



THE LEGAL AND REGULATORY FRAMEWORK RELATIVE TO SAFETY AND ENVIRONMENT IN THE URANIUM MINES IN NIGER

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Abstract

The mining sector holds an important position in Niger economy. Considerable funds have been invested for the promotion, exploration and exploitation of mineral resources since the colonial period. This has resulted in the discovery of numerous deposits among which those of uranium. Today, uranium represents more than $\frac{3}{4}$ of Niger export revenues. The mining sector is supervised by the Ministry of Mines and Energy. The Ministry applies the mining policy as defined by the government. It elaborates legislative and regulatory texts and see to their implementation. Regarding uranium, mining activities has been governed since 1961 by various orientation laws and implementation decrees. However, to face up the harmful consequences on national economy of successive drops of price and sales of its major export product, and taking account the new international requirements relating to economy globalization and sustainable development, Niger set up a diversification strategy of its mining productions as part of which a new mining code particular incentive has been established in 1993. The new mining code provides significant advantages to investors. These advantages insure them a great cost effectiveness of their investments in Niger and easy and less onerous respect of regulations regarding safety and protection of environment. Tremendous efforts have been, thus, provided by the IAEA, the Ministry of Mines and Energy and the uranium companies for an optimal protection of workers and the public, especially against the hazards of ionizing radiations. This will to improve the situation has resulted in the adoption of several laws and their application decrees as well as various sectorial laws designed by various Ministry departments concerned with environmental issues and risks prevention. Among these texts are the renewal of the order N° 31 M/MH which has defined since 1979 the main axis of the Niger regulations as regards to radioprotection and the design of new texts relating to radioactive wastes management and the transportation of radioactive materials.

1. INTRODUCTION

Many people heard about NIGER in literature as a great uranium producing country (if not confused to NIGERIA).

Indeed, Niger is currently the third uranium world producing country and the first in Africa.

The discovery of first indications of uranium dated back to the 50's. The first commercial production of yellowcake dated back to 1971.

This is why, uranium mining has been the first industrial activity in Niger which has benefited very soon from legislative and regulatory framework governing all aspects of its activities and especially specific risks to hazards exposure to ionizing radiations.

2. AIM OF THE PAPER

The aim of this paper is to present the modest experience of Niger as regards to uranium and other mineral substances mining regulations with emphasis on environmental issues and risks prevention and their consequences on exploration, mining, mineral processing and wastes management activities.

The plan of the paper will be as follows:

- (a) A brief introduction to the physical and macro-economic framework of Niger;
- (b) A brief overview on resources and types of uranium deposits in Niger;
- (c) A brief overview on the institutional framework of mining activities in Niger;
- (d) Regulation in uranium and other mineral resources in Niger;
- (e) Regulation practice in uranium mining companies in Niger.

3. PHYSICAL FRAMEWORK

3.1. Geographical situation

Niger is located in the heart of the north-western part of the African continent, surrounded in the north by Algeria and Libya, in the east by Chad, in the west by Burkina Faso and Mali, in the south by Nigeria and Benin (Fig. 1).

