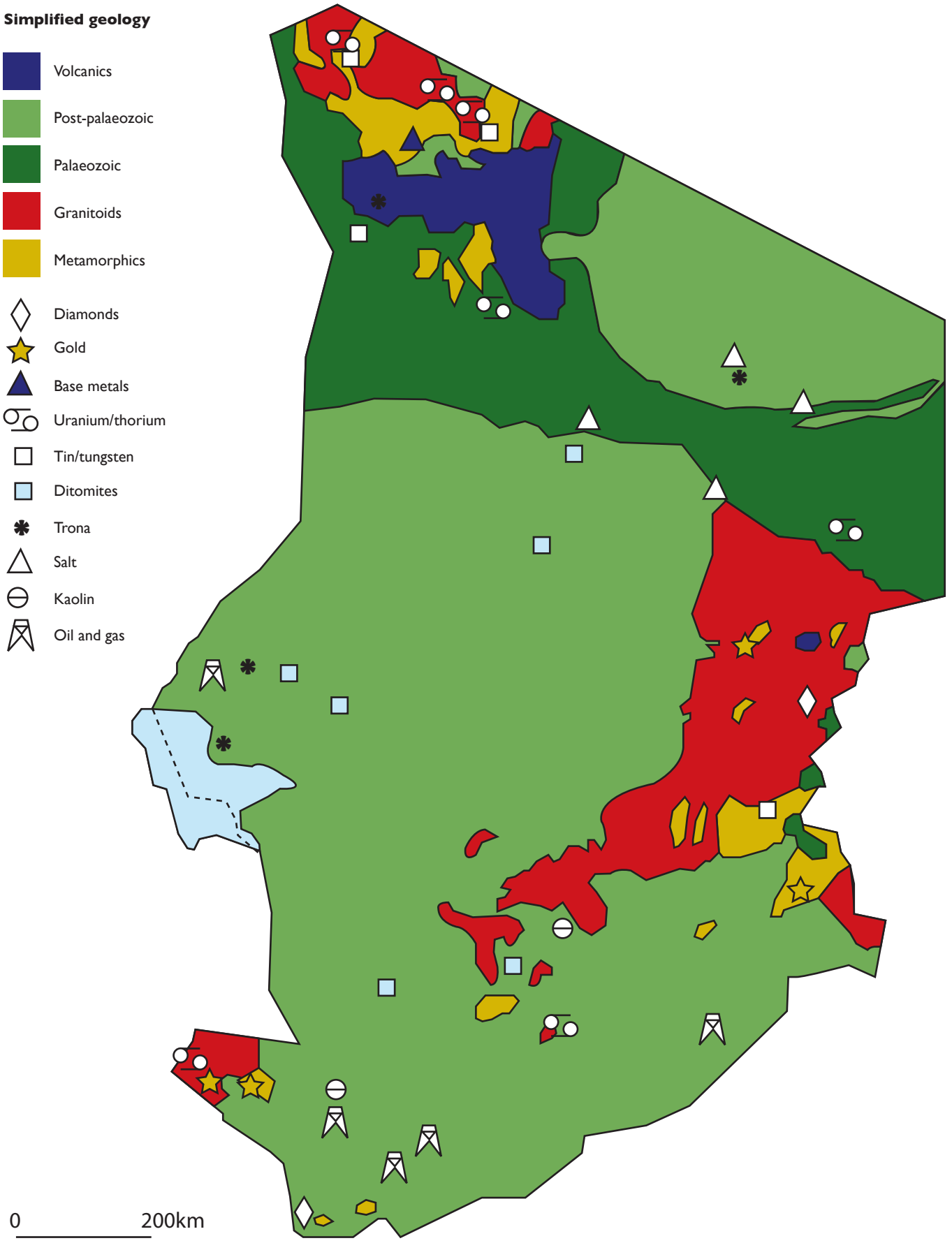
From a legal viewpoint, there is a distinction between 'various materials' and 'mining substances' (previously named 'quarry materials' and 'concession substances'). Exploration and mining activities for minerals substances are controlled by permits and legal titles (*see box, left*).

Permit Types

- Artisinal Mining
- Prospecting
- Small Mine Exploration
- Mining of Various Materials
- Exploration
- Exploitation

Note: In order to obtain a permit or a mining title; companies must have created a Chadian entity.

Mineral resources in Chad



FISCAL REGIME AND EXEMPTIONS

Permit holders, and their suppliers and associates, are subject to the Customs Code – unless special terms are set by a Mining Agreement.

The equipment and machinery, and their spare parts, provided they are used for prospecting and exploration work, are exempt from custom taxes and duties. Imported materials and consumables used exclusively for prospecting and exploration work, as well as the personal belongings of expatriate personnel and their families, are also exempt from custom taxes and duties. However, fuel, lubricants and other petroleum-based products are subject to these taxes.

