

# Hydrocarbons and Mining in EQUATORIAL GUINEA



República de Guinea Ecuatorial  
Ministerio de Minas, Industria y Energía





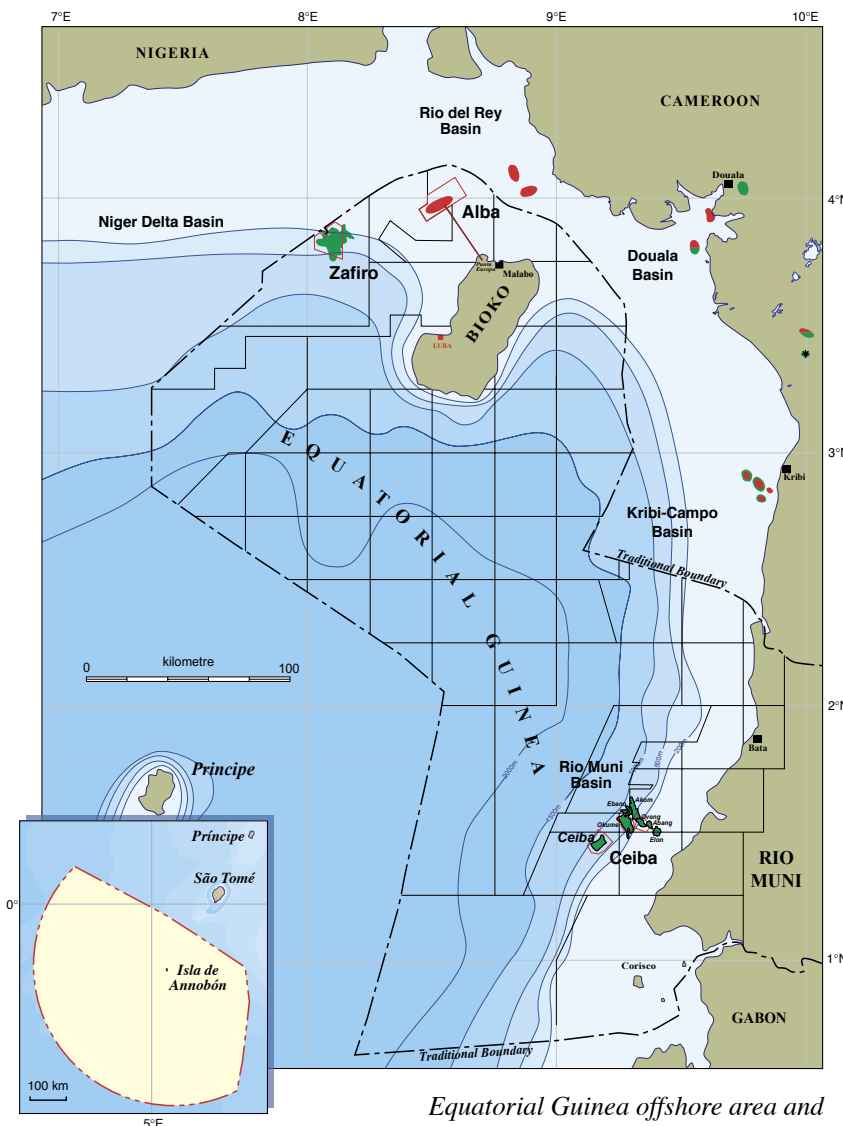
# INTRODUCTION

**Equatorial Guinea is situated at the hub of the dynamic offshore West Africa Petroleum Province and is now established as a significant petroleum producing nation. Vigorous exploration during the 1990's combined with rapid field development has resulted in liquids production rising from less than 2,000 bpd in 1992 to a 2004 average that exceeded 400,000 bpd.**

Petroleum production now dominates the Equatorial Guinea economy with oil revenues accounting for over 90% of the national income and the petroleum sector is the driving force behind the ongoing growth in Equatorial Guinea's GDP and the country's rapid development. With the establishment in 2001 of GEPetrol, as the national oil company, Equatorial Guinea embarked on a phase of increased local participation in this economic growth and diversification.

Equatorial Guinea has made rapid progress in monetizing its gas resources. The first LNG train is expected to be producing in 2007 and the country is positioning itself to be the gas hub of the eastern Gulf of Guinea. This expansion of the gas business will be facilitated by SonagasGE, the new national gas company which was established in 2005.

Equatorial Guinea also has unrealised minerals potential and substantial tracts of land are available for leasing for minerals investigations. Artisanal gold production is well established and preliminary exploration work has indicated possibilities for diamonds and columbo-tantalite in particular.



*Equatorial Guinea offshore area and oil and gas fields*



# OIL PRODUCTION

## Ceiba Field

The Ceiba Field was discovered in October 1999 and first production was achieved in November 2000, less than 14 months from discovery. Initial production during 2001 was from 5 wells into the Sendje Berge FPSO (Floating Production, Storage, and Offloading vessel). In January 2002, this vessel was replaced by the Sendje Ceiba which has facilities to inject up to 135,000 bwpd into the Ceiba reservoir to maintain field pressure and optimise oil recovery. Field development was completed in 2004 with 13 producing wells and 8 water injector wells. Oil production averaged around 40,000 bpd during 2004.

## Zafiro Field

The Zafiro Field complex produces around 270,000 bopd and 220 mmcf/d of gas via the Zafiro Producer, Jade Platform and Serpentina Producer facilities. Zafiro was discovered in 1995 and was brought on stream within eighteen months of discovery. Facilities have been expanded each year since production commenced and the field is now fully developed. In 2000, the original Zafiro Producer FPSO was converted to an FPU (Floating Production Unit.) with crude oil being stored in the MT Magnolia FSO (Floating Storage and Offloading vessel). In 2004 approval was given for the installation of crude transfer pumps on the Zafiro Producer FPU and as of August 2004 all crude produced via the Zafiro Producer FPU and Jade Platform is transferred to the Serpentina FPSO for storage and offloading, with the Magnolia FSO being released from service in the



*Sendje Berge FPSO on Ceiba Field*



*Ocean Alliance testing Ceiba-1*



*Exploration well*



*Serpentina Producer FPSO*



*Alba Production platform*

field. Gas is separated from the crude on the platform and is substantially flared. However in 2005 the Equatorial Guinea Government as a signatory to the Global Gas Flaring Reduction (GGFR) Partnership, in conjunction with the World Bank, has initiated a programme to bring the flared gas to the Alba Field processing facility at Punta Europa thereby eliminating flaring from the Zafiro Field.

### **Alba Field**

Alba is a gas condensate field with reserves in excess of 4.6 TCF. The Alba Field was placed on production in 1991 and by 1995, when Nomeco acquired Walter, Alba's developer, it was producing at a rate of around 65 mmcfd to yield over 6000 bpd of condensate with all the gas being flared. During 2000, CMS (who had acquired Nomeco) drilled the Alba -6 to -9 development wells and by mid 2001 Alba was producing over 195 mmcfd, to generate 14,000 bcpd and 2,000 bbls LPG/day. In January 2002, Marathon Oil acquired the CMS interests in Equatorial Guinea and continued to expand Alba production. A new LPG plant was constructed together with gas re-injection compressors and improved storage facilities for both condensate and LPG. The field was expanded to 11 producers and 5 gas injectors that now deliver over 800 mmcfd to yield over 65,000 bpd of condensate. Flaring has now been eliminated. 125 mmcfd of processed gas supplies a methanol plant which produces at a rate of 19,000 bpd and from 2007 600 mmcfd will supply the new LNG plant.

### **Okume Field**

In August 2004, the Ministry of Mines, Industry and Energy approved the development plan for the Okume Field located in Northern Block G, offshore Rio Muni. The integrated development of the Okume, Oveng, Ebano and Elon pools will be by two tension leg platforms (TLP's), four fixed platforms and 29 producing wells. The development plan also includes 16 water injection wells and two gas injection wells to maintain reservoir pressure and enhance oil recovery. Production from the reservoirs will be gathered at a Central Processing Facility (CPF) which will be linked via a 24km pipeline to the Sendje Ceiba FPSO. First oil is anticipated by year-end 2006 with initial production estimated at 60,000 bopd.

# GAS UTILISATION

A key strategy of the Government of Equatorial Guinea is to diversify its energy and revenue base by utilizing the country's natural gas resources.

The main focus has been on the Alba Field and associated plant. Over 600 mmcf/d of Alba gas is now reinjected into the reservoir with the remainder providing the feed for various gas utilisation projects based at Punta Europa in the north of Bioko island.

## Gas Processing Plant

The plant has storage capacity for 1.3 million bbls of condensate and 730,000 bbls LPG. The plant currently processes up to 850 mmcf/d with an additional 13 mmcf/d being used as fuel for the gas plant utility and generates up to 20,000 bpd LPG and 65,000 bpd condensate.