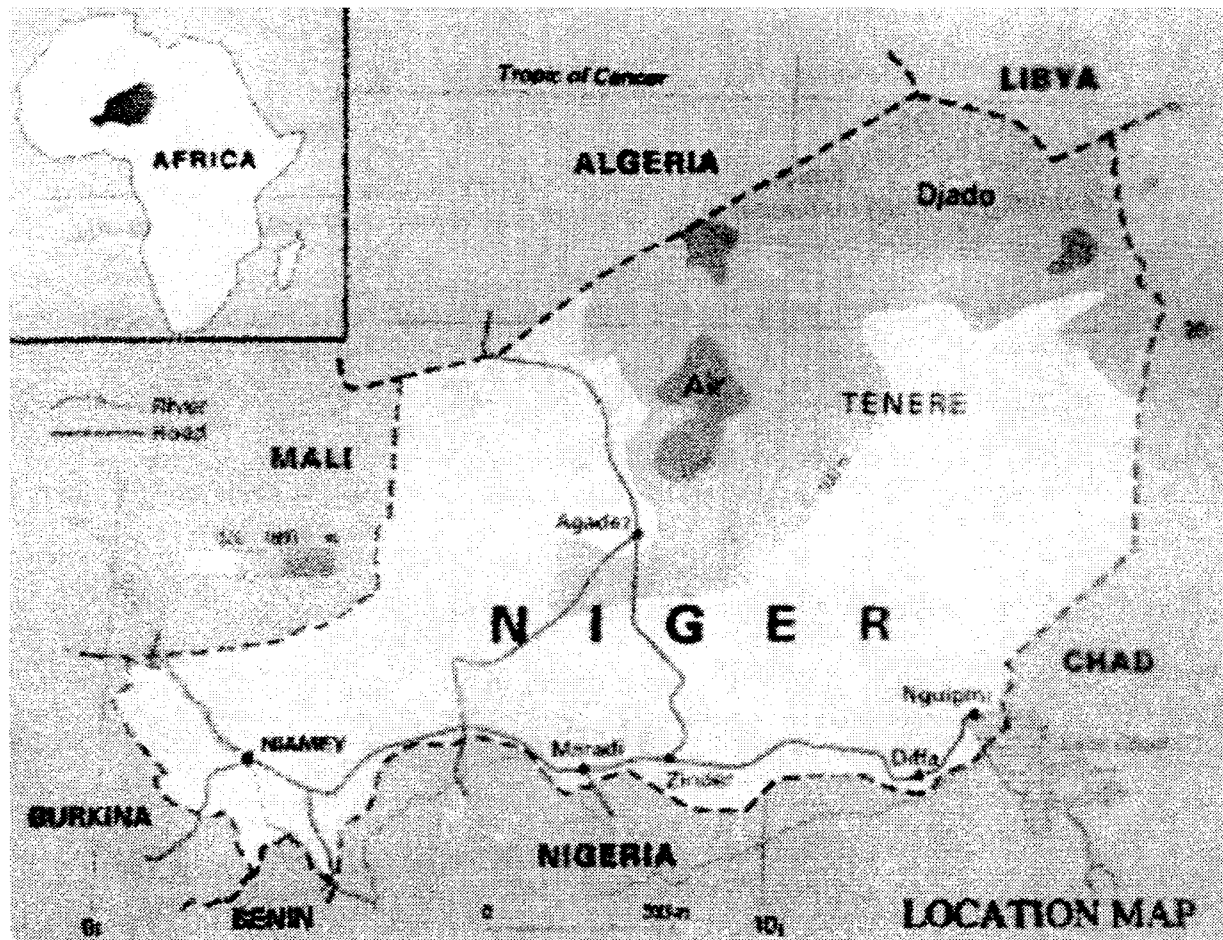


FIG. 1. Location map.

Located in full Sahelian zone, it covers 1 267 000 square kms for a population estimated to 9.5 million inhabitants in 1997. French is the the official language. The rural sector (staple food agriculture and extensive cattle rearing activity) provides jobs to 85% of the population and contribute for 40% of the GDP.

3.2. Mining and petroleum potential

From economic point of view, Niger, however, can be considered as a rather mining country, not for the volume or diversity of its mineral productions but for:

- (a) The position occupied by the mining sector in the national economy;
- (b) Its considerable mining potential;
- (c) Its long mining tradition.

3.2.1. *Role of the mining sector in national economy*

During the years of « the Uranium boom in Niger » (1975-1981) uranium has contributed for 20 to 25% of GDP, 40% of the country budget revenues, 85% of the export revenues and provided an economic mean growth of 21% and employment for more than 4,000 permanent salaried employees.

Nowadays, despite the drastic drop of price and sales, uranium still represents more than 75% of Niger export revenues.

3.2.2. *A large and diversified geological potential*

In addition to uranium, around thirty mineral substances (gold, silver, nickel, cobalt, titanium, lithium, lanthanides, chromium, vanadium, etc. and fossile fuels (coal, oil)) and near 400 indications and deposits have, up to now, been registered though mineral investigations have only been carried on a tiny part of the national territory.

In fact, in front of the dramatic consequences on the socio-economic sector due to successive drops of price and sales of the nuclear fuel since the beginning of the 80's, and in order to avoid the dangers and fragility of an economy based upon the monoproduction of uranium, the Ministry of Mines and Energy has set up an all directions diversification policy of the national mineral productions.

Thus, intensive geological investigations for the setting up of basic geological infrastructures and several promotion actions in the international mining fora have been conducted.

This resulted in the granting of several exploration permits to international companies (majors and juniors) from Canada, UK, Norway, Germany, South Africa, Australia, etc. among which: Ashanti Goldfields, Anglo-American, Barrick Gold, Etruscan, etc. for gold and other precious metals, Exxon, Hunt Oil, Tg World Energy for hydrocarbons.

The territory of Niger is mainly located within the Central African mobile zone which slightly overlaps the western African craton at the Liptako region. Niger mining potential is mainly related to (Fig. 2):

- The Phanerozoic sedimentary formations of the immense basins of Iullumenden in the West (Iullemeden, Ader - Douchi, Tin Mersoï and Tamesna sub - basins) and the ones of Chad to the east, covering 90% of the national territory.

The stratigraphic series of the sedimentary basins run from the Cambrian to the Pleistocene and are characterized by alternating marine and continental sequences.

It is, in particular, in the basin of Iullemeden, characterised by an alternance of layers with a marine influence and continental complexes that have been discovered the important coal (Anou Araren, Solomi) and uranium deposits some of them in exploitation stage (Arlit).

