Secretariat

KENYA NATIONAL ASSEMBLY
NINTH PARLIAMENT – FOURTH SESSION

DEPARTMENTAL COMMITTEE ON ENERGY,

COMMUNICATIONS AND PUBLIC WORKS

REPORT OF THE SECOND CONFERENCE ON THE PETROLEUM POTENTIAL AND INVESTMENT OPPORTUNITIES IN EAST AFRICA

ON MARCH 2 TO 5, 2005

Parliament Buildings
Nairobi

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PREFACE

Hon. Speaker,

1. The Departmental Committee B. on Energy, Communications and Public works was constituted at the commencement of the Ninth Parliament pursuant to the provision of Standing Order 151 of the Kenya National Assembly. Standing Orders 151(1) 4 define the mandate of the Committee.

2. The Committee is charged with the responsibility of inquiring into and reporting on all matters pertaining to the mandate, management, activities and administration of the assigned Ministries and Departments in the areas such as energy production and distribution, air and sea ports, transport and communications, among others.

3. On March 1, 2005, the Committee resolved to attend the Petroleum Conference in Uganda necessitated by the fact that exploration and prospectivity in Kenya had declined and the poor utilization of available natural resources. The Conferences was the second to be held in East Africa.

4. The first International Conference on Petroleum Potential and Investment Opportunities in East Africa was organized under the auspices of the East Africa Community (EAC) and was held on March 5th to 7th 2003 at the Safari Park Hotel in Nairobi, Kenya.

Hon. Speaker,

5. Since then, the three Partner States of the East African Community of Kenya, Uganda and Tanzania have increased promotional activities for crude oil and gas exploration in the region. They have agreed on the need to provide an investment environment with low entry cost and large areas open for licensing. This Conference led to renewed interest in the region with a lot of activity picking up in exploration and development.

6. More than 100, 000 km of seismic data is available as at least 60 wells have been drilled to date and Oil exploration has been going on in the region intermittently for 70 years.

7. Sedimentary Basins of East Africa occur in settings similar to some of the world's most prolific oil producers. The region has about 15 major sedimentary basins covering more than 500, 000 sq. km.

Hon. Speaker,

8. Gas discoveries in Mozambique, Songo Songo and Mnazi Bay in Tanzania, Hydrocarbon discoveries in Lake Albert, Albertine graben in Uganda are evidence of the potential in Eastern Africa margins. The region is under explored yet it has the potential of becoming a significant producer of both oil and gas in the near future.

9. To give the promotion further impetus, the three countries held 3-day event dubbed the 2nd East Africa Petroleum Conference (EAPC2005) from March 2nd -5th

2005 at Entebbe, Uganda. The **theme of the EAPC 2005 is energy for Sustainable development without energy at affordable prices, there can be no development. Oil and gas are expected to continue to be key energy sources in the foreseeable future.**

Hon. Speaker,

10. East Africa is hotspots for frontier exploration and EAPC 2005 was used to showcase incentives being offered to investors to under take petroleum exploration and development. Incentives offered by National Oil Corporations (NOCK) include quick access to new geological data, flexible negotiations for deep water prospecting and productions, and favorable fiscal regimes.

11. The incentives offered by Tanzania Petroleum Development Corporation (TPDC) include data provisions, fast tracking negotiations for productions sharing Agreements (PSA) and tax exemptions on exploration of equipments and materials.

12. In the offshore, Lamu Basin there is increased exploration activity with **Woodside Energy (K) Ltd**, large independent and global oil exploration company, entering the first additional period of Production Sharing Contract (PSC) in October 2004. Woodside has acquired about 3,600 km of 2D seismic data.

13. Woodside has also conducted surveys between August and September 2003 and the survey paves way for

Kenya's first offshore basin well in over 20 years by end of this year, the well was expected to be drilled by the end of this year or early 2006.

14. In the two offshore blocks, 25 percent acreage totaling 5,181.50 sq. km was relinquished to the government of Kenya in October 2004 and another 8,891.75 sq. km was expected to be relinquished by Dana and Afrex/Panacontinental Companies by the end of Last year.

15. The relinquished area has quality 2D seismic data acquired in 2003, which coupled with open acreage in other offshore blocks forms attractive and frontier potential acreage opportunities to investors.