## Methanol Plant

The Atlantic Methanol Production Company (AMPCO), a consortium comprising Marathon Oil, Samedan and the Government of Equatorial Guinea, completed the construction of a methanol plant at Punta Europa in May 2001. The plant consumes around 125 mmcf/d of 1000 BTU quality gas to produce 19,000 bpd of methanol. The plant has a storage capacity of 900,000 bbls and the methanol is exported to worldwide markets via two dedicated 300,000 ton methanol carriers.

## Power Generation Plant

In 1999 a 10.4 MW Turbo Gas Power Generation Plant, owned by the Government of Equatorial Guinea, was completed at Punta Europa to supply electricity to Bioko Island. In 2004 an additional 17 MW of generation capacity was added resulting in a total power generation capacity of 27.4 MW. This is more than sufficient to supply the current demand on Bioko Island. The power plant consumes around 5.5 mmcf/d which is supplied from the Alba field.

## Equatorial Guinea Liquefied Natural Gas (EG LNG)

In March 2004, the Ministry of Mines, Industry and Energy announced the formation of Equatorial Guinea LNG Holdings Limited, a joint venture between Marathon and GEPetrol, as the parent company to construct, own and operate an LNG plant in Equatorial Guinea. Following ownership interest sales by Marathon and GEPetrol in July 2005, the shareholders in EG LNG comprise Marathon (60%), GEPetrol (25%), Mitsui (8.5%) and Marubeni (6.5%). This project represents a gross investment of US\$ 1.4 billion of which US\$ 1 billion is managed through an EPC contract awarded to Bechtel. The plant is under construction with the first shipment of LNG scheduled in 2007. Output has been contracted to the BG Group who will purchase 3.4 million metric tons per year for a period of 17 years beginning in 2007.

The Ministry of Mines, Industry and Energy sees the start-up of EG LNG Train 1 in 2007 as the catalyst for a multi-train facility that could become a regional hub. This would serve to monetize gas in the Gulf of Guinea, creating value for numerous resource holders. It is anticipated that the Governments and National Oil Companies of Nigeria and Cameroon will cooperate to allow the cross border importation of gas into the EG LNG facility.



*LNG plant under construction*



## INFRASTRUCTURE - LUBA PORT

Luba Freeport is a deep water port and oilfield service logistics base on the the west coast of the island of Bioko. It is constructed and operated by Luba Freeport Ltd., under a 25-year concession from the Government. Construction work commenced in March 2000 and the port became operational early in 2001.

The Luba development covers 100 hectares adjacent to the town of Luba, situated on the west side of Bioko island approximately 40 km by road from the main town and international airport of Malabo. Luba Port occupies a strategic location on the West Africa coast with approximate distances by sea to other regional centres of 660 km to Lagos, 220 km to Port Harcourt, 160 km to Douala, 210 km to Kribi, Cameroon, 270 km to Bata, Rio Muni and 390 km to Libreville, Gabon.

The development includes world-class port and dockyard facilities with berthing for ocean-going ships, an oilfield logistics base with warehousing, storage and workshop facilities and fabrication, repair and maintenance yards capable of handling deep water drilling rigs. The Freeport also offers the benefits of an autonomous duty free zone with its own 24 hour customs and immigration regime and fuel storage and bunkering services.

Luba Port has unrestricted marine access at all states of tide. The deep water jetty has sufficient water for vessels of up to 10m draught. The loading dolphin has 12m water depth on its ocean-ward side. The port has a helicopter landing pad and there is good road access to Malabo and other parts of Bioko.



*Luba Port development area*

# PETROLEUM EXPLORATION HISTORY

License blocks were first designated by the Spanish administration and offered for international tender in 1965 with awards going to groups operated by Mobil and Spanish Gulf Oil (Spangoc) but the exploration efforts led to no commercial success. After independence in 1968, petroleum activity was much reduced and further significant exploration did not occur until after the 1979 change of Government. Hispanoil and the new Government formed a joint venture company, GEPSA which discovered the Alba gas condensate accumulation in 1983. GEPSA deemed Alba to be non-commercial and their licences lapsed. During the 1980's, Total and Elf operated groups that explored onshore and offshore Rio Muni where extensive seismic surveys were undertaken and four wells were drilled without commercial success. Hamilton Oil Co. (subsequently BHP Petroleum) carried out seismic work in a Corisco Bay licence before withdrawing in 1995.

The Alba acreage was relicensed in 1990 to US independent Walter International who commenced production in 1991 from two new wells. In 1995 Nomeco (subsequently CMS Oil & Gas) acquired Walter and progressively expanded onshore processing capacity to cope with increased production from additional Alba wells. Other exploration in the Alba block has included North Alba-1 (Walter, 1992), South Luba-1 (CMS, 1996), as well as the Riaba-1 and East Luba-1 marginal discoveries (CMS, 1997). The success of the Estrella-1 well (CMS, 2001), a gas condensate discovery 6 km north of the Alba Field, emphasised the large potential of the Alba Block. All CMS assets were acquired by Marathon in January 2002 and Marathon has continued with investment and expansion of the Alba Field. In 2004, Marathon drilled the Gardenia-1 exploration well to the south east of the Alba Field which resulted in a gas-condensate discovery.

United Meridian Corporation (UMC, now Ocean Energy) licensed Bioko Blocks A and B in 1992, and blocks C and D in 1995. UMC drilled the Dorado-1 well in Block A and the Delta-1 well in Block B in 1994. Mobil then farmed-in to Block B and drilled the Zafiro-1 discovery well in 1995. Mobil has drilled nine exploration wells in Block B outside of the Zafiro area, with discoveries at Azurita-1 (1997), Berilo-1 (1998), Turmelina-1 (1998) and Esmeralda-1 (2005). Mobil also farmed-in to Block C in 1999 and drilled the Ostra-1 exploration well, followed by Oreja Marina-1 exploration well in 2001 and Estrella de Mar-1 in 2002. In 2004, Repsol additionally farmed into Block C to technically evaluate the block with a view to drilling an exploration well in 2006.

During 2000, Ocean Energy relinquished Block A and operatorship of Block D was taken over by CMS (now Marathon). Six exploration wells were drilled by Ocean in Block D and resulted in undeveloped discoveries at Tsavorita, Estauirolita, Apatito and Ambar (all in 1997). After farming-in to Block D, CMS drilled Los Loros-1 in 2001 and after the ownership change to Marathon, the Agate-1 and Ibis-1 exploration wells were drilled in 2002. In 2004, Marathon drilled the Bococo-1 exploration well resulting in a small gas discovery and the Corona-1 discovery which extended the Alba Field into Block D.

Elsewhere in the areas offshore Bioko, Elf signed a licence in 1999 for Block E, and acquired 3D seismic within the block before drilling the first exploration well, Hipocampo-1, in 2001.

Triton Energy was awarded Rio Muni Blocks F & G in 1997, covering areas previously licenced to Elf, and they acquired seismic through 1997 and 1998. In late 1999 Triton made a significant discovery with the first well on its licences, Ceiba-1, which tested oil at 12,400 bopd and led to



first production in November 2000. In response to the Ceiba discovery an aggressive exploration programme was undertaken by Triton during 2000-2001 that continued after the acquisition of Triton by Amerada Hess in 2001. This has resulted in 18 successful wells that have proved up several hundred million barrels of oil in northern Block G which is to be developed as the 'Okume Field'. The Okume Plan of Development was approved by the MMIE in late 2004 and Okume is anticipated to be on-stream by 2007. Additionally the G-13 discovery was made in southern Block G in late 2002 which was appraised in 2003.