- The formations of the Precambrian basement which outcrop in the metallogenic provinces of Liptako (30,000 km²), Aïr (60,000 km²), Damagaram - Mounio and South Maradi (20,000 km²) and Tenere (13,000 km²). These formations are essentially made of gabbros, dolerites, basalts, andesites, rhyolites, intermediary basic tuffs, granitoids, sedimentary sequences, etc. and are known for their indications in Au, Pt, Cr, Cu, Pb, Zn, Ti, Li, V, etc.

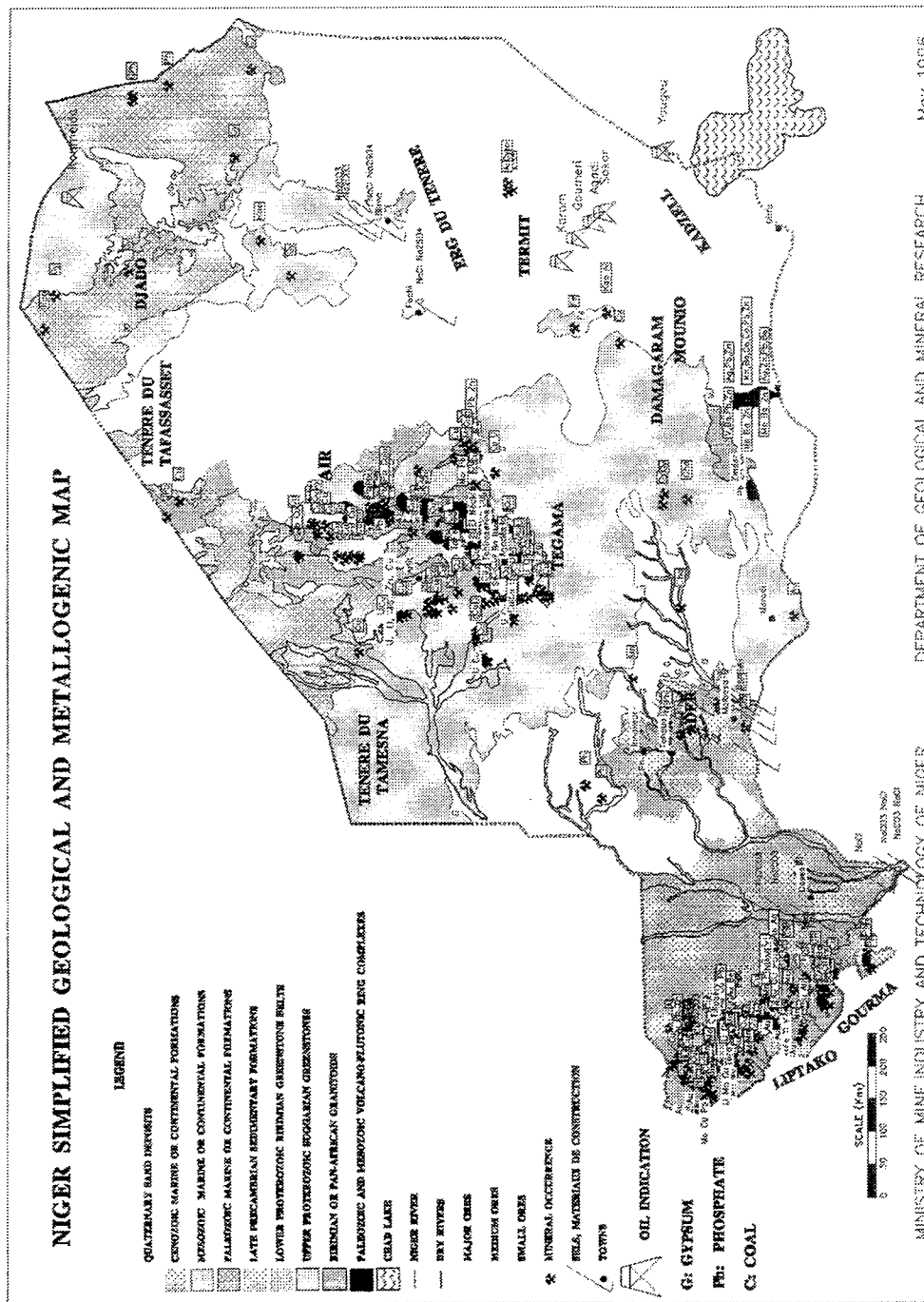


FIG. 2. Simplified geological and metallogenic map of Niger.

3.2.3. Mining industry experience in Niger

Niger has a long mining experience.

Industrial mining has begun in Niger in 1946 with tin production, followed by that of uranium in 1971, phosphates in 1975 and coal in 1981.

However, from its importance in the national economy, uranium remains undoubtedly the economic and social development engine of Niger.

4. URANIUM RESOURCES AND TYPES OF DEPOSITS IN NIGER

4.1. Location

Uranium deposits of Niger are located in the region of Arlit/Agadez in the central north-western part of Niger at an equal distance with the Mediterranean Sea and the Gulf of Guinea (Figs. 3a and 3b).