Hon. Speaker,

16. The Kenya National Assembly was represented by the Energy, Communications and Public Works Committee Members, which comprised: -

i. **Hon. Julius Arunga, MP,**
ii. **Hon. Gonzi Rai, MP,**
iii. **Hon. (Eng.) Philip Okundi, MP, and**
iv. **Hon. Lucas Maitha, MP,**

And accompanied by

v. **Mr. Rana Tiampati, Clerk Assistant was the Secretary to the Delegation.**

17. The delegation is grateful to the Speaker of the National Assembly for the opportunity to attend and participate in the Second Conference and to the office

of the Clerk of the National Assembly for facilitating and providing technical support.

18. It is now my pleasant duty, on behalf of the delegation, to present and commend this report to the House pursuant to provision of Standing Order 162.

SIGN.....

DATE.....

HON. GIDEON MOI, MP.
CHAIRMAN,
DEPARTMENTAL COMMITTEE ON ENERGY, COMMUNICATIONS AND PUBLIC WORKS

HISTORY OF EXPLORATION IN KENYA

18. Petroleum exploration in Kenya begun in the 1950's with the first well being drilled in 1960. British Petroleum (BP) and Shell began exploring in Kenya in 1954 in the Lamu Embayment where they drilled ten (10) Wells. None of the wells were fully evaluated or completed for production despite several indications of oil staining and untested zones with gas shows.

19. In Mandera Basin, Frobisher Ltd, Adobe Oil Company and Burmah Oil Company conducted photogeological field geology, gravity, aeromagnetic and seismic surveys that did not materialize into drilling programs.

20. In 1975, several consortium acquired acreage in the upper part of Lamu Basin. Texas Pacific et drilled Hargaso – 1 in 1975 and encountered oil and gas shows in the cretaceous rocks. In 1976, Chevron and Esso drilled Anza-1 and Bahati-1 Wells in the southern part of Anza Basin. The drilling mud of both tests was suspected of having hydrocarbons and microfossils that contaminated the geochemical and cuttings respectively.

21. An interest in the offshore portion of the Lamu Basin resulted in the drilling of three deep wells, Simba-1, Maridadi- 1 and Kofia-1 by a consortium of Cities Services, Marathon and Union in 1982. Seismic data reveal that salt diapiric structures were present along the Kenyan margin.

22. In 1984, the government of Kenya enacted a new Petroleum (Exploration and Production) Act, Cap 308,

Laws of Kenya which introduced a model production contract replacing the old Petroleum Mining Act. In the same year the government set up the National Oil Corporation of Kenya (NOCK) and vested it with the responsibility of managing petroleum exploration and production.

23. In 1986, the Petroleum exploration legislation in Kenya was revised to provide suitable incentives and flexibility to attract international exploration interest in the country and in the same year, the Government of Kenya entered into a joint venture exploration programme with Petro-Canada International Assistance Corporation. Seismic work was conducted and Kencan-1 was drilled to test deeper strata on the structure adjacent to Garissa-1 Well.

24. A group of companies led by Total and Amoco drilled ten (10) wells, eight (8) of them in the Anza Basin and two (2) in Mandera Basin between 1985 and 1990. The wells were dry but with indications of oil and gas. Total exploration drilled Ndovu-1, Duma-1 and Kaisut-1 in North Anza Basin while Amoco drilled Sirius-1, Bellatrix-1 and Chalbi-3 in the Northwest of Anza Basin and Hothori-1 well in South Anza Basin.

25. Amoco farmed out 50% of its interest to Shell who drilled Eliye Springs-1 and Loperot-1 located west of Lake Turkana in the Tertiary Rift Basin. The Loperot-1 well penetrated a lacustrine source rocks with high Total Organic Carbon (TOC) Content and recovered water and waxy oil on Repeat Formation Test (RFT) from Miocene sandstones interval.

26. While none of these wells encountered commercial reserves, fluorescence and gas shows were reported in Hothori, Endela and Ndovu wells. Biostratigraphic studies suggest that these wells may not have penetrated deep to test the Noecomian-lower Albian sediments which comprise the source reservoir, and seal within Sudan rifts basins.

27. In 1991, National Oil Corporation of Kenya initiated an in-house study of the Lamu Basin as part of a long-term strategy to re- evaluate the existing geological, geophysical and geochemical data relating to each of the sedimentary basins in Kenya. The Lamu Basin study was completed in 1995. Based on the above reports, Kenya subdivided the Lamu Embayment (both offshore and onshore) into ten (10) exploration blocks, each with a specific exploration play. Two (2) more exploration blocks have been created since the year 2001.