FOREIGN INVESTMENT RULES

According to the Investment Code, a company can be subject to a particular fiscal regime (called 'Regime D') if the activity involved is judged to be of great importance to the economic and social development of Chad, and if the investments involved are greater than CFA2.5 billion (US$4 million). This regime, which can be applied for a maximum period of 20 years, includes a long-term fiscal regime that guarantees to the company stable tax rates, tax contributions and other fiscal parameters.

Among the benefits of such a regime, are:

- Exemption from property taxes;
- Total or partial exemption on import duties for primary materials required for operations and exports;
- Temporary exemption on income tax for company personnel and for the company itself; and
- Deductions are allowed when profits are invested in the buildings or in the purchase of equipment and machinery.

At the end of the exploration and exploitation activities, the foreign permit holder can transfer out of the country any gains from the liquidation of the operation and the realisation of its assets.

MINING TITLE PROCEDURES

a) Permit for prospecting or artisanal mining

- Prepare a request file for each property. This will include the appropriate form, a location map (based on the official topography), a 1:200,000 scale map showing the extent of the property under consideration, and fees of CFA100,000.
- Submit file at DRGM in N'Djamena.
- The file will be transmitted to the Director of Mines, who will arrange for the permit.

b) Exploration permit

- Prepare a file for each permit. This will include the appropriate form, a location map, 1:200,000 scale map showing the extent of the property under consideration (max. 200km², required information about the applicant, a work plan and budget for the first year, and fees of CFA100,000).
- Submit file at DRGM in N'Djamena.
- The file will be transmitted to the Director of Mines, who will arrange for the permit.
- Evaluation of the file by the Ministry, followed by negotiation, finalisation and signing.
- Delivery of a five-year permit after signing of the (renewable) agreement.

International Monetary Fund mission

At the end of September, the IMF issued a statement following a Staff Mission to Chad

The IMF has held a series of what it described as "constructive discussions" with Prime Minister Yousouf Saleh Abbas, Finance Minister Gata Ngoulou, Infrastructure Minister Adoum Younousmi, Petroleum and Energy Minister Mahamat Nasser Hassane, as well as Christian Ngardoum, National Deputy Director of the Banque des Etats de l'Afrique Centrale, and other senior officials.

The mission also met representatives of the private sector, trade unions, civil society and the donor community.

At the conclusion of the mission, Christian Josz, IMF Mission Chief for Chad, issued the following statement in N'djamena:

"Implementation of the staff-monitored programme has been uneven in the period through end-August. Efforts to mobilise non-oil revenues have been successful, but public spending has exceeded targets by sizeable margins because of larger-than-budgeted outlays on security and on investment. As a result, the financial targets for 2009 are not expected to be met and the staff-monitored programme will need to be re-examined.

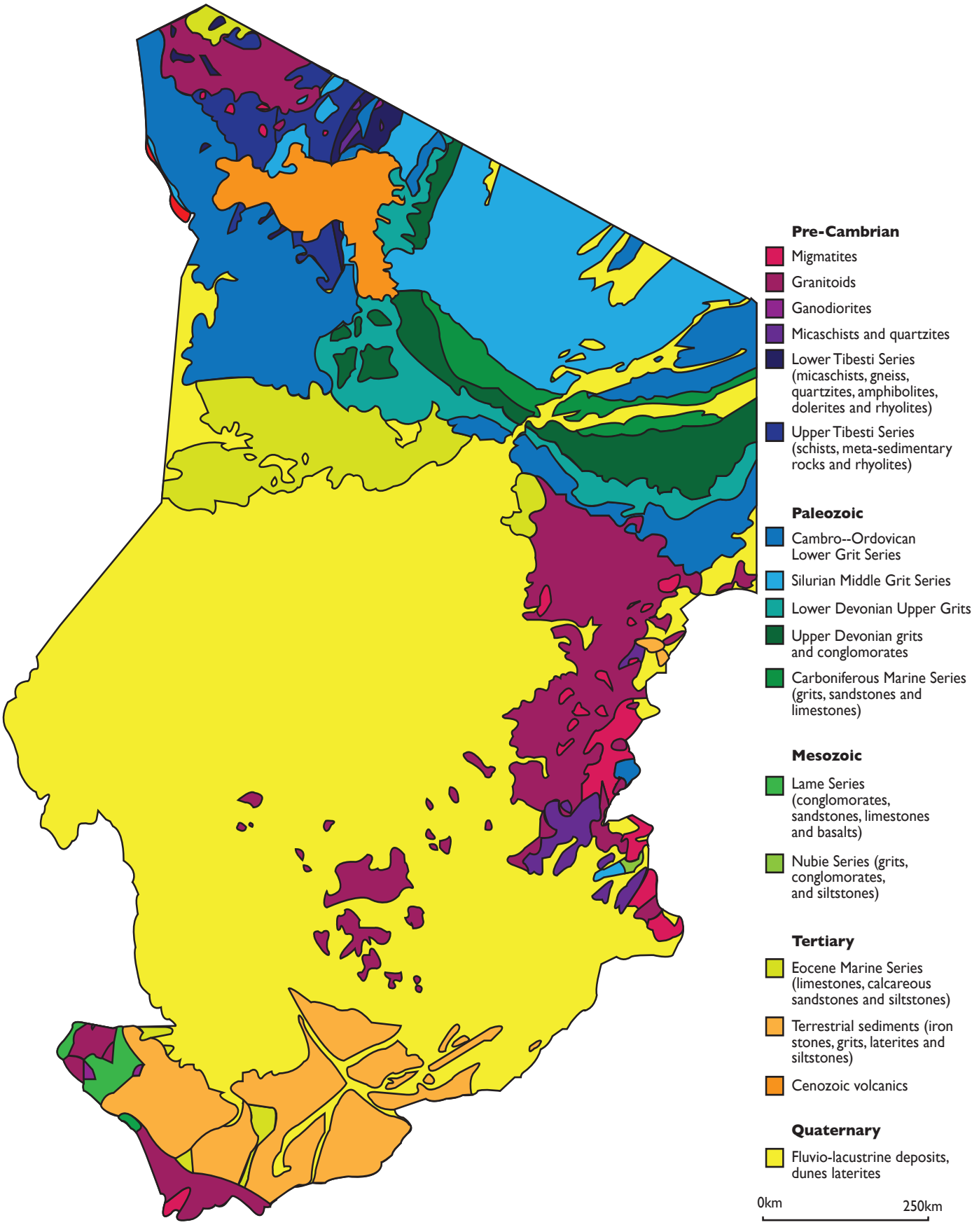
"Against this background, the mission and the authorities agreed on the need for the government to take corrective action to minimise the gap between the 2009 budget outturn and the quantitative objectives set out under the programme for end-December 2009. This will mainly entail some slowing of the pace of spending on non-priority investment projects.