The climate is desertic, dry and the temperature exceeds 45°C during the dry season. It rains scarcely (under 100 mm/year). Sandstorms are frequent during the raining season from May to September.

4.2. Stratigraphy

Uranium deposits are around 35 m to 250 m depth in sandstone – clay sedimentary formations with a continental origin for sandstone and marine for clays.

These formations rely on the western border of the crystalline Massif of Air in the basin known as Tin Mersoï (Agadez Basin).

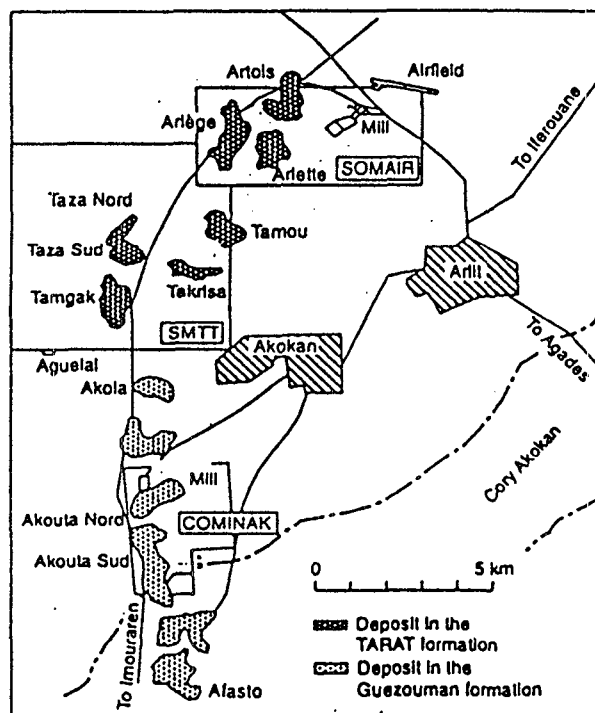


FIG. 3a. Uranium deposits and prospects in Niger.

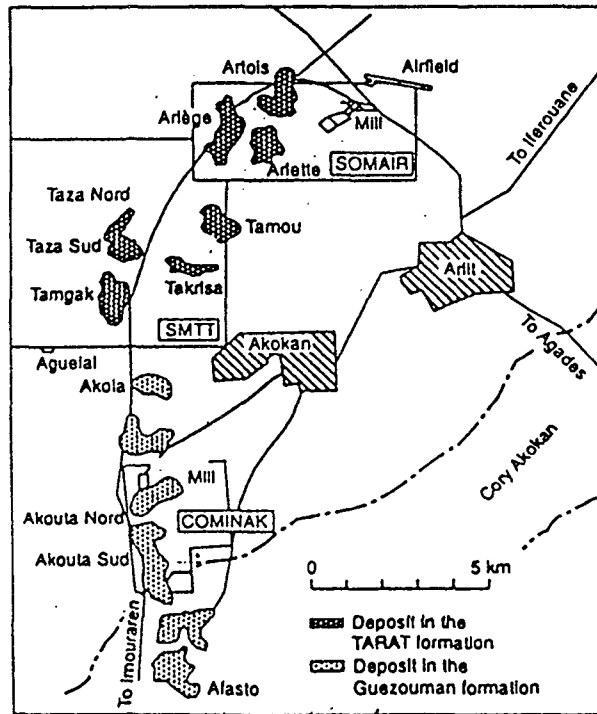


FIG. 3b. Uranium deposits in the Arlit region, uranium producing district of Niger.

In general, the whole system is sub-horizontal with local variations of dip.

Uranium mineralization is associated with upper Carboniferous units, principally in the Guezouman, Tarat and Madouela sandstones. The upper continental sequence (Irhazer) can also indicate some mineralizations (Fig. 4).

The host rocks of uranium mineralizations consist of sandstones, siltstones or argillites. Clay are, regarding to their content in organic materials, at the origin of uranium trapping. Uranium exists:

- (a) In clays in split form, linked, to the phyllites,
- (b) In sandstones in the form of pitchblende (oxyde) and coffinite(sillicate).

Incidentally associated are molybdenum and vanadium at low grade and also some iron sulfides.

4.3. Uranium resources and mining in Niger

The estimated uranium resources of Niger represent a total of 281,000 tons of uranium spread over a dozen of mining permits, each containing one or many deposits. The resources consist of 180.860 tU of RRA and RSE-I and 100.800 tU of RSE-II and RS.

The Takriza, Tamou, Artois, Arlette, Ariège, Afasto West, Madaouella, Akola, Akouta, Teguidan Tessoum, Abkoroum Azelik, Imouraren orebodies are among the most importants uranium deposits of Niger.

Some of these deposits are being developed or mined either by open cast method (Somair) or by underground method (Cominak).