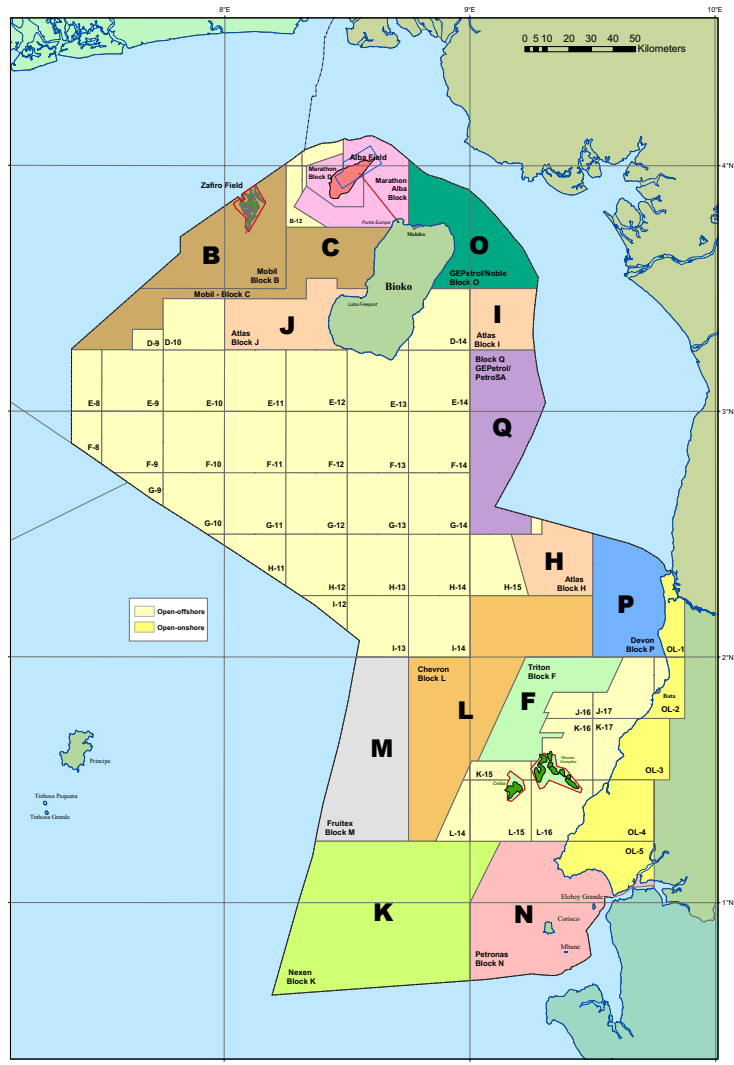
Following a Deep Water Licensing Round in 1998-99, five exploration licences were signed during 2000 with Atlas Petroleum (Blocks H, I and J), Vanco (Block K) and Chevron (Block L) as operators. Extensive 3D seismic surveys were acquired in these licenses in 2001 and exploratory drilling commenced in early 2003 with the drilling of the L-1 well by Chevron. In 2000 RocOil farmed-in to the Atlas Block H and became Technical Manager. This was followed in 2004 by the farm-in of Pioneer and the drilling of the H-1 well. In 2004, Nexen farmed-in to Block K, assumed operatorship and drilled the K-1 well in late 2004 followed by the K-2 well in 2005.

During 2002 new exploration licences were awarded to the Fruitex Group covering Block M in western offshore Rio Muni and to a Petronas-operated group for Block N covering Corisco bay.

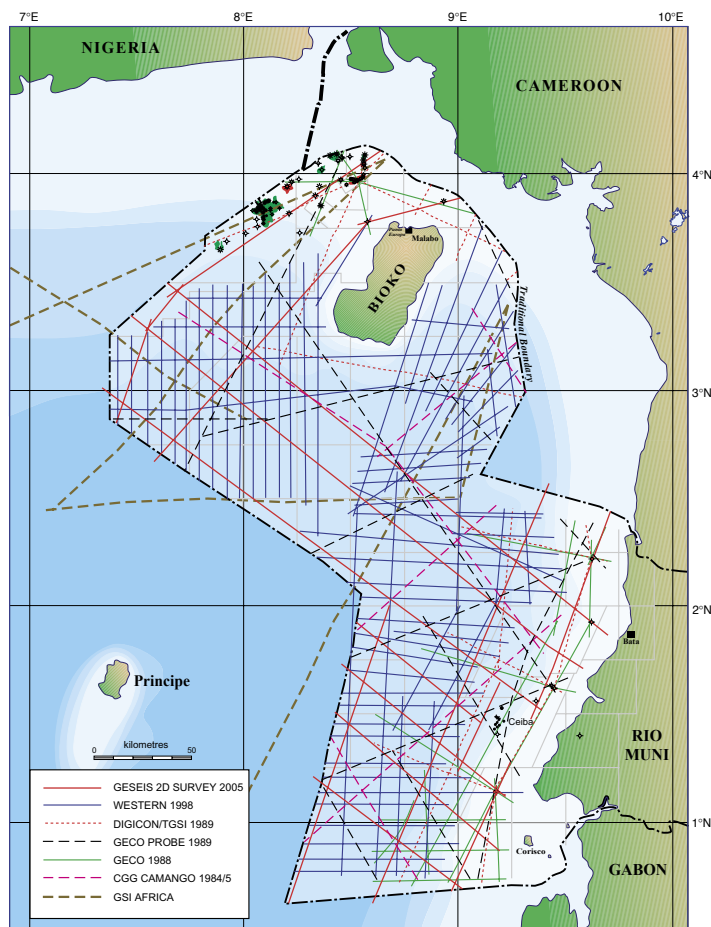
In 2003, Devon Energy was awarded Block P in the Rio Muni Basin and in 2004 Noble / GEPetrol was awarded Block O and PetroSA was awarded Block Q, both in the Douala Basin

In late 2003, Petronas drilled the N-1 well and in 2004 Devon drilled the P-1 well in Blocks N and P respectively.

Further exploration drilling will take place in Blocks H, I, K, L, M, N, O and P during 2005 / 2006.



# TECHNICAL DATA BASE



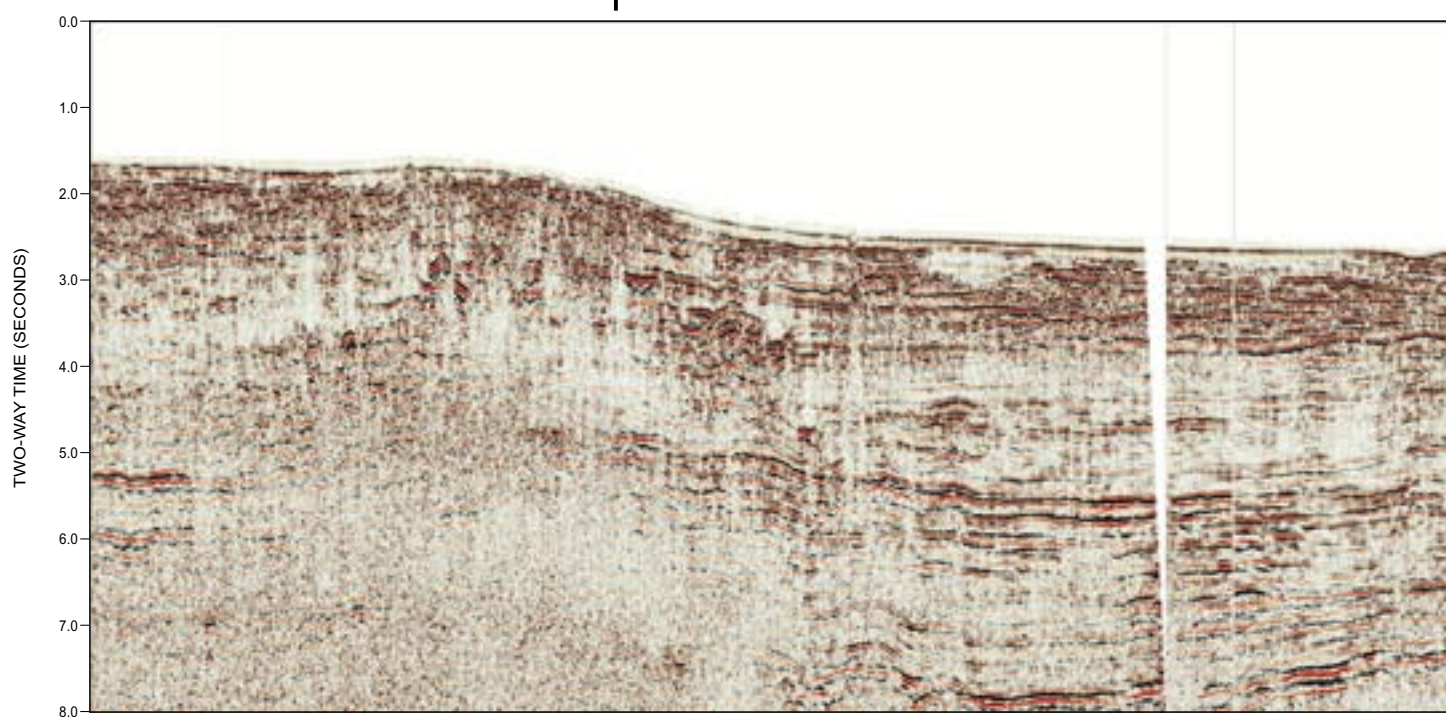
## Speculative Seismic Surveys

Since 1989, various seismic contractors have acquired regional 2D seismic surveys in Equatorial Guinea territory under agreements with the Ministry of Mines, Industry and Energy. The most extensive survey (approximately 7600kms) was undertaken by Western Geophysical in 1998 over the previously unexplored deepwater areas. These data are available directly from Western Geco who should be contacted at their office in the UK. During 2002 reconnaissance seismic data were acquired around Annobon by GESeis and in 2005 GESeis acquired a long offset 2D well tie survey over the Rio Muni Basin, Douala Basin and offshore Bioko. Enquiries regarding the long-offset 2D survey should be directed to GESeis in the UK.