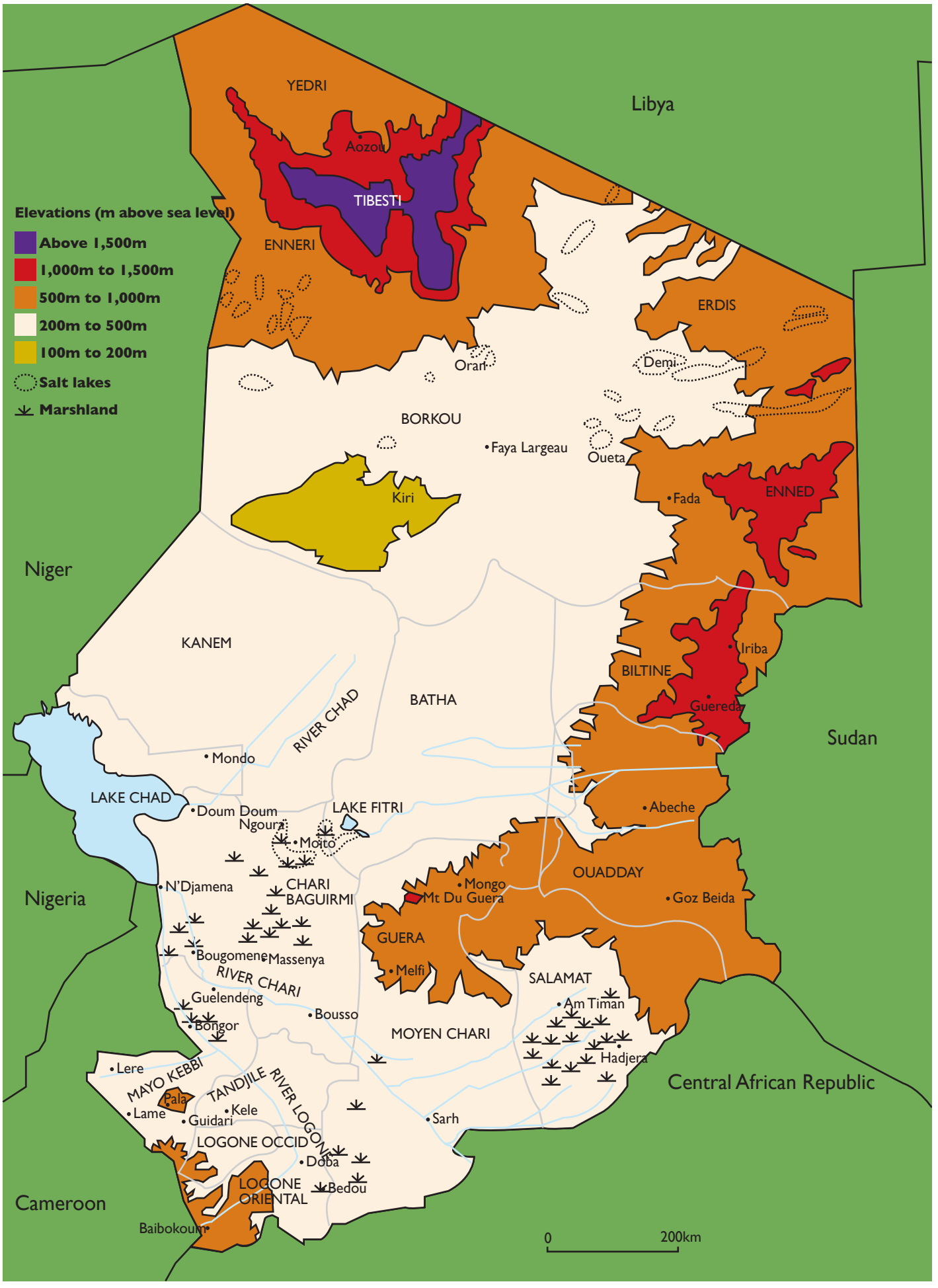
The government is encouraging a move to modern exploration and development methods