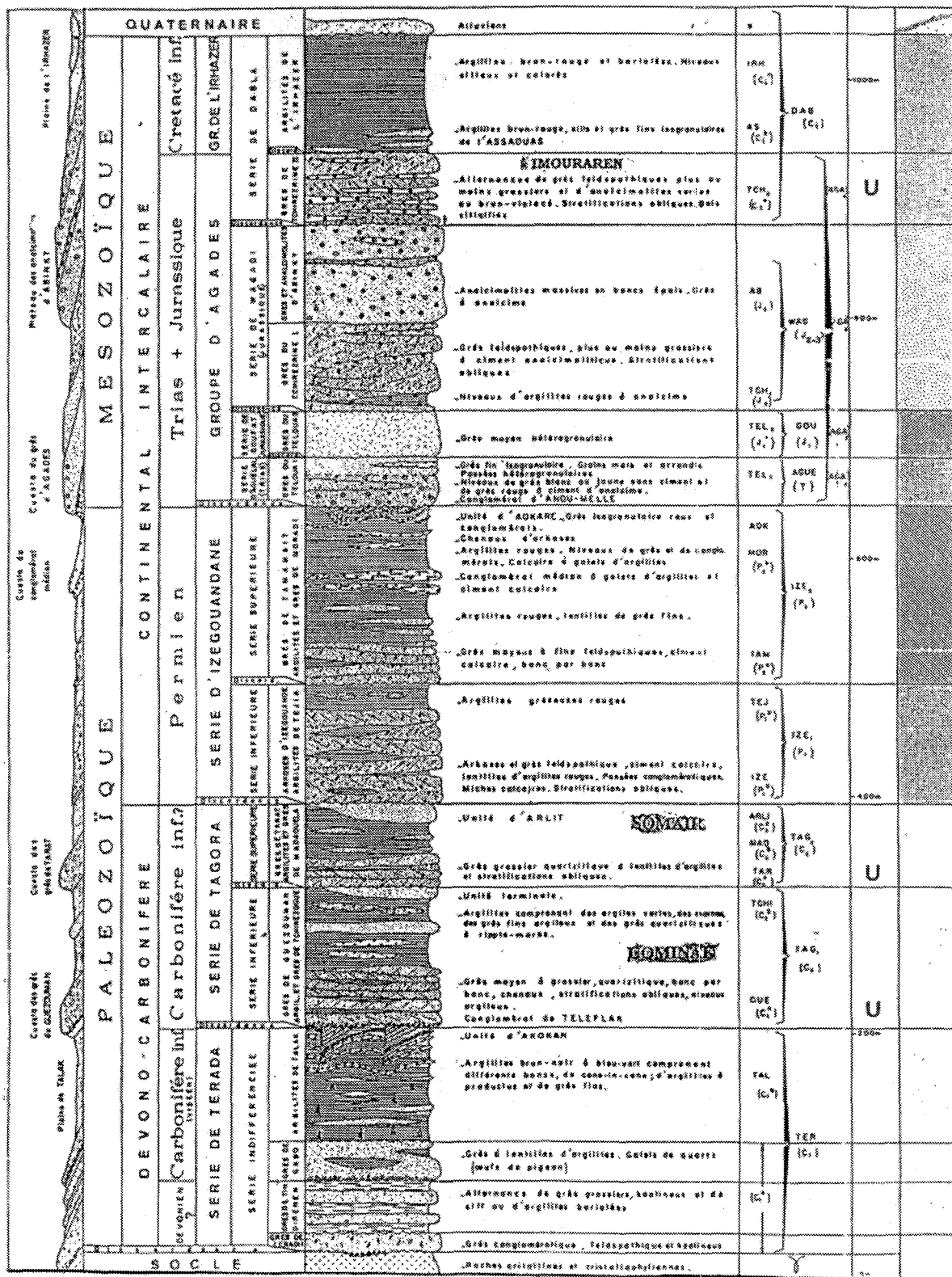


FIG. 4. Stratigraphical section of the Tin Mersoï Basin.

In both cases, the processing method is the acid leaching with extraction by solvents (Table I). The 1998 production is 3,500 tons of uranium.

TABLE I. URANIUM MINING COMPANIES CHARACTERISTICS.

Name of the Company	SOMAIR	COMINAK
Date of Creation	1968	1974
Put in Service Date	1970	1978
First Commercial Production	1971	1978
Production Site Name	Arlit	Akouta
Shareholders (%) :		
• ONAREM	36,6%	31%
• COGEMA	63.4%	34%
• OURD	-	25%
• ENUSA	-	10%
• Others		
Ore Source:		
• Current Deposits Name	Arlette - Takriza – Tamou	Akouta – Akola
• Deposit Type	Sedimentary (Sandstone)	Sedimentary (Sandstone)
Mining:		
• Type	Open Pit	Underground
• Daily Tonnage (metric tons/day)	8.000	1.800
• Average mine recovery rate (%)	90%	90%
Milling Process		
• Type	AL/Extraction by solvents	AL/Extraction by solvents
• Daily Tonnage (metric tons/day)	1.800	1.900
• Average recovery rate (%)	95%	93%
Nominal Capacity (tU/y)	1.500	2.300
Jobs at 31/12/97	779	1255

5. THE INSTITUTIONAL FRAMEWORK OF MINING ACTIVITIES

The mining sector is administered by the Ministry of Mines and Energy.