North-west

BIOKO ISLAND TREND

R I O





## Historical Data Archive

Seismic and well data become the property of the Government on licence relinquishment and the policy is to make these data available to companies interested in evaluating exploration opportunities in Equatorial Guinea.

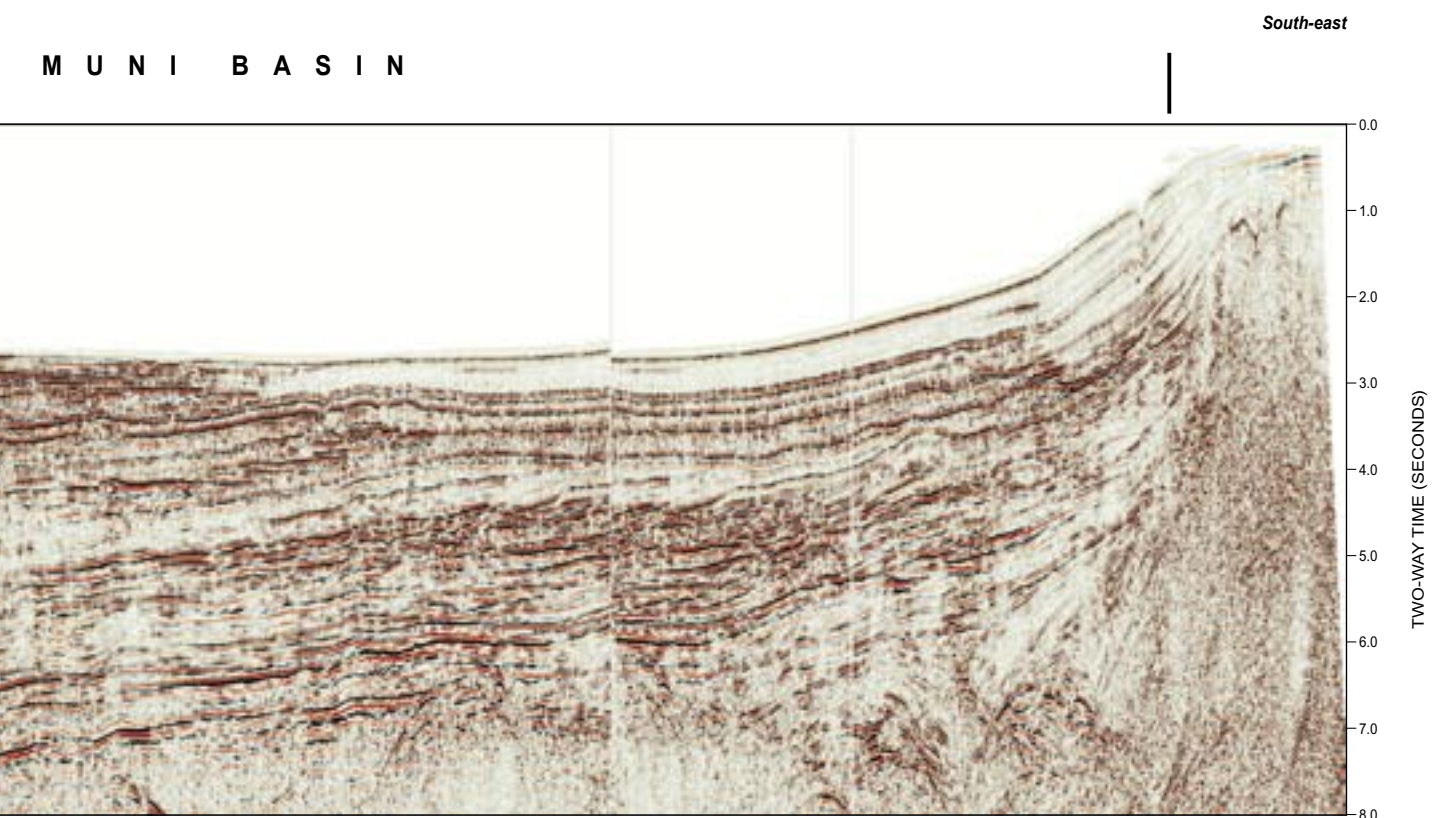
## Interpretation and Analytical Studies

A synthesis report on the geology and petroleum potential of Rio Muni was produced by ECL in 1997, including time and depth mapping based on the historical seismic data. The report enables rapid evaluation of the exploration potential of the region.

Two analytical/interpretation studies were completed in 2001 that access the historical well sample archive and outcrops from Rio Muni. A Biostratigraphic Report by Lacustrine Basin Associates addresses the age, zonation and depositional environment of the Cretaceous strata through new sample analyses. A Source Maturity and Geochemistry study by ECL and Geotrack addresses the timing of source rock maturity and hydrocarbon migration through new sample and oil geochemistry and AFTA analysis.

A comprehensive synthesis report was completed in 2005 that integrates all well, seismic and analytical data in Equatorial Guinea to define Play Fairways for prospect evaluation.

Full details of the historical database and data licence fees are available from the Ministry of Mines, Industry and Energy in Malabo or from ECL in the UK where the data are available for viewing. Details of the data archive are also provided on the internet web site at <http://www.equatorialoil.com>. The data can be provided in film, paper or digital formats.



# PETROLEUM POTENTIAL

Equatorial Guinea territory overlies parts of two world-class petroliferous sedimentary basins. Both are highly prospective for hydrocarbons with proven petroleum systems including marine oil-prone source rocks and high quality sandstone reservoirs.

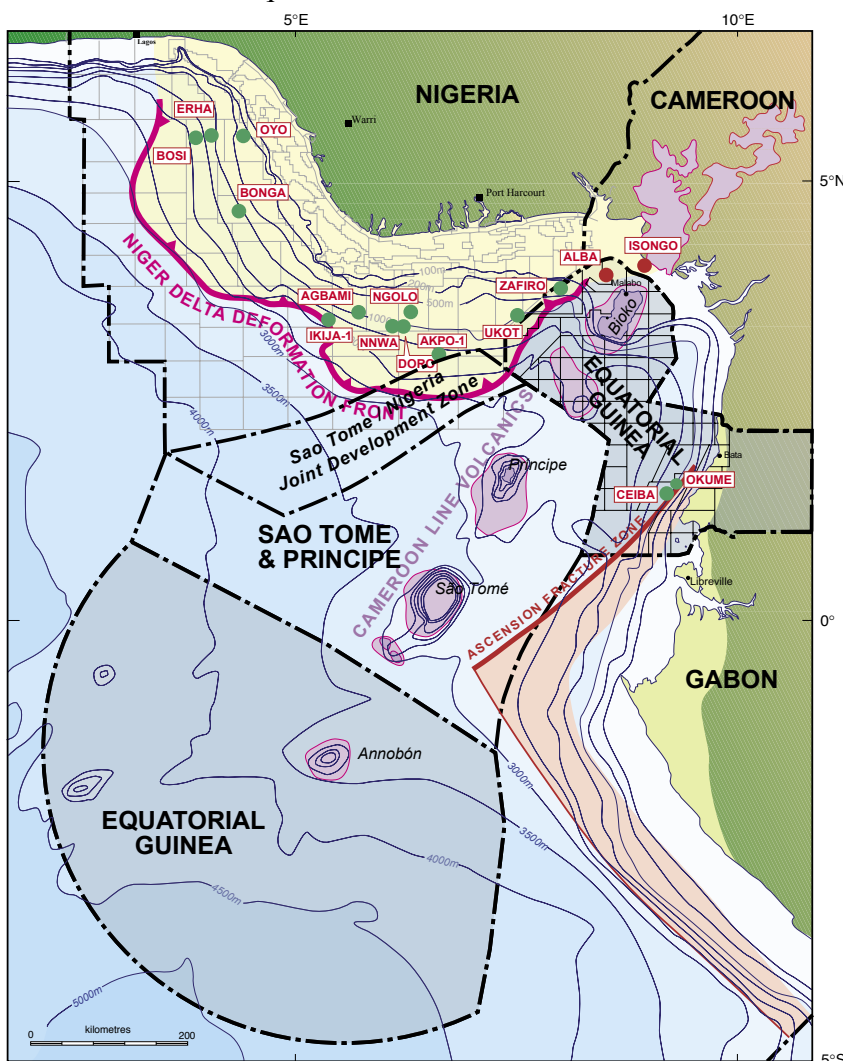
In the north of the country around Bioko, the offshore sector overlies the distal parts of the Niger Delta-Rio del Rey basin system. The Niger Delta is one of the world's largest petroleum provinces with estimated proven reserves of 48 billion bbls of oil and 135Tcf of gas. The Equatorial Guinea part of the basin has established oil and gas production from the Zafiro, Ceiba and Alba fields plus a number of other discoveries.

