

Benin

Total population (July 2000 estimate): 6,396,000

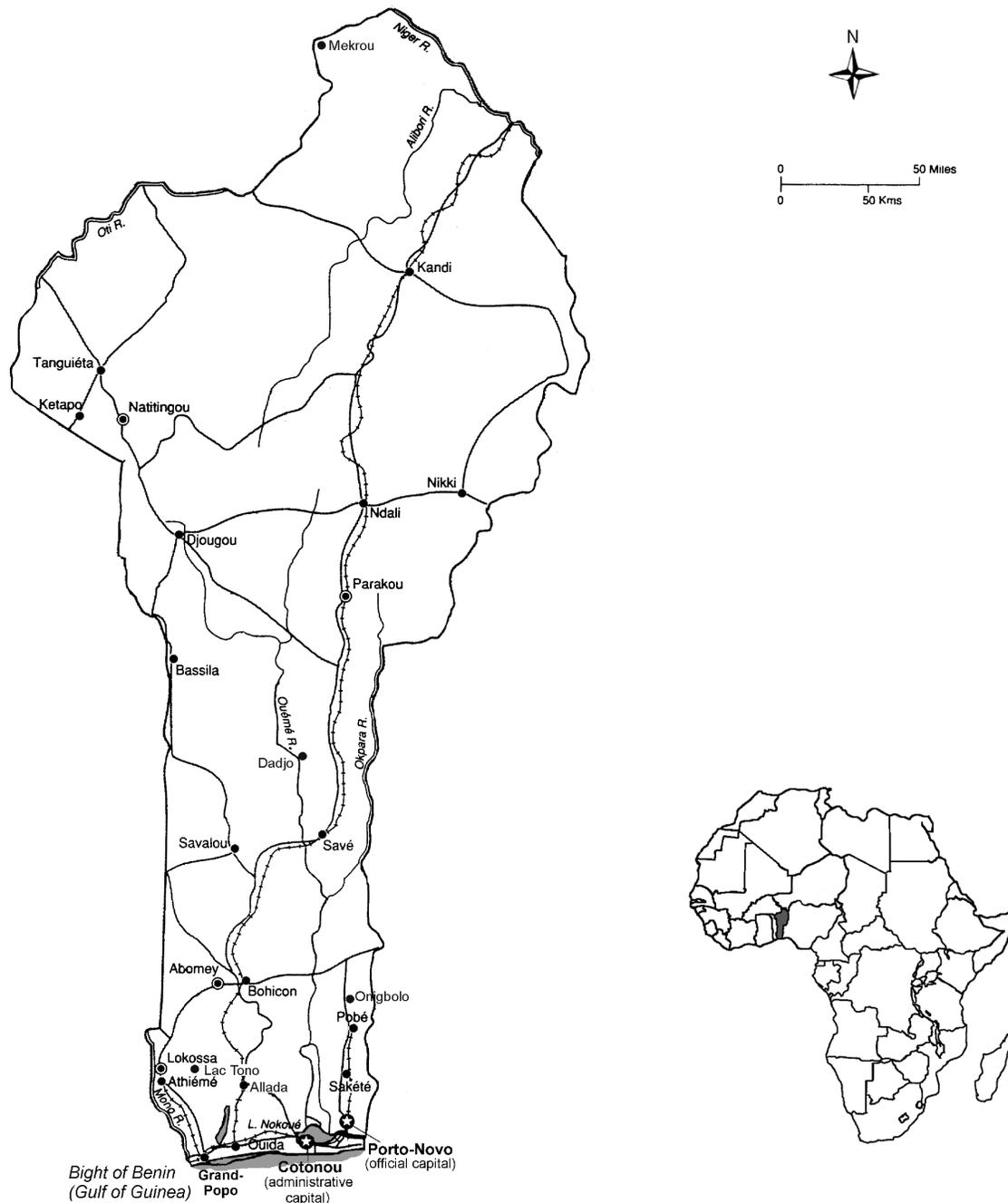
Area: 112,620 km²

Annual population growth rate (2000): 3.03%

Life expectancy at birth (1998): 53.5 years

People not expected to survive to age 40 (1998): 28.9% of total population

GDP per capita (1998): US \$867



Benin is a tropical, long and narrow, north-south striking country between Togo and Nigeria. The landscape of Benin consists of a narrow sandy coastal strip enclosing a chain of lagoons, and an extensive plateau area. Several isolated mountain ranges occur with altitudes between 300 m and 1,500 m.

Agriculture is the dominant sector of Benin's economy. Subsistence farming produces mainly food crops like cassava, maize, yams, sorghum and millet. Other agricultural products are cotton, palm products, cocoa, cashew nuts and sugar cane. In 1999, the agricultural sector contributed 38% to the GDP and employed an estimated 65% of the labour force.

There is little mining activity in the country, except for extraction and quarrying of industrial minerals for construction.