"The mission reviewed the main elements of the 2010 draft budget currently under preparation within government, concluding that the proposal under consideration provided a sound aggregate framework for macroeconomic policy in 2010. The mission underscored the importance of aligning budget spending priorities with those articulated in the national Poverty Reduction Strategy, completing ongoing projects before starting new ones, and allocating adequate resources to make already completed infrastructures operational.

"The mission also held discussions on reform measures that could improve macroeconomic management. These included the need for a better oil-revenue management system to make spending plans less dependent on volatile oil revenues and an action plan to improve public investment planning and procurement. The mission would like to thank the authorities for their excellent co-operation and the frank and constructive discussions."

Geology and resources




Elevations (m above sea level)
Above 1,500m
1,000m to 1,500m
500m to 1,000m
200m to 500m
100m to 200m
Salt lakes
Marshland
Libya
Niger
Nigeria
Cameroon
Sudan
Central African Republic
YEDRI
Aozou
TIBESTI
ENNERI
ERDIS
Orari
Demi
BORKOU
Faya Largeau
Oueta
Kiri
Fada
ENNED
KANEM
Iriba
BILTINE
Guereda
BATHA
RIVER CHAD
Mondo
LAKE CHAD
Doum Doum
Ngouri
LAKE FITRI
Moito
Abeche
OUADDAY
Mongo
Mt Du Guera
Goz Beida
N'Djamena
CHARI BAGUIRMI
GUERA
Bougomene
Massenya
Melfi
SALAMAT
RIVER CHARI
Guelendeng
Am Timan
Bousso
Bongor
MOYEN CHARI
Hadjera
Lere
MAYO KEBBI
TANDJILE
RIVER LOGONE
Pala
Lame
Kele
Guidari
Sarh
LOGONE OCCID
Doba
LOGONE ORIENTAL
Bedou
Baibokoum
0
200km

Discovering new mineral wealth

Mineral development in Chad has been largely overlooked

CHAD is a land-locked country, located in the heart of Africa. The neighbouring countries are Libya to the north, Sudan to the east, the Central African Republic to the south, and Cameroon, Nigeria and Niger to the west.

It covers an area of 1.28 million km^2 and has a varied geology, very similar to that of its neighbours, all of which possess economic deposits of minerals including gold, diamonds, uranium, base metals and oil.

The government has taken several legislative steps over the past few years to improve the economy and it is keen to encourage the development of mineral resources.

Several important geological and mineralogical research programmes were recently initiated by the Directorate for Geological and Mining Research (DMG) and were funded by the UN through the United Nations Development Program (UNDP).

Preliminary results from these programmes have been very encouraging and have justified further exploration. The government is also keen to begin a systematic geological survey of the country and to compile an inventory of mineral resources.

Although it is thought that the country could host large hydrocarbon reserves, and deposits of precious and industrial metals, and diamonds, the geology and mineral potential of Chad has never been investigated to any notable extent.

The DMG research programmes indicate that there is every likelihood that significant mineral deposits exist.

Chad's economy has recovered in the 12 years since the end of their civil war. The growth of medium-scale enterprises in the food and light industries sectors demonstrate that industry is steadily developing. However, the mining sector is still underdeveloped. To date the only resources mined in Chad are alluvial gold and diamonds, trona, salt and building materials.

GEOGRAPHY

Chad's population, estimated at 9 million, is concentrated in the southwest of the country, and only 21% live in urban areas. The capital, N'Djaména, is located on the southeastern tip of Lake Chad. French and Arabic are the official languages.

There are over 110 recognised ethnic groups; the main groups being Baguirmi, Sara, Arab and Sudanese. It is mainly a low-lying country with average elevations ranging between 290 and 320m above sea level.

The lowest part of the country, at 120m, is the Bodole depression, which is situated to the southwest of Faya Largeau. Three mountain belts dissect Chad; the Ouadday massif to the east on the Sudaneese border (500-1,000m); the Guera massif in central Chad (1,600m); and the Tibesti massif to the north, where several summits exceed 3,000m (*see map, page 7*).