28. Promotion efforts generated new interest in the offshore Lamu Basin, and resulted in signing of seven (7) Production Sharing Contracts (PSC) covering blocks L5, L6, L7, L8, L9, L10 and L11 between 2000 and 2002. a total of 7,884 km of 2D seismic data covering blocks L5, L6, L7, L8, L9, L10, L11 and L12 was acquired offshore Lamu Basin by Woodside between August and October 2003.

29. In August 2000, NOCK commissioned the Tertiary Rift Study, which was completed in March 2001. Tertiary rift study led to qualification of potential source and reservoir rock units in the study area as well as the petroleum system at play in the sub-basins.

PETROLEUM EXPLORATION OPPORTUNITIES IN KENYA

i. SEDIMENTARY BASINS

30. Kenya's Petroleum potential is best depicted by the four large sized sedimentary basins that straddled the country. These are: -

- Anza Basin
- Mandera Basin
- Tertiary Rift Basin
- Lamu Basin

ii. ANZA BASIN

31. The Anza Basin is one in a series of Cretaceous-Tertiary failed rifts that trend across the Central African Craton from the Benue trough in Nigeria through Chad and the Central African Republic, the Sudan and Kenya. The right lateral movements on the Central Africa rift system is interpreted to have translated to northwest – Southwest extension in Sudan and Kenya beginning by Barremian-Neocomian (Lower cretaceous) time, resulting in basins with an overall northwest –southwest trend that is nearly perpendicular to the shear zone. Rifting continued into the Tertiary Muglad, Melut and Blue Nile Basins of Sudan strike in the same direction as the Anza Basin. The Anza basin is thought to correlate with the Muglad Rift Basin of South Sudan where prolific oil discoveries have been made.

32. The Basin extends towards Lake Turkana and is separated from Mandera and Lamu Basins by the NW-SE trending Lagh Bogal fault and ENE – WSW trending Garissa – Walmere basement high inferred fault respectively. The total surface area of the Anza Basin is about 94, 220 sq. Km the deepest well drilled in this basin to date reached a total depth of 4, 392km.

(a). Reservoir rocks

33. Characteristics in this basin comprise of Cretaceous to Tertiary fluvio-lacustrine deposits together with upper Jurassic marine deposition. Intermittent volcanics occur.

34. Source rocks identified in this basin comprise of lower Cretaceous gas prone one and an upper Cretaceous lacustrine oil prone source rock. An Upper Cretaceous lacustrine source rocks has been identified on the horst structure drilled as Sirius-1 well and paraffinic oil has been recovered in DST.

(b). Source Rock Analysis

Chalbi Sub-Basin

- 152m thick
- TOC: 1-4%
- HI: 250 – 400
- Oil prone

Meri Sub-Basin

- 300m thick
- TOC: 1-3%
- S2 value>2

- Oil prone

Yamicha Sub-Basin
- 200m thick
- TOC: 1-6%
- HI: 50 – 200

Oil and gas shows have been encountered in seven out of the eleven wells drilled in this basin to date.

iii. MANDERA BASIN

35. The Mandera basin originated as a late Paleozoic rift extending from Kenya Northwards to the Ogaden basin of Ethiopia and Somalia. The Basin covers an area of 51, 920 sq. Km with Lagh Bogal fault forming the boundary in the southwest, Precambrian shield in the west and Daua river in the north. Extensive gravity and magnetic data have been acquired and 2,233 Km of seismic data recorded.

36. The stratigraphy of the Mandera Basin is divided into six megasequences (Precambrian Basement to upper Cretaceous) bounded by major boundaries that record punctuation in rifting and subsidence during the depositional history of the Basin. Two main structural trends occur: NNE SSW trending structures parallel to and controlled by the strike of the Karoo Graben, and NNW – SSE trending structures follow a strike parallel to the Lagh Bogal Fault.

(a). Source Rocks

37. An oil seep at the Tarbaj Hill is considered to originate from Liassic pre-evaporite Laminites which migrated laterally into lower sands. Burmah Oil (Kenya) Limited

concluded that specific Toarcian to Kimmeridgian shales intercalated in the marine Murri limestones and Didimtu formations contain potential source rocks. The Elgal shale in the Mandera Basin is correlated with their age equivalents in the Ogaden Basin. This Permian Bokh shale may have been the source for the calub gas field in Ethiopia.

(b). Reservoir Rocks

38. The Marls, claystones and mudstones interbedded with the carbonates of the Seir and Dakacha formations could provide good reservoir rocks. Also, the tidal channels sandstones and siltstones of the Golberobe and Danissa formations have good reservoir characteristics.