The southern part of Equatorial Guinea's offshore sector overlies the Rio Muni Basin. This is contiguous with the Kribi-Campo (Douala) Basin of Cameroon to the north (which hosts the Sanaga Sud and Kribi oil and gas fields), and with the North Gabon Basin to the south which contains numerous oil and gas discoveries. The excellent potential of the Rio Muni Basin has been demonstrated by the oil production at Ceiba and Okume fields and the continuing discoveries.

The sedimentary section beneath both the Bioko and Rio Muni areas extends oceanward to the territorial limit of Equatorial Guinea. The sediments of the distal Niger Delta Basin and those of

the deep water Douala and Rio Muni basins merge in the region south of Bioko, giving significant petroleum potential to the whole of Equatorial Guinea's offshore areas.

Industry attention is now extending to the ultra-deep-water Gulf of Guinea around the islands of the Cameroon volcanic trend which include the Equatorial Guinean island of Annobón. Here it is postulated that the extensive offshore economic zone could contain a thick sedimentary section with petroleum potential, as evidenced by oil seeps on the neighbouring volcanic islands of Sao Tome and Principe.



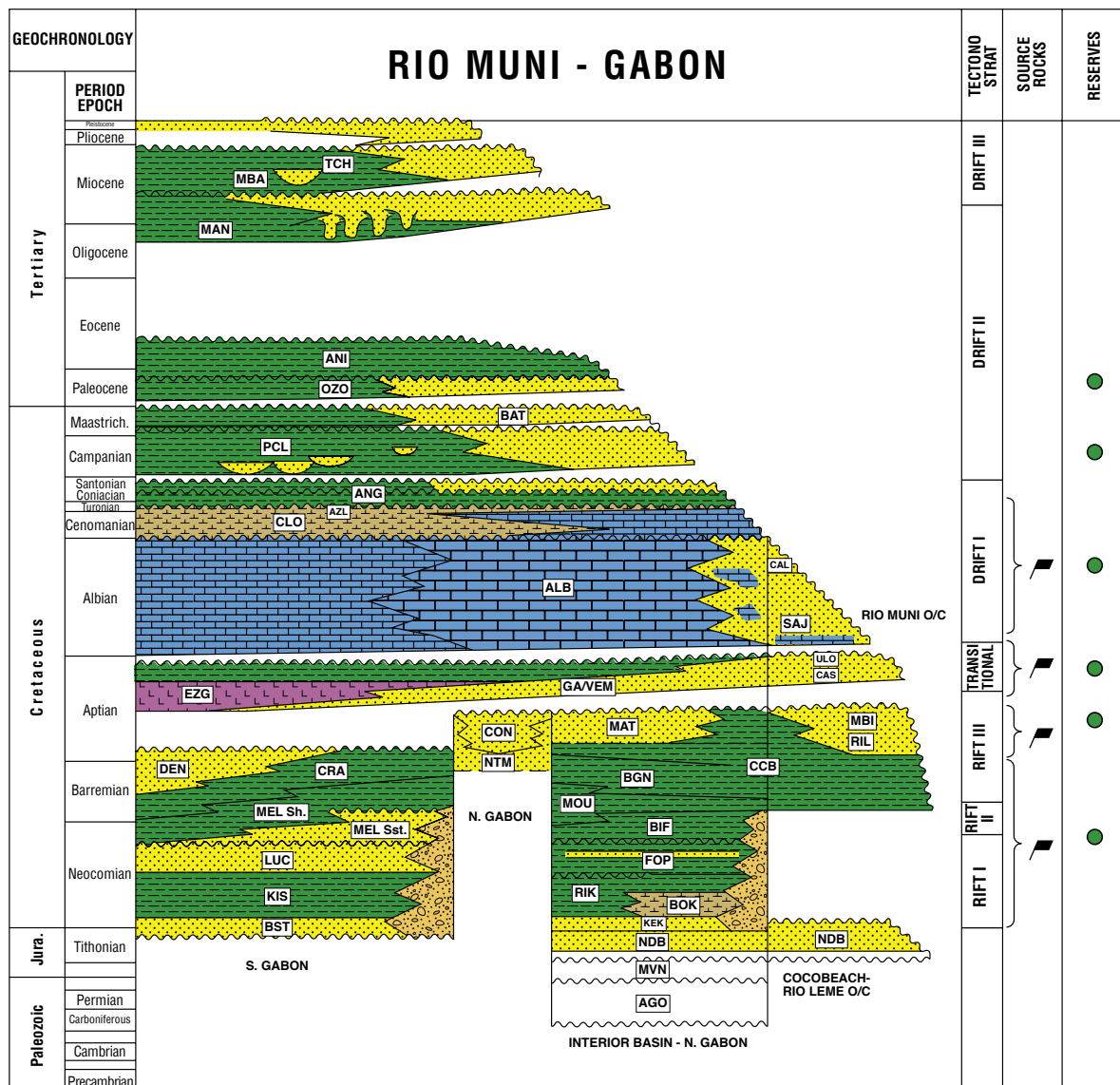
*Gulf of Guinea deep water situation*



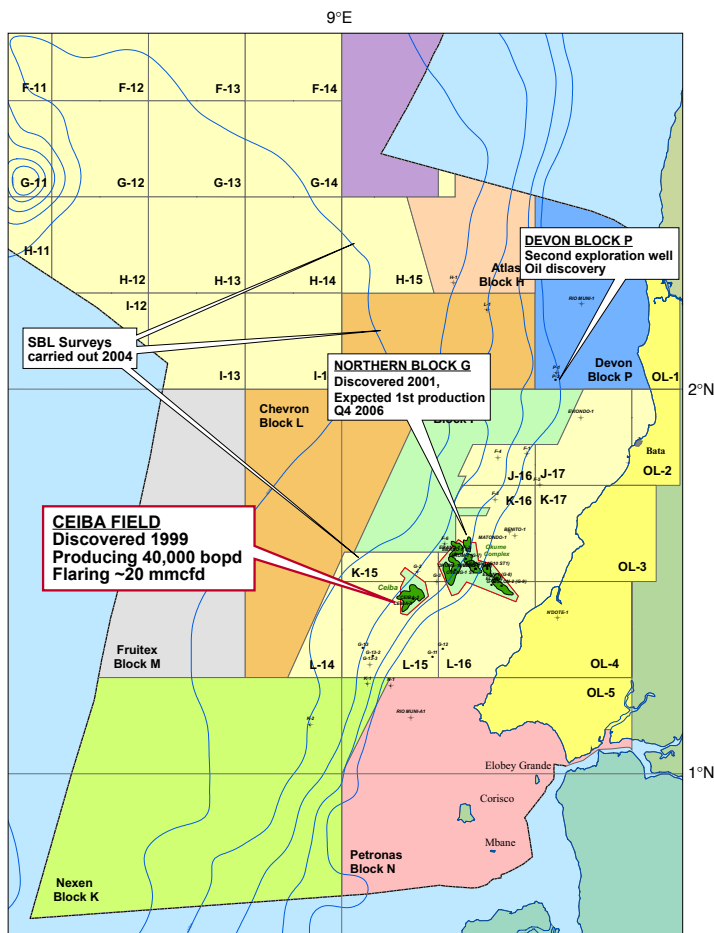
## Geology of the Rio Muni Basin

The Rio Muni Basin forms part of the extensive West African margin basin system, formed during continental separation and creation of the South Atlantic Ocean through the Cretaceous and Tertiary. This basin system contains a thick wedge of Cretaceous to Tertiary sediments built over an early Cretaceous rifted terrane.

In the Northern Gabon Basin and extending into southern Rio Muni, the rift section comprises lacustrine and fluvio-deltaic faulted and tilted strata of Barremian and Neocomian age. In Gabon this section includes proven sandstone reservoirs, and the Kissenda and Melania lacustrine shales which are prolific source rock intervals. Overlying the syn-rift section is a thick section of Late Aptian salt and a well developed succession of Mid to Late Cretaceous and Early Tertiary marine limestone and sand-shale sequences. Movement of salt has formed a wide range of prospective traps including diapirs, turtle-backs, and rollover structures to growth faults on the margins of salt walls.