There are three distinct climatic zones. From north to south they are:

> "The geology and mineral potential of Chad has never been investigated to any notable extent"

- Desert zone with low precipitation (between 50-250mm) and high evaporation. Vegetation is restricted to oases;
- Savanna zone with rain fall ranging between 200-500mm, falling mainly during June to September; and a
- Tropical zone averaging 500-1,200mm of precipitation, which mainly falls during April to September. The area is characterised by savanna, progressing to true forest in the far south.

Lake Chad is the country's largest body of water covering some 25,000km^2. It is located on Chad's western border. Although its average depth ranges from only 4-7m, under normal precipitation conditions it has an estimated capacity of 35,000 million m^3.

The lake is fed by two permanent rivers, the Chari and its tributaries, and the Logone. These provide the lake with 95% of its total yearly recharge. The Chari (1,200km in length) and the Logone (790km) constitute the major part of the primary hydrographic network of Chad. The country's third largest river, Batha, flows into Lake Fini.

Chad's paved highways extend for 1,300km, and the main routes connect N'Djaména to Koumra in the south, and N'djamena to Mongo and Dandi to the north. The capital is also connected by paved road to the port of Douala in Cameroon, and to the port of Hartcourt in Nigeria.

The southwest has an extensive network of dirt roads that are in very good condition. A large number of dirt roads also cover most of the southern half of the country, although many are often unusable during the rainy season between June and October.

However, during this season most commodities are transported along the Chari and Logone rivers. Navigable sections extend from N'Djaména to Sahr along the Chari, and to Bongor along the Logone.

Air France, Etiopian Airlines and ifriqiya provide regular passenger and airfreight services to Europe and other destinations from N'Djaména. The capital is also connected by air to most of the surrounding African capitals and most of Chad's other major towns have air strips.

Currency

THE African Financial Community Franc (CFA) is the common currency in the six member states of both the Monetary Union of Central African States (UMEAC) and the Customs and Economic Union of Central African States.

The six members are: Chad, Cameroon, Central African Republic, Congo, Gabon and Equatorial Guinea. The CFA has a fixed exchange rate with the Euro of ☐ = CFA 656, which is guaranteed by the French Treasury.

Any foreign exchange and international capital movements must be made through the Central Bank, the Post Office Administration or a chartered bank, except where prior permission has been obtained.

Geological Overview

Chad is dominated by two main geological units, the Precambrian crystalline basement and the Palaeozoic to Quaternary sedimentary cover (*see map, page 6*). The basement rocks occur in several massifs, representing the edges of three major cratons.

The majority of the sedimentary cover lies within a central depression. There are five main regions in Chad: the Tibesti massif is situated in the northwest, the Erdis basin in the northeast, the Ouadday and Guera massif along the eastern edge of the country, the Lake Chad Basin in the centre and the Mayo Kebbi massif in the southwest.

PRECAMBRIAN

The two largest areas of basement rock are Tibesti in the north, and Ouadday – which covers most of the eastern side of Chad extending from Ouadday down the Guera massif.

Other notable areas of basement rock are Baibokoum and Mayo Kebbi in the far south. Gneisses and granites are the main rock types found at Guera and in the northern part of the Ouadday massif, while greenstones dominate Mayo Kebbi, Tibesti and the southern part of Ouadday.

The basement rocks have been structurally and regionally overprinted by the Panafrican orogenesis, which occurred at the end of the Proterozoic.

There are two main Precambrian formations at Tibesti, separated by an unconformity. They have been intruded and weakly metamorphosed by post-tectonic granites.

The lower metamorphic assemblage outcrops in the north Tenere and Enneri Misky massif and comprises amphibolites, pyroxenites, quartzites, marbles, gneisses and mica schists. The upper assemblage consists of a basal conglomerate overlain by thick layers of arkosic sandstone, pelitic schists and limestones. These are interlayered with rhyolites and mafic lava flows or sills.

Precambrian volcano-sedimentary rocks occur at Ouadday. They have been intruded by various calcalkaline and alkaline granitoid stocks, as well as being separated by a large batholith comprising granitoids, migmatites and gneisses.

> "The research programme provided an excellent indication of Chad's mineral potential"

To the south of the batholith a large area of volcano-sedimentary rocks form the Ankarouba Series. To the north, lesser amounts form the Goz Beida Group.

The Guera massif, in the centre of the Lake Chad Basin, is subdivided into three main massifs (Abou Telfan, Kengas and Melfi) and numerous smaller massifs separated by dunes. The highest point is 'Mt du Guera' at 1,613m and the average elevations of the lowlands are 400-500m. The Guera massif, Mayo Kebbi and the Yade (Baibokoum) massif all have a similar geology to Ouadday, except that the volcano-sedimentary rocks form greenstone belts.

PALAEOZOIC TO RECENT

Palaeozoic to Quaternary sedimentary sequences cover almost 85% of Chad. There are two main sedimentary basins, the Erdis (to the northeast) and Lake Chad (in central and southern Chad).

The Lake Chad Basin is subdivided into several sub-basins; Kanem, Doba and Salamat. The Erdis Basin is an extension of Koufra Basin in Libya, which evolved as a rift during the Panafrican orogenesis.