The Ministry is in charge, in accordance with the orientation defined by the government, of the design and the execution of the national policy as regards to mineral and energetic resources. It elaborates and executes, or make carry out exploration and prospection programs through bilateral or multilateral cooperation. It elaborates legislative and regulatory texts and see to their implementation.

The institutional framework related to the legislation on environmental issues and prevention of risks in mining exploitations involves three other Ministerial departments. These are:

- (a) The Ministry of Hydraulics and Environment;
- (b) The Ministry of Labour and Employment;
- (c) The Ministry of Public Health.

Each of these Ministries elaborates legislative and regulatory texts depending on its attributions and or its fields of competence and see to their implementation.

Three structures of support and administrative control attached to some of these Ministries have also been created. These are:

- The radioprotection laboratory created in 1980 at the mining sub-division of Arlit on mining exploitation sites in order to perform mine and mill plant installations control and proximity surveillance actions.
- The National Committee on Radioprotection and Nuclear Technics (CTNR) created by decree N° 97-252/PRN/MME of 10 July 1997. The CTNR is an advisory organ at the Ministry of Mines and Energy for any issues related to the pacific use of nuclear energy.

The Committee is composed with representatives of all Ministries and establishments concerned by the use of nuclear techniques: Ministry of Mines and Energy, Public Health, Employment, Hydraulics and Environment, Agriculture and Rearing, Research and Higher Education, Interior and various institutes and national research laboratories.

- The National Radioprotection Center (CNRP) created by law N° 98-011 of 7 May 1998 and placed under the tutelage of the Ministry of Public Health is the national authority in charge of all radioprotection activities.

6. LEGISLATIVE FRAMEWORK AND LEGAL INSTRUMENTS

6.1. Legal instruments

As a consequence of the plurality of actors in Administration, legislative and regulatory framework is governed by many laws and their implementation decrees, especially:

- The Labour Code recently revised (1996), whose implementation is part of the attributions of the Ministry of Labour, sets the principles of professional risks prevention in general.

- The ordinance (law) N° 97-001 of 10 June 1997 relating to the institutionalisation of environmental impact assessments is the initiative of the Ministry of Hydraulics and Environment.
- In the mining field and particularly that of uranium, mining activities have been governed since 1961 by:
 - ⇒ Law N° 61-8 of 29 May 1961 related to prospection, exploration, exploitation, ownership, circulation trade and transformation of mineral or fosile resources on the territory of Niger Republic (Mining Law).
- Law N° 68-02 of 26 January 1968 on fiscal regime institution for exploration, mining and physical or chemical concentration of uranium and related resources firms in Niger.
- Law N° 74-22 of 6 April 1974 fixing mining rights taxes and duties.
- The implementation decrees fixing the implementation modalities of the various laws, particularly: the decree N° 61-219/MTP of 14 October 1961, the decree N° 61-157 MTP of 24 July 1961, the decree N° 61-158 MTP of 24 July 1961, the decree N° 68-022 MTPTUMU-MF of 31 January 1968 and the decree N° 74 -154 PCMS/MMH of 25 June 1974.
- However, in order to harmonise the legislation and regulation over the entire activities related to all mineral resources, these various laws and their implementation decrees have been abrogated and replaced by a new Mining Code in 1993 according to the ordinance N° 93-16 of 2 March 1993 and its implementation decree N° 93-044/PM/MMEI/A of 12 March 1993.

However, the ongoing uranium exploitation activities at the date of these texts abrogation remain governed by the former texts.

The new Mining Code was put forward also from the necessity for Niger to face the fierce competition between the various mining countries in order to attract investments in the field of geological and mining exploration which have registered a significant decrease subsequent to the persistant crisis in which the mining industry is plunged since the beginning of the 80's.

Most of theses countries competed to revise their mining codes in order to create legal and fiscal framework that will provide more incentive.

6.2. The main articulations of the new mining code

6.2.1. Structure

- (a) The code which includes the mining law and its implementation decree as well as a model of the mining convention offers the advantage to compile in a unique structured and organised document all that concerns the mining sector in Niger.
- (b) The code clearly sets up rights and general conditions for the acquisition, prolongation, renewal, extension, transaction (partial cession or total transfer), relinquishment, withdrawal procedures as well as the validity duration conferred to each type of the mining lincence.
- (c) According to the law, the signing of a mining convention is required before the granting of an exploration or an exploitation permit. The convention is valid 40 years because it covers the exploration as well as the exploitation phase in case of discovery of an economically exploitable deposit.