(c). Exploration Plays

39. Exploration plays in the Mandera Basin are confined to lower Jurassic, middle to Upper Jurassic and lower Cretaceous. Jurassic and Early Cretaceous sediments are rolled over against a series of NW-SE faults to form several anticlinal features, which are regarded as structural exploration leads.

iv. TERTIARY RIFT BASINS

40. The Tertiary Rift has five Sub Basins, these are:-

- Lotikipi Sub-Basin — Block 11
- Turkana Sub-Basin — Block 10B
- Kerio Trough — Block 12A
- Nyanza Trough — Block 12B
- Magadi Trough

41. Rifting in the Tertiary area has been controlled by several major south trending faults. Some of these master faults have had long periods of activity, or were reactivated. The Basin has a total area of 7, 652 km of Seismic data, Aeromagnetic more than 151, 198 km and 12,313 gravity stations. In the North of the Tertiary Rift Basin, two wells have been drilled, namely the Eliye Springs-1 and Loperot-1 wells.

(a). Reservoir Rocks

42. Reservoirs are present all along the section of the Eliye Springs-1 well with porosities ranging from 25 to 30 per cent in the best sandy intervals. In Loperot-1 well where oil shows have been reported, two potential reservoir intervals have been identified: the oil sandstones of lower/middle Miocene age (total thickness 123 m, net reservoir 26 m, effective porosity 16%) and the main reservoir are sandstones of Oligocene/lower Miocene age (total thickness 397m, net reservoir 280 m and effective porosity 11%).

(b). Source Rocks

43. Source Rocks are present in Lokichar Basin with excellent characteristics at levels of Lokhone shales. Geochemical modeling studies prove to have reached the oil window. Early mature source-rocks have also been found in the North Kerio Basin, TOC values of upto 5% Loperot shale whilst probably mature source rocks are possibly present in the thick sedimentary section of the Lake Turkana. The Basin has thus:

- Good mature source rocks, working petroleum system.

(c). Trapping Mechanism

44. Trapping Mechanisms are related to faulted structural closures. Several prospects and leads have been defined, among them the large lobster structure (20 sq. Km) in the North Lokichar Basin. Many of the leads can be converted into prospects after additional seismic shooting. Valuable targets remain to be tested mainly in the Lokichar and Turkana Basins. The only one structure which was tested (Loperot-1) has no structural closure. Therefore oil indications and prolific Lokhone source rocks make numerous structural possibilities attractive.

v. LAMU BASIN

45. The Lamu Basin formed during rifting associated with the breakup of the Gondwanaland. It is the failed arm of rifting that resulted in the opening of the West Somalia Basins in the upper Jurassic to Cretaceous. The continental margin formed as a combination of extension and strike-slip motion as Madagascar moved south along the Davie Fracture Zone. The basin covers both onshore and offshore with an aerial extent of 132,720 sq.Km and sediments thickness ranging from 3km (onshore) to 13km (offshore). Offshore sediments consist of marine sandstones, shales and carbonates and range from the Karoo through tertiary while onshore sediments vary from continental-rift basin sandstones and shales of the Karoo to fluvial- deltaic sandstones, marine shale and platform carbonates of the Jurassic through Tertiary sections.

46. The stratigraphy is divided into four megasequences (Karoo-Jurassic, Cretaceous - Early Paleocene, Paleocene-Eocene, and Miocene-Recent) separated by

regional unconformities. The unconformities are related to a series of tectonic pulses that resulted in the development of new structures and periods of increased subsidence.

Fifteen (15) exploration wells have been drilled in the Lamu basin with several oil and gas shows.

(a). Source Rocks

47. The Lamu Basin has good source rocks which have yielded type III to type IV Kerogen (gas prone. these include Jurassic oilitic Limestones and lacustrine shales with an average TOC of 1.4%.

(b). Reservoir Rocks

48. On the coastal onshore area of the Lamu Basin, potential reservoirs exist in the Jurassic carbonate sequence (limestones). The Eocene to Oligocene deltaic clastics and shelf carbonate facies underlying the present coastal area also constitute good prospective reservoirs while the Lamu reefs are potential reservoirs targets in near-shore and offshore. 3.1MCF/D of gas recovered in Dodori Well. The reservoir is 40m thick Paleocene Sands. In Pandagua Well, 12.7MCF/D gas was recovered during DST in about half an hour.