Palaeozoic sediments consist of mainly continental material that was deposited in three main areas:

- Northern Chad, in the Ennedi massif (north of the Erdis Basin) and in Borkou (in southern and western Tibesti);
- Northeastern Chad, where thick layers of Massalit Sandstones extend westwards into Tibesti and Ouadday;
- Erdis basin, where continental material infilled the basin throughout the Palaeozoic, except for a few minor interruptions caused by sea transgressions in the Carboniferous. The thickness of Palaeozoic sediments within the Erdis Basin totals 3,500m.

During the Upper Jurassic and beginning of the Lower Cretaceous, a number of large grabens were formed, which generated the Lake Chad Basin. Initially, sedimentation was predominately terrestrial and was derived from the extensive erosion of the bordering massifs under wet tropical climate conditions.

This style of deposition is characterised by a series of wet and dry periods. Deposition continued until the Quaternary and resulted in very thick sedimentary sequences, such as at Doba where 6,000-7,000m of terrestrial sediments were laid down.

Marine sediments were deposited during the Upper Cretaceous in the Erdis Basin and Tibesti area. In some areas this series, known as the Lame formation, is over 200m in depth and includes conglomerates, marine limestones, sandstones, marls and argillites.

In Erdis, the marine sediments form a large plateau with lateritic crusts, ferruginous sandstones and argillite. In Tibesti they cover a much wider area and have a more coarse character.

The most important volcanic period in Chad began in the Early Cenozoic. The thick alkaline succession, which covers around 30,000km^2 of the Tibesti massif, comprises rhyolite, trachyte, phonolite, ash stone, ignimbrite and basalt. These were emplaced by large shield volcanoes that were active from the end of the Cenozoic to the early Quaternary.

Lesser amounts of rhyolites and microgranites of Mesozoic age are exposed in the Ngoura-Moito area near Lake Chad.

Terrestrial sedimentation continued over most of Chad during the Cenozoic, with only one notable marine transgression during the Eocene, which laid thick sediments in north Tibesti.

A desertification phase followed this tropical period during which extensive dunes were deposited, as well as evaporitic salt and trona deposits.

Taxation

CUSTOMS and taxes for which permit holders, their subcontractors and affiliates are liable, are stated in the Customs and General Taxation Codes.

Individual companies may be exempt from some of these taxes and customs, which will be stated in the Mining Convention.

Any equipment, corresponding spare parts and consumable goods, from both domestic and overseas sources, that are intended for research and exploration are excluded from tax and customs rights, as are the personal goods of expatriates. However, fuels and lubricants are liable to taxation.

Under the Mining Convention, the rate of taxes on revenue, which is normally 45%, can be negotiated.

A number of deductions can be applied to profits, depending on the capital invested and characteristics of the exploration or mining project.

Exploration

Although numerous mineral occurrences have been reported since the early 1950s, it was not until the recent UNDP/DRGM geological and mining research programmes that they were evaluated in any detail.

The research programme, which considerably updated Chad's mineral inventory, also identified new mineral deposits and has provided an excellent indication of Chad's mineral potential.

It is important to note that Chad is still very under explored compared with other African countries. There has been no systematic reconnaissance using modern exploration techniques, no airborne geophysical data for example are available for 95% of the country. The only area covered by an aeromagnetic and radiometric survey is the Mayo Kebbi area.

The Tibesti massif is thought to be one of Chad's most attractive areas for mineral development. It is known to host significant occurrences of tungsten, tin, niobium and tantalum.

Preliminary exploration has also indicated that further studies should be made on the Tibestian volano-sedimentary formations for gold, silver and base metals, as well as precious and semi-precious gemstones.

Gold exploration over the past few years has focused on the Precambrian formations of Ouaddai, Lake Fitri in Guera and Mayo Kebbi.

The excellent gold potential in Mayo Kebbi has been known since the 1940s, when the only recorded gold production came from two primary gold deposits owned by Compagnie Minière de l'Oubangui Oriental: one, situated near Gamboke, operated between 1939-41 and produced 180kg Au.

The other was a small operation near Lere, which produced 4.9kg in 1941. However, it was not until the end of the 1980s that any notable exploration was conducted in the area under the DRGM/UNDP programme. Geochemical exploration surveys of the Mayo Kebbi greenstone belts identified three distinct gold regions – Lere, Mourbame and Pala – where quartz veins and silicified zones show visible gold and have returned grades up to 33g/t.

The Lere gold occurrences are located west of the town of Lere. The gold is hosted in Precambrian amphibolites and green schists, and in local granitoid intrusions such as the Mayo Kebbi batholith and the alkaline granite of Zabili.

The rocks are crosscut by mafic to ultramafic intrusions and by microgranite dykes. One strong geochemical anomaly was delineated at Teubara in the Zabili green schists.

Gold in the Mourbame area is also contained within a greenschist assemblage comprising meta-volcanic and meta-sedimentary formations.

The gold, which can be visible, is found in quartz veins in shears, along with pyrite, arsenopyrite, chalcopyrite and malachite, which are concentrated in the meta-sedimentary formations.