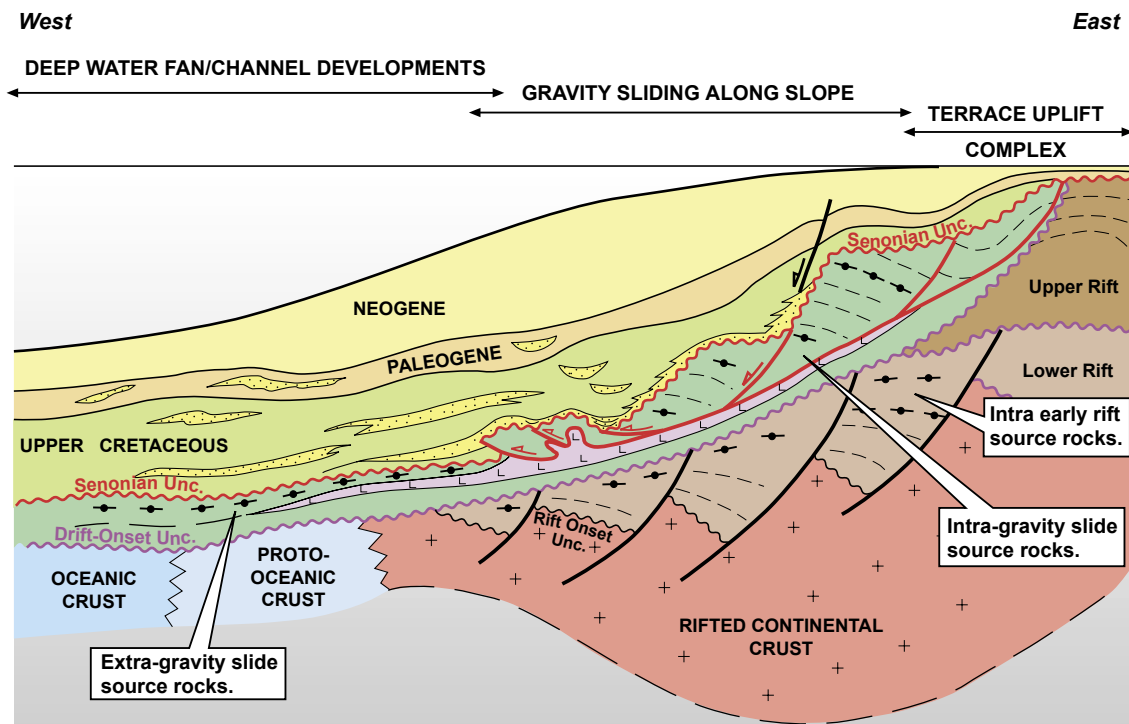


Rio Muni Basin stratigraphy



Activity in Rio Muni Basin

In northern Rio Muni, the syn-rift section comprises Late Barremian to Mid Aptian terrestrial clastics and lacustrine shales characterised by extensional rollover structures to mega-scale listric faults updip, and toe-thrust structures downdip. The syn-rift section is overlain by a “transitional” sequence of well-developed salt and good quality marine oil-prone source rock intervals. An Albian (Madiela) carbonate platform developed over the area plus an Albian-Turonian sand-shale sequence which contains a major source interval. This post-salt sequence commonly forms extensional rafts detaching on an Albian-Aptian shale or salt. A well developed Senonian section onlaps the earlier rafted topography. The latest drift sequence is dominated by a thick wedge of Miocene to Recent clastics.



Rio Muni Basin play concepts

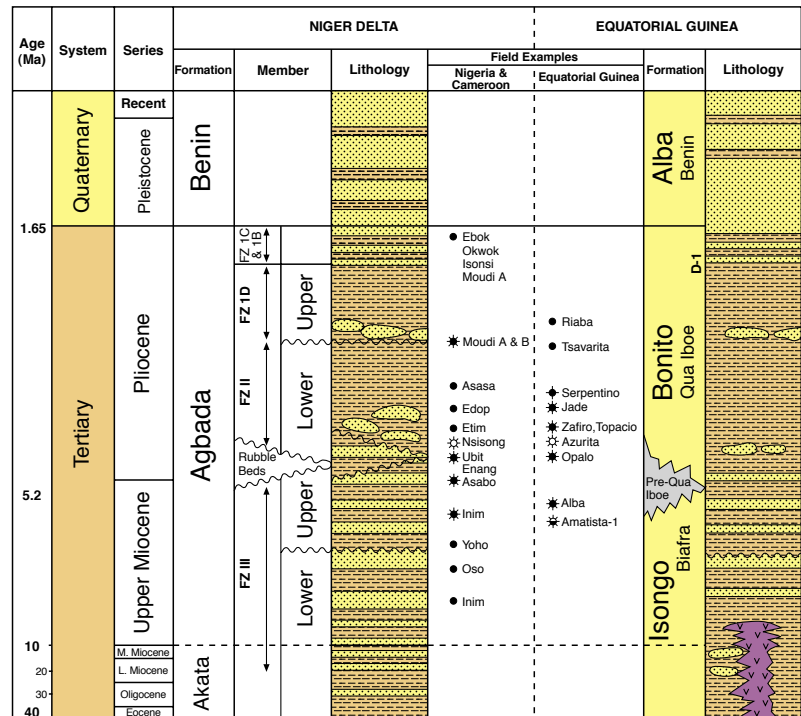


Modelling indicates that the “transitional” source intervals may be locally mature on the shelf and may have charged Albian to Turonian carbonates and clastics. The deep water equivalents are believed to have been generating hydrocarbons from Mid Tertiary times and provide the likely source to the deep water sandstones which provide the excellent reservoirs encountered at Ceiba.

### Geology of Offshore Bioko

Offshore Bioko contains an active petroleum system comprising reservoir sands that lie structurally above voluminous marine shales containing oil-prone source rocks. The most important of these are the marine shales of the basal Pliocene Qua-Iboe and the Miocene Akata (Isongo) Formations which contain mixed Type II and Type III kerogens.

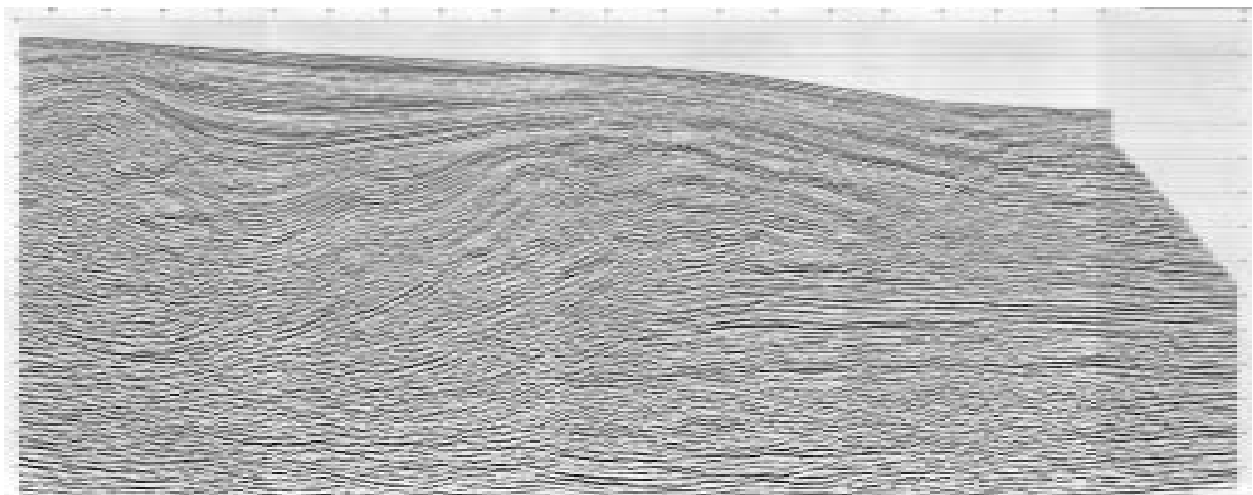
A thick sequence of Tertiary to Quaternary sands and shales was deposited as a wedge of clastic sediments in the distal Niger Delta basin setting. Shelf edge sedimentation has led to deposition of delta slope and basinal clastics by a variety of gravity driven processes including gravity sliding, debris flow and turbidity currents. Progradation of the delta has been accompanied by shale