(c). Seals and Trapping Configurations

49. The shales provide adequate sealing potential and characteristic traps are mainly block faulted anticlinal structures with associated antithetic faults.

PETROLEUM POTENTIAL OF LAKE TURKANA AREA

i. GEOLOGICAL OVERVIEW

50. The East African Rift system forms a narrow (50 – 150 Km wide), elongated system of normal faults that stretches some 3, 500km in a submeridian direction. It is connected to the world wide system of oceanic rifts via the Afar Triangle to the Gulf of Aden and the Red Sea.

51. The East African rift system is composed of two rift trends called the Eastern and Western branches. The two branches have undergone different tectonic histories. Both are characteristized by large half graben systems filled by up to 7 – 8 km thick fluvio-deltaic and lacustrine sediments, and /or by volcanics and volcaniclastics. In comparison with the eastern branch initiated probably in the Eocene, the western branch is younger (late Miocene –recent) and less volcanic – rich. The extension estimates for the eastern branch depend upon location, but is up to 40 km (Turkana area), While the maximum extension in the western branch is only about 10 – 12 km.

52. The Kenya Rift develops in the eastern branch of the East African System (EARS). Major extensional faults in the Kenya rift define separate basins with distinctive structural and geological settings. Rifting in the Turkana basin area has been controlled by several major North – south trending faults some of these master faults have had long periods of activity, or were reactivated.

53. The Turkana area boost past exploration hence there exist Well data of Eliye Springs – 1 and Leporot – 1 drilled by Shell in 1992. the reports on the potential of the basin by Shell and Amoco, about 2,000 km of Seismic Data , partly reprocessed and available on landmark system, Gravity Data, geophysical and petrophysical results of 2 Wells, among others.

54. Lake Turkana Area is sub divided into four basins with unique exploration opportunities, namely: -

i. Lokichar basin (North and South)

The basin has good mature source rocks, working Petroleum system, fair to good structures and leads (lobsters structure-20 sq. km, 5 leads), an area of about 4,600 sq. km. the basin requires more tests and further explorations.

ii. Kerio basin

Kerio basin has thick sedimentary sequence, complex structure with possible strong volcanics in Miocene, non-proven mature Kitchen and large leads or structures. It covers an area of about 1,500 sq. km.

iii. North Kerio/south Turkana

Covering an area of about 3,900 sq. Km, it is fair but young source rocks with no proven Petroleum system, Moderate and young sedimentary section. The basin also has good structures and 6 main leads.

iv. Lake Turkana (Central and North)

The basin covers an area of 6,700 sq. Km with young source rocks of Eliye that are probable

reservoirs and seals with 2 structural leads though unknown petroleum system hence needs further exploration and seismic acquisition.

vi. Petroleum Potential

55. The Lake Turkana area draws it potential from:-

a) Reservoirs

They are present all along the section of the Eliye Springs -1 well with porosities ranging from 25 to 30 percent in the best sandy intervals. In the Loperot -1 well where oil shows have been reported, two potential reservoir intervals have been identified; the oil sandstones of lower/middle Miocene age (total thickness 123m, net reservoir 26m, effective porosity 16 %) and the main reservoir sandstones of Oligocene/lower Miocene age (total thickness 397 m, net reservoir 280 m and effective porosity 11%).

b) Source Rocks

Source rocks are present in the Lokichar basin with good to excellent characteristics at level of the Lokhone shales. After geochemical modeling studies, they are proven to have reached the oil window. Early mature source rocks have also been found in the North Kerio basin, TOC values of Loperot shales and others whilst probably mature source rocks are possibly present in the thick sedimentary sections of the Lake Turkana basin.

c) Trapping opportunities

Trapping opportunities are related to faulted structural closures. Several prospects and leads have been defined, among them the large Lobster structure (20 sq. km) in the North Lokichar basin. Many of the leads can be converted into prospects after additional seismic shooting. Valuable exploration targets remain to be tested (Loperot – 1) has no structural closure. Therefore oil indications and prolific Lokhone source rocks make numerous structural possibilities attractive.