To date, only trench samples have been taken. These have returned grades of 1-33g/t gold.

There are four main areas of gold mineralisation in the Pala region; Gamboke, Goueigoudoum, Massonebare and Mbibou. These are all located in volcano-sedimentary formations, with abundant igneous intrusions such as serpentine, diorite and microgranites.

Mineralisation occurs in quartz veins, often as stockworks cutting the host rocks. The gold is sometimes visible and is often associated with galena, pyrite, chalcopyrite, arsenopyrite, covellite and malachite.

Most of the areas have been investigated by trenching, but only the Massonebare and Gouelgoudourn deposits have been drilled, revealing grades of 3.5-4.6g/t over 1-1.3m and 1.3-3.3g/t over 0.3-3.25m, respectively.

One particularly rich alluvial deposit discovered in the Mayo Kebbi region was Mayo N'Dala, located north of Pala. The ore grades 4g/m^3 of gold with over 3t of gold metal resource.

Small-scale production from the deposit began in 1992, and a further four small-scale mining permits were issued to local groups to work this resource. In 1994, a 400g gold nugget was found in the Mayo N'Dala River.

The Ouaddai region is also known to host gold, which was first discovered in Goz Beida during 1963. In 1988 the UNDP/DRGM project undertook further exploration work in the form of geological mapping and regional geochemical surveys on the Ouadday massif.

The project identified some 40 gold anomalies around Goz Beida, Ade Ardelik, Echbara, Karoub and Koukou Angarana. Further detailed analyses of these anomalies identified auriferous quartz veins and stockworks within volcano-sedimentary schist assemblages.

The most promising gold occurrences noted were:

- **Am Ouchar:** gold is found in a shallow dipping shear zone, thought to be a thrust. Channel and trench samples indicated 33g/t of gold. Typical intersections are 4.73g/t over 16m, 5.7g/t over 12m and 6.8g/t over 20m. The mineralisation can be traced at surface for over 100m along strike.
- **Goz Beida:** several anomalies were discovered, the most promising is associated with a granite/quartzite contact and is traceable at surface over a distance of 500m. Exploration trenches gave grades of 1.5g/t over 4m and 3g/t over 2m. Alluvial gold has also been found at Goz Beida, the primary source of which has not yet been identified.
- **Echbara:** five anomalies were identified, including one that extends over 1,600m. The down-dip continuity of these anomalies has not yet been verified.
- **Ade Ardelik:** five gold anomalies were defined, one of which was traced over 1,100m and graded 4.3g/t gold. Following the discovery of gold nuggets in alluvium in the Aozou area and Tibesti, and the favourable geological terrain, it is considered that there is a good potential of finding primary gold deposits in this area.

BASE METALS

To date, discoveries of base metals in Chad have been uneconomic. Copper sulphides, silver-bearing galena and traces of zinc were found in breccias in the Ofouni granitic stock in Tibesti.

The UNDP/DRGM programme also discovered copper sulphides and galena in the gold-bearing veins of Massonebare and in Poyeme. Malachite is reported in various locations south of Teubara and in hornblendes east of Mourbame.

When taking into account the copper mineralisation in neighbouring Niger, where mineralisation is reported in extensions of geological formations found in Chad, it is thought that economic base metal deposits in Chad are undiscovered, rather than non-existent.

Uranium

RADIOACTIVE mineralisation, essentially uranium, has been identified in both Tibesti and Mayo Kebbi, where they occur in veins associated with alkaline granite and syenite stocks. Sedimentary uranium, in Cambro-Ordovician conglomerates and sandstones, has also been reported at Bouboa, Ouadi Bakou – near Fada – and Tibesti.

Other metals

There is an excellent potential for the discovery of a wide range of other metals in Chad including tin and tungsten, iron ore, bauxite and various minor metals.

Tin and tungsten mineralisation has been recorded in association with post-tectonic granite stocks in the Yedri massif in Tibesti.

The greisen mineralisation contains large cassiterite accumulations that are often capped with a dome of quartz veins and stockworks, which also host wolframite, cassiterite and copper. Gigantic wolfram crystals weighing several hundred kilograms have been found in the Yedri massif.

During the 1930s, 22t of wolframite was collected from the surface of the massif. Similar mineralisation has been reported at other Tibesti massifs.

Some iron-ore deposits have been worked on a small-scale in the pasto. Iron can be found in the Precambrian ferruginous quartzites of Hadjer Hadid (near Gourgoundji) and Ouadday; in haematite schists of the Koukou Angarama region in Ouadday; in oolitic iron formations near Tile Nougar (in the far south of Guera); and in laterite crusts in various areas. No reserve estimations have been made for these deposits.

The Koro bauxite deposit, located south of Guidari in southern Chad, comprises several small plateaus topped by ferruginous crusts that trapped an oolitic bauxite layer up to 10m thick.