- (d) The object of the mining convention is to specify and to guarantee to the investor the stability of the general, legal, fiscal, economic, administrative, customs and social operations conditions during the validity period of the convention.

6.2.2. *The legal framework*

The mining Code makes provisions for four types of mining titles:

- (a) The prospecting authorization (prospecting licence) issued for sub-surface investigations is valid one year but confers to its owner a preemption right in case of an application for extension to an exploration permit.
- (b) The exploration permit (exploration licence) is valid three (3) years, renewable twice for a period of three (3) years.
- (c) The exploitation permit (mining licence) is valid twenty (20) years, renewable twice for a period of ten (10) years.
- (d) The artisanal mining authorization: for very small scale mining is valid two (2) years, indefinitely renewable.

6.2.3. *The fiscal framework*

Mining Companies operating in Niger are submitted to the following main taxes and rights:

- (a) Fixed Rights: for any application related to attribution, renewal, extension, prolongation or transaction (transfer, cession) of mining titles.
- (b) Mining royalty: at the rate of 5.5% of market value of the final product.
- (c) Direct tax on profits (BIC) at the rate of 40.5% of taxable profit.
- (d) Tax on movable property revenue (IRVM): at the rate of 16% of distributed dividends.

6.2.4. *Advantages conceded to the investors*

The mining Code grants important advantages to the investor such as fiscal and and custom exemptions and diversifies facilities among which :

- (a) Exemption from all custom duty and income tax during the exploration phase;
- (b) Total customs exemption from duties and taxes on importation of materials, supplies, equipment and spare parts to be used for the mining operations;
- (c) Exemption from rights and taxes on exportation;
- (d) Exemption from rights and taxes on bank loans;
- (e) Exemption from entry duties on petroleum fuels and derivatives used on fixed installations;
- (f) Discounting and refund of exploration expenses during the production phase as first establishment costs;
- (g) Five years income tax (BIC) holiday from the start of commercial production;
- (h) Carry - over of losses forward up to three years;
- (i) Quick depreciation scheme;
- (j) Possibility to defer depreciation when in deficit;
- (k) Deduction of the mining royalty from taxable profit for the calculation of the BIC duty;
- (l) Deduction for depletion allowance up to 20% of taxable profit;
- (m) Free importation and exportation of products, free convertibility and free transfer abroad of funds, dividends and outcome from capital invested;

- (n) The institution of a unique desk for mining investment at the Ministry of Mines and Energy for all acquisitions and movements of mining titles formalities.

The new mining Code has strongly taken into account the environmental concerns:

- (a) All prospection, exploration and mining of mineral resources activities should be conducted with respect to the physical, cultural and social environment;
- (b) A preliminary environment impact assessment should be realised before the grant of any exploitation permit.

7. REGULATORY FRAMEWORK AND REGULATION TOOLS

Several regulatory texts have been designed specifying the modalities and obligations imposed to operating mining companies so that mining activities be undertaken with respect to permanent protection of the environment and the public.

Among these, texts relating to protection against ionizing radiations constitute specific tools linked to uranium mining activities with regard to:

- (a) The structure of the associated regulation and
- (b) The regulation tools themselves.

7.1. Structure of the Nigerien regulation

In order that a regulation be implemented, it must be applicable. The Niger regulation structure is inspired by the ICRP recommendations and international practices. It hinges on the known classical principles that are:

- Respective responsibilities of employers and workers.
- Description of risks dealt by the regulation.
- Objectives in terms of prevention of risks (doses limitations).
- Principles of workers allocation with regard to their exposure perspectives and classification of working zones according to the level of radioactivity (mine, yellow cake area, solid wastes areas).
- Risks limitation strategy (ventilation strategy in the case of underground mines) and general hygiene of staff.
- Methods, means and procedures for:
 - (a) Surveillance of physical atmosphere in working areas,
 - (b) Individual dosimetric surveillance of exposed agents,
 - (c) Medical surveillance: hiring and end of contract medical examinations, periodic medical examinations, etc.,
 - (d) Administrative surveillance (activity reports and control of installations).

7.2. Regulation tools

- Until 1979, all radioprotection actions carried out were based on French regulation.
- From 1979 order N°31M/MH of 5/12/79 of the Ministry of Mines and Hydraulics fixing the particular rules of safety and hygiene to which are subjected the exploration and exploitation sites of radioactive resources defines the main axes of NIGER regulation on radioprotection.

- In the light of new knowledge and experiences of regulation, a draft order on protection against ionizing radiations in the mining sector has been elaborated in 1998 within the IAEA model project « Re-enforcement of Radioprotection Facility in Niger » to replace the order N° 31 M/MH. This draft order provides some modifications on dose exposure limitation and on risks accumulation calculation formula (Table II).