Geological outline

Most of Benin is underlain by migmatites, gneisses and granites of the Neoproterozoic Dahomeyan Belt. Strongly folded quartzites and mica schists (Badagba quartzites) within the Dahomeyan Belt occur in a north-south striking belt across the country (Wright *et al.* 1985). Neoproterozoic to early Cambrian rocks of the Voltaian, a clastic sedimentary sequence that is mainly exposed in neighbouring Togo and Ghana, occur in the far northwest of the country. In southern Benin, a thick sequence of east-west striking sediments of Cretaceous to Tertiary age unconformably overlies the Dahomeyan. This sequence itself is overlain by continental sediments of the Tertiary 'Continental Terminal.'

AGROMINERALS

Phosphates

Two types of sedimentary phosphates are known from Benin:

- the southern phosphates of Eocene age, similar to the phosphates of neighbouring Togo,
- the northern phosphates of Neoproterozoic age, similar to the phosphates in neighbouring Niger.

Both phosphate rock deposits have been investigated in great detail by the Direction des Mines de la Géologie et des Hydrocarbures (DMGH) of Benin, by the United Nations Development Programme (UNDP), and by the United Nations Revolving Fund for Natural Resources Exploration (UNRFNRE). The southern phosphates have also been studied by the oil company Shell.

The southern phosphate rock deposits are part of the coastal basin sediments that strike along the coast from Nigeria, across Benin into Togo and Ghana. In Benin, Eocene (Lutetian) phosphatic sediments occur in the striking continuation of phosphate rock deposits of neighbouring Togo where the Hahotoe phosphatic sandstone beds are currently being mined. To test whether mineable phosphate rocks such as those found in Togo continue into Benin, a series of geological and geochemical exploration programs were carried out. Altogether 367 pits were dug by various exploration teams. In addition, a total of 44 boreholes (Shell: 37, UNDP: 7) were sunk in prospective areas. The results of the pitting and drilling program were disappointing, as were the geochemical surveys. Only thin (up to 0.7 m) and irregular phosphate beds were discovered in the Kpome, Pobe, Toffo, and Lokossa areas. The main phosphate beds are intercalated with greenish glauconitic clays containing phosphate nodules.

An evaluation of the phosphate exploration work was made for UNRFNRE by a consultant. He concluded that the small and marginal phosphate deposits in Benin would be unable to compete with the nearby extensive Hahotoe phosphate deposit in neighbouring Togo (Exploratech 1979b).

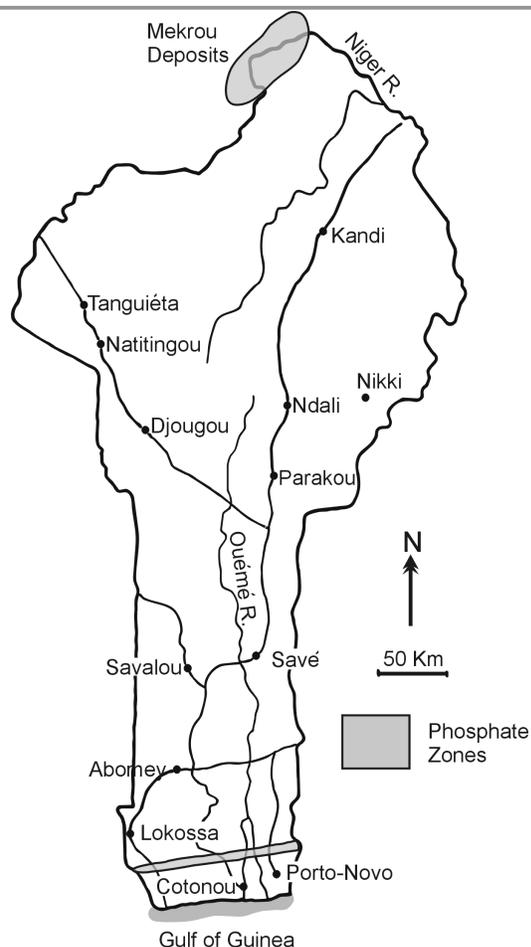


Figure 2.3: Location of the two phosphate zones in Benin.

The phosphates in northern Benin have been studied in detail by UNDP exploration teams (Barry 1981). The phosphate mineralization is located more than 800 km from the coast in a remote northern area at the Mekrou River close to the border with Burkina Faso and Niger (12°09' N, 2°25' E) (Figure 2.3). The phosphate beds are part of the middle-Voltaian Mekrou Formation of Neoproterozoic age, comparable to the ones in neighbouring Niger and Burkina Faso (Trompette *et al.* 1980; Trompette 1989). The phosphates occur as very hard, dark gray, massive phosphate rocks within a folded sedimentary sequence consisting of dark organic shales and cherts. The average thickness of the phosphate bed is 2.2 m.