The post-tectonic granitic stocks of Tibesti also host niobium, tantalum and beryllium. Columbo-tantalite and beryl are commonly associated with cassiterite, although in Chad they occur mainly in pegmatites in the Yedri massif and the Orda Oudengui massif (southeast of Yedri).

Various titanium deposits have been reported, including an alluvial ilmenite deposit, grading 50kg/m^3, at Guera massif and an alluvial rutile deposit down stream from Bousso. Manganese mineralisation has recently been discovered in the Goz Beida area.

DIAMONDS

The main areas of alluvial diamond production in Chad are in Abeche, Biltine, Am Zoer and Adre in Ouadday, and at Melfi-Bitkine in Guera. Local prospectors have also discovered alluvial diamonds in many regions, including Melfi, central Ouadday and the Lim River in Baibokoum.

The latter region, which is located in the far southwest of Chad, has similar geology to that of the small-scale diamond mining areas across the border in the Central African Republic and Cameroon. This supports the belief that further finds will be made.

ROLE OF GOVERNMENT

The mining sector in Chad is controlled by the Ministry of Mines, Energy and Petroleum. The ministry is subdivided into directorates and divisions, such as the General Directorate of Mines, Energy and Petroleum, the Directorate of Water Resources and Meteorology, the Directorate of Petroleum and Renewable and Non-Renewable Energy and the Directorate of Geological and Mining Research (DMG).

The DMG has a multi-functionary role in managing and enforcing the mineral resources policy, managing the mining sector, supervising exploration and mining activities and defining mineral development strategies. The Ministry's Geology and Mines divisions, and the state geochemical laboratory, are also part of DMG.

The DMG also acts as an intermediary for investors, and with the support of the UNDP. It is now well equipped with transportation, a diamond drill, a fully operational geochemical and petrographic laboratory, and facilities for data documentation and map processing. Staff have been trained in field exploration and prospecting techniques.

Chad's new mining code was drafted in June 1994, replacing the 1970s Mining Code. The new legislation encourages competitive minerals development, and is intended to attract foreign investors to help develop the country's minerals industry.

The new mining code allows for three main permits:

- **Prospecting Authorisation:** a non-exclusive right allowing regional and surface investigations only.
- **Research Permit:** allowing any research activities on the permit area, including subsurface workings.
- **Mining Permit:** authorising the development of a mine, including production facilities. Any foreign company wishing to apply for a Mining Permit, must sign a 'Mining Convention', which establishes specific terms such as taxes and royalties.

Other minor rights and permits noted in the new mining code include the 'gold digger authorisation' and 'small-scale authorisation'. These are issued to nationals and allow the exploitation of any ore deposit on a small-scale. The 'mining authorisation for various materials' allows production of any minerals found on the surface in the permit area.

Signet Mining

SIGNET Mining Services is an exploration and mining company that has been active in Africa since 2005.

Although Signet is also pursuing opportunities in coal, gold, platinum, copper and diamonds, the focus has been on exploring for uranium in sub-Saharan Africa in areas where historical work has identified potentially economic grades of uranium, principally Chad and Niger.

Signet's wholly-owned subsidiary, Chad Mining Services (CMS), currently holds six concessions in the Mayo Kebbi Province of southwestern Chad, near the towns of Lere and Pala. CMS has its head office in the Chad capital of N'Djamena, and a field camp at the Lere project.

In addition to the exploration permits, CMS has two exclusive reconnaissance areas known as the 'Central Area'. Current exploration activities by CMS are centred on the promising Lere project, which is currently at the resource definition drilling stage.

Lere incorporates three concessions, with a total area under license of 330km^2. Six radiometric anomalies were identified within a granitic body from a high-resolution radiometric and magnetic survey completed in 2008.

The focus to date has been on Anomaly A, which was also subject to historic drilling and trenching by the UNDP during the 1970s.

Percussion drilling is underway to delineate and extend the uranium deposit at Anomaly A, and a diamond drilling rig is expected on site by mid-November to add to resource confidence and improve the geological model. Signet has developed a block model using Micromine software and completed an unclassified grade and tonnage estimation based on downhole spectrometer probe data.

CMS will update and revise the deposit model in the coming months with new geological data and the XRF laboratory assay results.

The lab results have already shown that mineralisation extends below the current model and there is also believed to be good potential to expand the currently defined orebody laterally.

The target deposit size at Lere contains 15Mlb of U_3O_8, and it is anticipated that the deposit will be mineable by open pit and amenable to conventional heap-leach processing methods.

Signet engaged SRK Consulting to conduct a technical review on the project in November 2009, and will continue this engagement to ensure the high quality of the project.

SRK Consulting has also been engaged to produce a SAMREC-compliant resource statement and a Competent Person's Report, anticipated for delivery by mid 2010 following completion of the current exploration campaign.

Actively exploring for uranium in Chad

Signet is currently completing an advanced drilling program on the exciting Lere Project

The Signet portfolio consists of 13 attractive uranium exploration concessions in Chad and Niger. Signet is a results driven company with a strong management team and a good project pipeline in strategic locations.

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