East Niger Delta stratigraphy

North-west

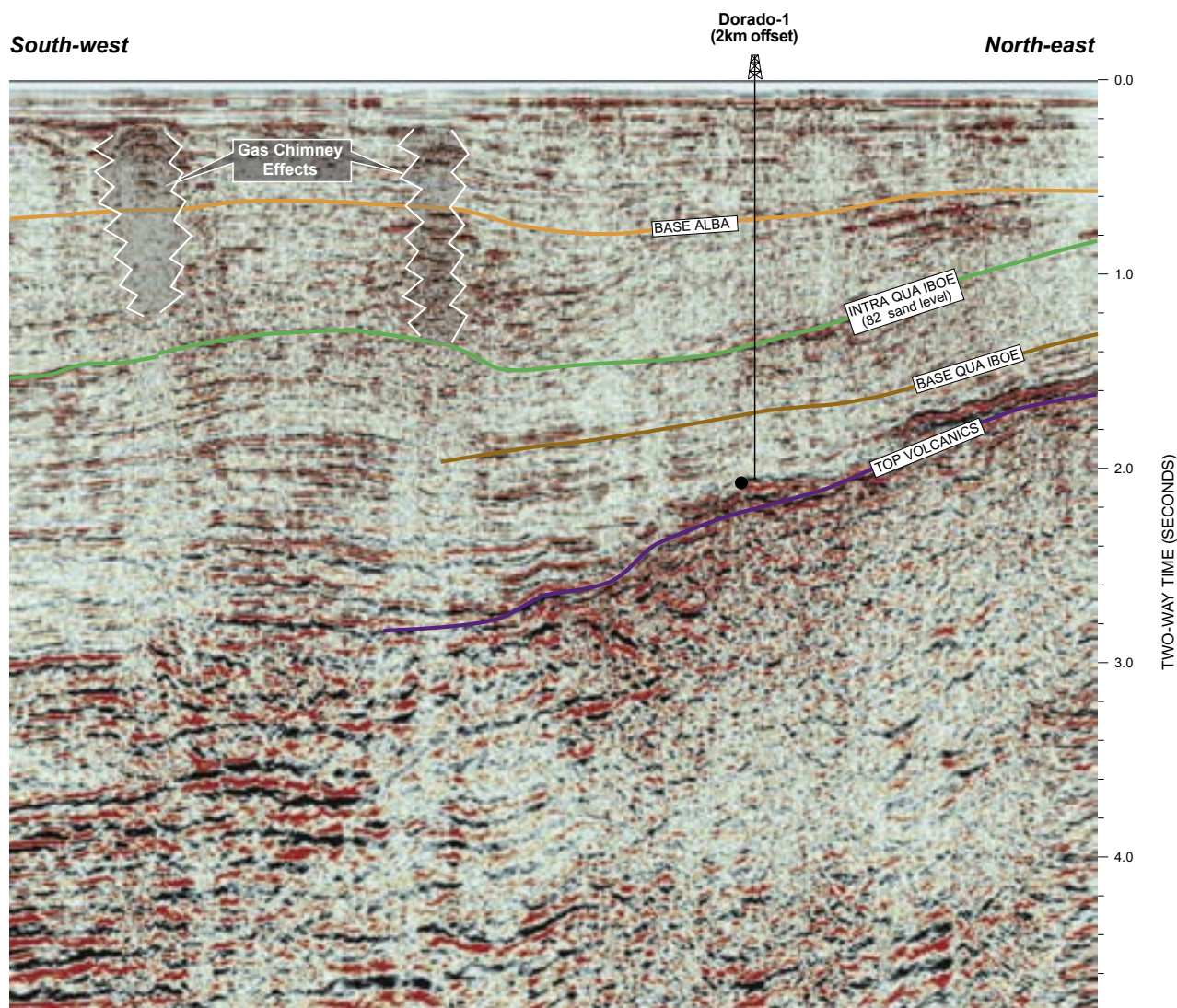
South-east



Historical seismic data offshore Bioko







*Historical seismic data north-east of Bioko*

Simple four-way dip structural closures and toe-thrust structures are common within the Isongo Formation whereas the Qua-Iboe Formation contains a number of structurally enhanced stratigraphic traps. Good seals for all traps are provided by the interbedded Qua-Iboe and Isongo shales.

Regional seismic lines show that Mid to Late Cretaceous strata extend far into the ultra-deep water and certainly beneath the present-day volcanic edifices such as Bioko Island. This is evidenced by the oil seeps on the volcanic trend in Sao Tome and the occurrence of Turonian ammonites on Bioko. The presence of volcanics in this setting therefore need not preclude hydrocarbon occurrences in the vicinity of Bioko and the other islands in the chain, including Annobon.

Exploration is at an immature stage in offshore Bioko and holds considerable potential for future discoveries. The deep water areas to the south and west of Bioko hold potential, particularly within large fan-like mound features recognised on seismic data in front of the toe-thrust limit, which are as yet untested by drilling.

# PETROLEUM LEGISLATION

The current Law concerning hydrocarbon exploration and production activities is Decree Law No. 7/1981 of June 1981 (the Hydrocarbons Law) as amended by further decree in November 1998. The Hydrocarbons Law provides the framework for the licensing and award of exploration and production rights and authorises the Minister of Mines, Industry and Energy to enter into contracts with oil companies. Decree Law No 9/2001 concerns the establishment of a national oil company (GEPetrol) and mandates it to manage the State's interest in petroleum contracts.

The taxation of petroleum exploration and production activities is covered by the general tax provisions in Decree Law No. 1/1986, as amended by Decree Law No. 7/1988, Decree Law No. 10/ 1991, Decree Law No. 2/1997, Decree Law No. 3/1997 and Decree Law No. 4/2004. Local content issues are dealt with by Decree Law No.127/2004 which addresses National Participation on Business Activities. Additionally, Equatorial Guinea is a member of CEMAC (formerly UDEAC) and is signatory to certain regional agreements concerning tax and trade.

## Contracts and Fiscal Terms

The form of the Model Petroleum Production Sharing Contract is always under review but includes the following provisions:

- **INITIAL EXPLORATION TERM** of five years divided into two sub-periods (of 3 & 2 years), extendable on a yearly basis for up to a total of 7 years.
- **RELINQUISHMENT** of 40% after the initial exploration term, with a further 25% of the remaining area at the end of each renewal period. Voluntary relinquishment at the end of each contract year is permitted.
- **EXPLORATION COMMITMENT** is negotiable, but usually involves purchase and interpretation of all existing data relating to the contract area and seismic acquisition in the first sub-period, with exploration drilling in the second sub-period and a well in each of the annual extensions.
- **ROYALTY:** Minimum rate of 10%, escalating to a maximum of 16% in steps according to average daily production.
- **COST RECOVERY** from a minimum of 60% of production net of royalty.
- **PRODUCTION SHARING** from profit oil according to a stepped scale related to cumulative production.
- **BONUS PAYMENTS** on contract signature, on notification of a commercial discovery and on production targets.
- **ANNUAL SURFACE RENTAL** during exploration phases a flat rate of \$0.50 per hectare is applied to acreage in over 200m water depths, rising to \$1 per hectare during development. Rate for areas with water depths less than 200m is \$1 per hectare.
- **STATE PARTICIPATION** of a direct working interest carried through exploration and development but cost recoverable.
- **INCOME TAX:** According to the Tax Law, currently at the rate of 35%



The national oil company, GEPetrol was established by Presidential decree in February 2001 and became operational in January 2002. GEPetrol trains Equatorial Guinea nationals in order to progressively increase local participation in the petroleum and associated industries.

GEPetrol manages:

- the State's participation in existing licenses
- the sale of the State's royalty oil and share of production
- the promotion of unlicensed exploration acreage

GEPetrol will initiate commercial ventures and will participate in Joint Ventures, particularly in the area of petroleum services.

GEPetrol interacts with the Ministry of Mines, Industry and Energy on a regular basis in order to coordinate the affairs of the industry in Equatorial Guinea, but is a separate and autonomous body.

***The Ministry of Mines, Industry and Energy is the overall regulatory and administrative body for the petroleum industry in Equatorial Guinea.***

Further information on GEPetrol's commercial activities can be obtained from:

## **GEPetrol**

Calle Acacio Mane 39, PO Box 965  
Malabo, República de Guinea Ecuatorial.  
Tel: +240 09 6769  
Fax: +240 09 6692  
Attention: The National Director

## **GEPetrol**

13 Park Place  
London, SW1A 1LP  
Tel: +44 207 493 4776  
Fax: +44 207 493 4780  
Attention: Chief of London Office



## **GESeis**

GESeis is a geophysical joint services venture between GEPetrol and Terra Energy Services that undertakes proprietary and multi-client surveys in Equatorial Guinea. For information and current data availability contact:

## **GESeis**

c/o Terra Energy Services  
Thornbrook, Weyside Park, Catteshall Lane  
Godalming, Surrey, GU7 1XE, England  
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Fax: +44 (0) 1483 239910

# MINERALS POTENTIAL

The mainland of Equatorial Guinea (Rio Muni) offers the wide variety of mineral potential that is expected on an Archaean cratonic setting with later Pan-African overprinting; with possibilities for gold, diamond, columbo-tantalite, platinum-group elements, bauxite and base metals.

Rio Muni comprises the Archaean terranes of the Ntem Complex and the Monts de Cristal Massif of the northern Congo Craton, both of which were partly re-worked during the Paleoproterozoic Eburnian orogeny. They consist of largely granitic gneisses, charnockites, mafic intrusions and broad mylonitic shear zones (including an Eburnian terrane boundary), with subordinate amounts of banded ironstones, metasediments, and post-orogenic intrusions. Pan African transpressional structures are common in the west and are associated with granitic intrusions and pegmatite bodies, which also occur throughout the interior. Sub-greenschist shales, argillaceous dolomites, and quartzites occur in the southwest. Higher-grade sedimentary packages, also attributed to the Pan-African, are found along the northern border of the country where they are associated with major strike-slip and thrust faults and post-tectonic granitic intrusions.

