

URANIUM GEOLOGY NIGER, WEST AFRICA

Exploration History

The starting point of uranium history in Niger can be set at 1957 with the discovery of uranium showings at Azelik by the “Bureau Minier de la France d'Outre-mer.” The French “Commissariat à l'Energie Atomique,” informed about this discovery when uranium was actively being sought, almost immediately started a detailed study of the showings and launched an airborne survey.

Then, a succession of discoveries followed: Azelik and Abokorum in 1959; Madaouela in 1963; Arlette, Ariège, Artois, Taza, Tamou and Takriza in 1965; Imouraren in 1966; and Akouta in 1967.

At the same time, Niger, as a country, experienced several major milestones in its history with the creation of the Republic of Niger in 1958, followed by its independence from France in August 1960. To some extent, one can say that the history of modern Niger coincides with the history of its uranium industry.

The “Société des Mines de l'Aïr” (Somaïr) was the first uranium company to be incorporated in February 1968 after the discovery and development in 1965 of the Ariège, Artois and Arlette deposits. Its mill started in 1970 and two production lines, with a total capacity of 2,300 tU per year, have been added since 1980.

Production is from several open pits of about 70 meters deep:

- Arlette open-pit opened in 1968
- Ariège in 1976, now exhausted
- Taza in 1996
- Takriza in 1996
- Tamou in 1998

Other open pits are projected to mine the Artois and Tamgak deposits. The nominal owners of the company are Cogema and affiliate companies.

La “Compagnie Minière d’Akouta” (Cominak) was set up as a company in 1974, after the discovery in 1967 of the Akouta and Akola deposits. Cominak is an underground mine and its entrance at Akouta provides access to the producing stopes at a depth of about 250 meters. The current production capacity of the mill is about 2,500 tU per year.

Regional Geology

▪ Aïr Massif

The Aïr Massif, the Hoggar and the Adrar des Iforas form the Touareg Shield, which along with the Benin-Nigerian Shield, is part of the Central African mobile belt, deformed by the Panafrican orogeny about 600 million years ago.

The crystalline basement of the Air is composed of a central, highly metamorphosed core intruded by panafrikan granitoids. The crystalline core is separated from only slightly metamorphosed terrain by the important overthrust sheets of Tafadek to the west and Aouzegeur to the east. The pre-Panafrikan upper crustal formations (schists, gneiss, leptynites) of probable Suggarian age are folded and metamorphosed either to upper amphibolite or upper greenschist grades (schists, gneisses, leptynites).

The molasse formations of the "Proche-Tenere" are supposedly Infracambrian in age. They are sub-horizontal, only slightly metamorphosed and lie discordant on the Suggarian basement.

Subvolcanic ring complexes of Paleozoic age, intruding through the Suggarian basement, constitute the northern extremity of the younger granites that extends into neighboring Nigeria. This magmatic activity began with an important acidic volcanic phase that was followed by the rise of gabbros, anorthosites, syenites and alkaline and peralkaline granites, all derived by differentiation of a basic magma. Tertiary and quaternary volcanism is characterized by 30-odd trachyte and phonolite plugs and associated basaltic flows.

The Air Massif structure is an anticlinorium with kilometric isoclinal folds dipping to the east. The north-south thrusts inwardly dipping characterize a panafrikan collision between the West African Craton and the Central African Mobile Zone after an oceanic enclosure.

▪ **Iullemeden Basin**

The Iullemeden Basin, to the west of the Air Massif, is a vast structural depression of about 360,000 km² covering virtually all of western Niger and with extensions in Algeria, Mali, Benin and Nigeria. It is filled with 1,500 to 2,000 meters of Cambrian to Pleistocene sediments of alternating marine and continental origin.

The Paleozoic formations outcrop in the Tim Mersoï Basin near Tamesna-Talak area, along the western margin of the Air Massif. Upper Carboniferous units, especially the Guezouman, the Tarat and the Madaouela sandstones, host uranium occurrences. Carboniferous units also host coal deposits in the Anou Araren area.

Palaeozoic to early-Senonian units are organized as a succession of wedges, thinning from north to south. The deep structural configuration is thought to be controlled mainly by north-south to NNE-SSW oriented block-faulting, possibly caused by Hercynian tectonics.