UNDP geologists calculated near surface 'proven' reserves of 3,265,500 tonnes at 25.1% P_2O_5 covering an area of 0.225 km² with a waste to ore ratio of 2.6:1. Additionally, 'indicated reserves' are 2,204,900 tonnes with a grade of 25.77% P_2O_5 (Barry 1981).

Investigations of the phosphate rock concentrate by the Bureau de Recherches Géologiques et Minières (BRGM) indicated a 2% citric acid solubility of 19.1% and a neutral ammonium citrate (NAC) solubility of 5.6% (quoted in Barry 1981). In contrast to the data obtained by the International Fertilizer Development Center (IFDC) reports a NAC solubility only 1.9% (McClellan and Notholt 1986).

The evaluation reports of Exploratech (1979a,b) and Barry (1981) indicate that mining and production of superphosphates and/or phosphoric acid would be not economic using large-scale mining and processing techniques. However, on economic grounds, Exploratech (1979a,b) recommended the investigation of

small-scale extraction and direct application of ground phosphate from the Mekrou river area. Whether any agronomic testing has been carried out with Mekrou phosphate rocks is not known.

Other agrominerals

Limestone/Dolomite

Carbonate rocks occur in Benin in two environments, in the metamorphosed Neoproterozoic to early Paleozoic Dahomeyan Belt and in Tertiary (mainly Paleocene) sediments. Several occurrences of marble in the Dahomeyan Belt are located near Dadjo, approximately 50 km north-northwest of Save in the central part of Benin. A 6-million tonne marble resource has been identified and is exploited by a Benin-Libyan company. Paleocene limestones, approximately 90 million tonnes, occur near Onigbolo north of Pobe, close to the border with Nigeria. The biogenic limestone with a strike length of 3 km and a width of more than 500 m is used as feed for the local cement plant at a rate of 500,000 tonnes per year (Lorenz 1996; Thiriot 1996). The French company Lafarge leases and manages the cement company 'Ciments d'Onigbolo.'

Peat

Peat deposits have been discovered near Cotonou. The 12.5 million tonnes of peat resources are in addition to the peat deposits in the Tono Lake (Lac Tono) area east of Lokossa and at Kpakpatan in Mono Region (Mining Annual Review 1998).

Agromineral potential

The potential of developing phosphates in Benin is very limited since the southern phosphate occurrences are too small to be economic and the Mekrou phosphates in northern Benin are uneconomical from a large-scale perspective. However, they might be useful for small-scale application on acid soils in northern Benin. Agronomic testing of these phosphates in crushed and ground form should be considered on P-deficient acid soils. Modification techniques using locally available organic waste products should also be tested. The phosphates from neighbouring Togo should be agronomically tested on soils of the southern parts of Benin. The development of liming materials should be tried, particularly on acid, aluminum toxic soils.

References:

- Barry GS 1981. Study of the Mekrou phosphates mineral survey phase III, People's Republic of Benin. Report to United Nations Development Programme UN/TCD BEN/76-004, United Nations New York, 87pp.
- Exploratech Ltd 1979a. Evaluatory study of the Mekrou phosphates, People's Republic of Benin. Report to United Nations Revolving Fund for Natural Resources Exploration, United Nations New York, 31pp.
- Exploratech Ltd 1979b. Preliminary study of the coastal phosphates, People's Republic of Benin. Report to United Nations Revolving Fund for Natural Resources Exploration, United Nations New York, 10pp.
- Lorenz W 1996. Benin. In: Bosse H-R, Gwosdz W, Lorenz W, Markwich, Roth W and F Wolff (eds.) Limestone and dolomite resources of Africa. Geol. Jb., D, 102:74-78.
- McClellan GH and AJG Notholt 1986. Phosphate deposits of sub-Saharan Africa. In: Mokwunye AU and PLG Vlek (eds.) Management of nitrogen and phosphorus fertilizers in sub-Saharan Africa. Martinus Nijhoff, Dordrecht, Netherlands:173-224.
- Mining Annual Review 1998. Benin. Mining Journal, London, p. 204.

Thiriot F 1996. Benin. Mining Annual Review 1996. Mining Journal, London, p.160.

Trompette R, Affaton P, Joulia F and J Marchand 1980. Stratigraphic and structural controls of Late Precambrian phosphate deposits of the northern Volta Basin in Upper Volta, Niger, and Benin, West Africa. *Econ. Geol.* 75:62-70.

Trompette R. 1989. Phosphorites of the northern Volta Basin (Burkina Faso, Niger and Benin). In: Notholt AJG, Sheldon RP and DF Davidson (eds.) *Phosphate deposits of the world. Vol. 2. Phosphate rock resources*, Cambridge University Press, Cambridge, UK: 214-218.

Wright JB, Hastings DA, Jones WB and HR Williams 1985. *Geology and mineral resources of West Africa*. Allen and Unwin, London, UK, 187pp.