8. REGULATION PRACTICE IN THE MINING COMPANIES

Both mining companies inscribed radioprotection in their global security policy. Significant financial, human and organisational means are devoted to it. The implementation of regulatory stipulations in mining companies is based on two objectives:

- (a) Staff protection, particularly through radiologic risks prevention actions;
- (b) Environment and public protection through environment surveillance and wastes management.

8.1. Radiologic risks prevention

Radiologic risks prevention in the two mining companies is based on the two main known methods which are: the « a priori » and the « a posteriori » methods.

(a) The a posteriori method

Enables, from the dosimetric follow up of workers, to know regularly (per month, semester and year) the dosimetric situation of each radioprotected worker according to the regulation in force. Workers whose level of exposure is close to the acceptable limit are appointed to other working positions less exposed as a preventive access.

(b) The a priori method

The prevention is guaranteed by the improvement of working conditions, the endowment of workers with suitable protection equipment, the fitting out of the place and better planing of time and working methods.

For example: the limitation of exposure time in a confined working area, mostly when the ore is rich, the building of underground fixed installations (such as workshops, cafeterias etc.) in uranium poor or waste areas, the dilution of radon through adequate primary and secondary ventilation, the systematisation of airstream helmets carrying, the integral water drilling, the watering of blasted ore before loading, etc.

8.2. Control of environment

The region of Arlit is a desertic and less populated area. The implantation of the mines many kilometers from of the cities and other habitations constitute itself an important measure of people and public protection. However, a rigorous control of all the radioactive pollution vectors is moreover carried out.

Thus, at various places located around the industrial zone and the towns nearby are installed stations for the measurement of gamma dose, potential alpha energy and dusts.

TABLE II. THE MAIN AXES OF RADIOPROTECTION REGULATION IN NIGER.

Type of Exposition	Units	Order N° 31 MM/H	New Order (1998)	Remarks
External Irradiation . Entire Organism	mSv	50	50	Unchanged
Internal Irradiation : Total Alpha Activity of Long Life Daughters	Bq	3120	5400	Less Restricting
. for Uranium ore dusts	Bq	6240	2700	More Restricting
. for Yellow Cake Inhaled Dusts				
Potential Alpha Energy Of Short life Radon Daughters	mJ	17	42	Less Restricting
Divider of the external exposition ration in The Cumulative Risk Calculation Formula	mJ	150	50	More Restricting

$$\text{Cumulative Risks (TET)} = \frac{E_{\gamma}}{150 \text{ mSv}} + \frac{E_{\alpha}}{14.4 \text{ mJm}^3 \cdot \text{h}} + \frac{\text{Ep. Min}}{70 \text{ pCi.l}} + \frac{\text{Ep. Uranate}}{140 \text{ pCi/l}} < 1 \quad \text{in 12 Subsequent months}$$

The environment control device is essentially based on the measure of atmospheric transfers and especially the regularly (monthly, semestrial, annual) control of uranium 238 and radium 226 concentration by drinking water, soil and in gardens vegetables samplings.

8.3. Waste management

There are two main considered categories of wastes: the liquid wastes and the solid wastes from the mill plant.

The liquid wastes are stored in some basins known as evaporation basins. This is a satisfactory method because the basins are waterproof so that the infiltration risk are quasi inexistent.

Effectively, these basins are made of an embankment frame covered with banco clay and sand.

The waterproofness is ensured by a PVC geomembrane set at the bottom and along the slopes of the basin and maintained at the crest of the embankment in an enchorage trench.

On some basins, as a supplementary protection, a BIDIM or SITTEX geotextile has been placed all over the surface of the clay before the installation of the geomembrane.

The mill tailings are 20% residual humidity. The evaporation of the residual water contributes to the formation of a salt dry layer on the surface of the tailings which constitutes a short time protection against wind erosion.

All the measures taken by the mining companies in order to implement the various regulatory stipulations have shown that the impact of their activities on the people living near the sites and environment, in general, respect the national and international prescribed standards.

Thus, the measure of environment control have given, so far, values well under the international standards (1/10 of the limit for workers protection).

For the long term, a detailed study is under way for a more sustainable stabilisation method of the tailings.

9. CONCLUSION

In Niger, legal and regulatory statements stipulate that all exploration and mining activities of mineral substances must be conducted with respect to the physical, sanitary, cultural and social environment.

Thus, many laws and implementation decrees have been adopted since the 60's and others are still being worked out for an optimal protection of the public especially against the risks related to the activities of the uranium mining industry.

The structure and objectives of the Nigerian regulation are in accordance with those derived from international recommendations.

The efficiency of the prevention measures and security policies set into place by the mining companies for staff, public and environmental protection shows that uranium exploration and

mining activities respect easily the current and future prescriptions with values clearly below the recommended international standards.

The preventive and palliative measures, despite the colossal organisational, human, material and financial means involved have only insignificant impact on the uranium production cost.