A thick sequence of Permian to Lower Cretaceous age sandstones and shales form what is known as the Middle Continental series, or "Continental intercalaire," which outcrops mainly in the Tamesna, Irhazer and Tegama areas. These formations host uranium- and copper-rich horizons as well as saline-rich horizons mineable for salt.

The Upper Cretaceous and the Lower Tertiary are marine in origin and composed of a succession of argillites, marls, and fossiliferous limestones with silty, sandy and gritty horizons. These formations outcrop essentially in the Ader Douchi and the Daergou.

In the Tamesna-Talak area, the Palaeozoic succession has a thickness ranging from 100 to 1,500 meters. The Cambro Ordovician is composed of coarse siliciclastics and the Silurian by graptolitic shales. The Devonian is composed of continental and marine deposits (siliciclastics, shales, siltstones and carbonates). The Carboniferous (Visean-Namurian) is also made up of continental to marine, siliciclastics and shales.

Local Geology

The Irhazer and In Gall concessions are located in a desert plain about 80 kilometers to the west of the Air Massif. The Irhazer shales cover almost entirely the perimeter of the concessions; few mounds of sandstone appear near some faults. Formations from the Tegama are present in the southwest corner of the Irhazer concession.

The major tectonic features are the Arlit fault to the east, the Teguida N' Adrar fault crossing the northern part of the In Gall concession and two zones of fractures across the concessions that are oriented N30° to N45°.

The zones of fractures could be particularly favorable to the concentration of uranium mineralization. The geological targets are lenses of sandstone and conglomerate within the lower part of the Irhazer formation.

Most of the economic uranium mineralization in the Tim Mersoï Basin is within sandstone and conglomerate formations inserted between layers of siltstone and shale rich in organic plants or over a surface of discontinuity resulting from major erosion.

The crystalline basement of the Air Massif, and more particularly plutonic granite, is likely the source of the mineralization, which is structurally controlled by the Arlit fault and its satellite fracture zones.

The host rocks are more recent to the south and to the west; indeed the uranium showings north of latitude N19° are from Devonian-Carboniferous formations, whereas the Arlit and Akouta deposits further south are within Permian-Carboniferous units. The Abokorum-Azelik deposits further west are in lenses of sandstone at the base of the Irhazer formation from the Lower Cretaceous.

Economic Geology

▪ *Sources of Uranium Mineralization*

Niger's main uranium resources are all contained in the sediments of the Tim Mersoï sub-basin, which is mainly the continental part of the sedimentary layers of the Iullemeden Basin. The large deposits currently mined by Cominak and Somair are located respectively in the Guezouman conglomeratic formation, supposedly of a Visean age, and in the Tarat sandstone formation, which is younger and supposedly of a Namurian age.

Upward in the sedimentary pile, other mineralizations and deposits have been identified, the most important one being the Imouraren deposit located in the Tchirezrine sandstone of a Jurassic age. To describe the deposits in a very simple way, one can characterize them as belonging to the "sandstone type" uranium deposits.

In situ leaching mining methods are considered for the low-grade mineralization of the Imouraren orebody. The currently mined deposits are recovered through conventional mining methods.

▪ ***Uranium Mining***

In 2005, Niger uranium production reached 3,093tU, making Niger one of the world's largest uranium producers.

Niger is one of the most important uranium-bearing provinces of the world. Its contribution to past uranium production has already been mentioned as one of the few showing a cumulative production in the range of 100,000 tU.

Its remaining uranium resources recoverable at less than US\$15 per pound of U₃O₈ (uranium oxide) are estimated at more than 200,000 tU. Total reserves (tU recoverable as concentrates) are:

Mine/Project	Total reserves (tU)	Average grade (Kg. U/t)
Cominak	29,050	5
Somaïr	14,160	3
Imouraren	80,000	1.1

Shares in the Cominak mine are held by Cogema-France (65%), OURD-Japan (25%) and ENUSA-Spain (10%). Shares in the Somaïr mine are held by Cogema (64%) and Onarem (36%).

Niger Simplified Geological Map