The coastal strip of Rio Muni comprises Cretaceous sands, shales, and carbonates with basal conglomerates, all deposited during the rifting phase of Atlantic opening. Trans-Atlantic fracture zones link to major onshore lineaments, at least one of which shows evidence of Cenozoic rifting (the Benito Rift).

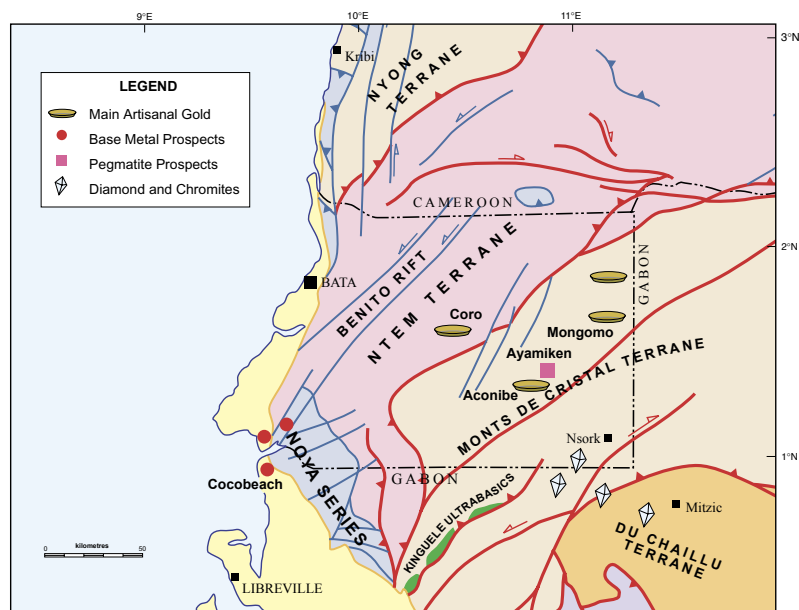
## HISTORY OF EXPLORATION IN RIO MUNI

In pre-colonial times Equatorial Guinea was known for gold and iron production however there are no records of any commercial production during the Spanish era, which ended in 1968.

After independence, early investigations highlighted the potential for gold, base metals, bauxite and pegmatite minerals such as tin, tungsten and columbo-tantalite. Initial systematic surveys were conducted from 1975 by Soviet Union geologists and from 1980-1985 BRGM (France) undertook regional and follow-up alluvial heavy mineral and geochemical exploration. Between 1981-1983

GEMSA (a Spain-Equatorial Guinea joint venture) prospected for gold, iron ore, ornamental stone, molybdenite, columbo-tantalite, bauxite and diamond opportunities. In the process, GEMSA undertook airborne magnetic surveys and constructed a SLAR mosaic of the country at 1:1,400,000 scale (about 20m resolution).

From 1996 to end 2000, UMCEG (Ocean Energy) held a contract area covering the whole of Rio Muni but with operatorship from 1998 being with joint venture partner BoMc. Early investigations included data compilation and



*Regional geological framework and minerals indicators*

regional reconnaissance work. Detailed sampling was undertaken in the Coro gold area, around nickel anomalies in the southwest and for heavy minerals in beach sands. Programmes included soil and sediment sampling using augers and development of a GIS database.

## MINERALS OPPORTUNITIES

### Gold

The rivers of Rio Muni are worked by local artisans using simple panning and wooden sluice technologies. Previous commercial investigations have concentrated on the three main areas of artisanal workings - Coro, Aconibe, and Mongomo and there are several other known occurrences that have been worked. Historical records are incomplete, but at least 2.3t of gold was produced from the Coro area alone in the mid-70's.

The alluvial gold is relatively coarse grained, occurring as either dendritic or rounded nuggets, mostly in the 350-180 $\mu$  size range, although larger nuggets up to 4mm x 8 mm are relatively common. The common occurrence of the gold with vein-quartz, clays, and lateritic minerals attests to the proximity and variable types of bedrock gold mineralisation which have yet to be delineated.



*Coro gold area*



*Panning for gold*

### Diamonds

Heavy-mineral sampling results have identified zinc-rich chromites in the Nsork area, similar to those found in the diamondiferous lamproite dyke swarm at Mitzi (Gabon), 50km to the southeast. Remote sensing and limited outcrop mapping show the dyke swarm trending into the southeastern corner of Rio Muni. Furthermore, exploration in Gabon for both gold and diamonds has identified trails of indicator minerals and diamond right up to the southern borders of Rio Muni. Detailed exploration work is required in the Nsork area to establish the primary sources of the diamonds.

### Columbo-tantalite

Mineralisation has been defined in the Aconibe and Ayamiken areas by Nb and Ta soil anomalies and by the presence of heavy minerals commonly associated with Nb-Ta-bearing pegmatites. Neither area has been explored in great detail and thus they represent early stage exploration prospects for pegmatites and skarn systems associated with PanAfrican granitic intrusions. The Aconibe occurrence comprises discrete, laterally extensive pegmatites that are also overlain by eluvial and alluvial deposits yielding grades of 3.0 to 7.5kg/m<sup>3</sup>. Sample assays have demonstrated niobium-rich columbo-tantalite (62.36% Nb<sub>2</sub>O<sub>5</sub>) with subordinate tantalum (18.74% Ta<sub>2</sub>O<sub>5</sub>).

### Other mineral potential

Widespread lateritisation and indications of bauxitic laterite, with grades up to 58.3% Al<sub>2</sub>O<sub>3</sub>, and 2.1 % to 5.3% SiO<sub>2</sub>, indicate some potential for bauxite. Anomalous values of base metals, U, As,



Ag, Mn and Mo have been detected in laterite above black shales in the Noya Series which is part of the West Congolian foreland basin. This has known base metal deposits immediately to the south in Gabon, and is also equivalent in age to the Katangan sequences of the Democratic Republic of Congo and Zambia. Basic intrusives have been mapped in southern Rio Muni, that may be a northern extension of the Kinguéle ultrabasics trend of northern Gabon, which contains known Ni-PGE mineralisation. Serpentinised ultramafics in central Rio Muni are as yet untested exploration prospects with some potential for base metals and platinoid elements.

## MINING LEGISLATION

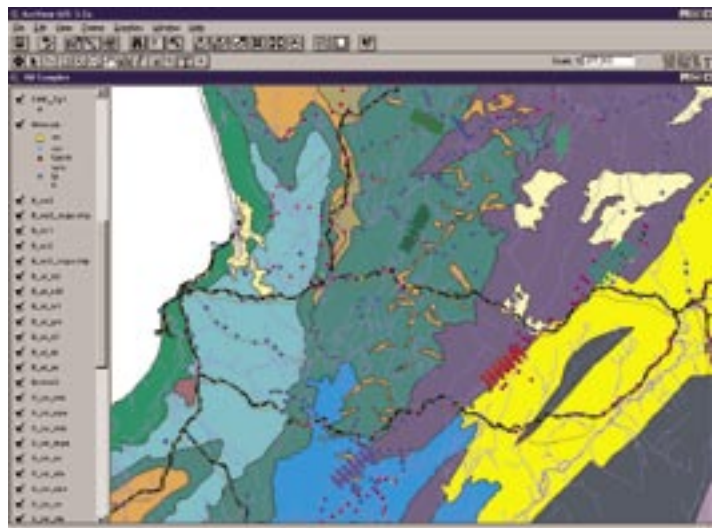
A new Minerals Act attractive to international mining and exploration companies is currently under review.

## MINERALS DATA ARCHIVE

The Ministry of Mines, Industry and Energy maintains a comprehensive database of exploration works carried out since the 1970's. All of the exploration data has been archived into a fully integrated GIS database - access to country-wide base dataset is available to all, with more detailed exploration results and processing available to companies taking ground positions. Hard-copy reports include methodology and interpretation of the raw data, as well as country reviews and prospectivity reports. All the available data is catalogued and may be viewed prior to leasing. Data viewing, licensing and confidentiality arrangements are handled by ECL in the UK.

### Highlights Of The Data Archive

- In excess of 12,000 multi-element geochemical analyses, including soils, stream sediment and rock samples
- Over 3,000 heavy mineral counts from alluvial gravels
- Over 2,300 analyses for gold, including several soil, alluvial and rock samples with tenors exceeding 40ppm Au
- Highly detailed infrastructural layers, including GPS-, satellite-, and radar-located road and drainage networks and remote-sensing-based geological maps
- Detailed reports by BRGM and international consultants on geochemical result interpretation, target models, and evaluation and logistical considerations



*Example from the Rio Muni GIS database*





## CONTACTS

Further information on data availability or any other matters concerning opportunities in Equatorial Guinea can be obtained from:

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