PETROLEUM POTENTIAL OF ANZA BASIN SYSTEM

i. GEOLOGICAL OVERVIEW

56. Anza Graben is part of the Cretaceous rift system of East Africa and has an area of 99, 220 sq.km and forms part of the Central Africa rift system that includes Muglad Basin in Sudan.

ii. Structural Evolution of Anza Basin

57. The Anza Graben is a continental failed rift and part of Cretaceous – Paleogene rift system. The maximum sediment thickness is up to 10km of mainly continental deposits.
The Basin has 3 sub-Basins:

- South;
- Central; and
- Chalbi

Each of the sub-Basins has different structural histories.

iii. Exploration History of the Anza Basin

58. There has been continued exploration of wells in the Anza Basin i.e. Anza and Bahati Wells where resulted in gas shows, the depth being 3,662m and 3,420m respectively. The geophysical data include a 2D seismic data of 14,362 km, Aeromagnetic data of 64,061 km and Gravity data of 15,096 km.

iv. Stratigraphy of Anza Basin

59. The stratigraphy data show that the Basin has deposition of sandstones shales in fluvial/lacustrine environment hence Cretaceous. The tertiary are a depositional of lacustrine, fluvial and deltaic sediments.

(a). Potential Reservoir:

60. There exist good porosities in Tertiary and Cretaceous fluvial sequence; the porosity values are of up to 30% and permeability of up to 223mD (outcrop samples).

In Sirius-1 well, porosity in the potential reservoir zone is 19-32% and in the Bellatrix-1 well, porosity is up to 20%.

(b). Hydrocarbon Occurrence

61. There exist in the lower Cretaceous Classics flowed gas during DST in the Ndovu-1 well with tany oil associated with water in Sirion-1 well. Gas shows in the lower Cretaceous sands and oil shows/fluorescence/Staining in asptian sands also in Ndovu-1 Well.

There also exist oil shows in the Paleogene in Hothori-1 Well and Miocene to Cretaceous in Chalbi-3 Well.

v. Conclusion

62. The source rocks and reservoirs in the Anza Basin and play types exist in the Jurassic – Dogogicha Antifoam, tilted blocks and Southwest Margin, Cretaceous play-flanks of Matasade High and Stratigraphy traps and sand bars associated with shales.

The TOC values fort he potential sources interval in Wells drilled in the Anza Basin range from 1 to 6%.

The organic matter is mainly oil-prone and porosity in the potential reserves is up to 29%.

Why frontier investment in Kenya?

63.

- Political stability with positive investment climate;
- Large frontier (onshore and offshore) acreage;
- Competitive commercial terms;
- Acceptable balance of risk or reward;
- Previous exploration data readily available;
- Low entry cost, no signature bonuses;
- Award focuses on work programme;
- Provides investor with growth opportunities.

CONFERENCE PRESENTATIONS

INTRODUCTORY REMARKS

Hon. Nuwe Amanya Mushega, Secretary General of the East African Community.

67. The presence of political leaders in the Conference symbolizes the political commitments of the partner states to the regional integration process. The EAC partner states are in the process of causing the region to have enhanced, equitable and mutual benefits as the custom Union is operational and more opportunities are up for the East African to contribute to the development of the region.

68. The Second international Conference on Petroleum Potential and Investment opportunities in East Africa organized by the East African Community is as result of the success of the First Conference held in March 2003 in Nairobi and has seen increased exploration and promotional activities in the region.

69. The aim of the EAC as is stipulated in the Treaty is to promote sustainable utilization of natural resources of the partner states, this joint exploration and exploitation of the potential in the petroleum sub-sector has been agreed upon to tap and maximize the investment opportunities.

70. East Africa is endowed with vast mineral and other resources which are under exploited and the EAC is committed to fast track the promotional of the East Africa region as a single market and investment area.

71. The importance of oil in the regional and world economy cannot be overemphasized, the turbulence experienced after oil prices in the world market fluctuate, thus need for this conference which creates an avenue for dialogue towards stepping up exploration and development of East African petroleum potential.

PRESENT AND FUTURE TRENDS OF THE EAST AFRICAN COMMUNITY

Dr. KIPYEGO CHELUGET, Deputy Secretary General, Projects and Programmes, EAC Secretariat

72. The broad goal of East African Community (EAC) is to widen and deepen cooperation among partner states in political, economic, social and cultural fields, research, and technology, defence, security, legal and judicial affairs for their mutual benefit.

73. There is great interest in the region today for widening and deepening the regional integration and development process. Two Protocols have been signed: The Protocol on the Establishment of the East African Community (EAC) Custom Union, which is the integral and entry point of the community, was signed in March 2004, and it commenced on January 1, 2005. The Protocol for the Sustainable Development of Lake Victoria Basin Commission as a body charged with the management and development of the Lake Victoria Basin.

74. The commencement of the EAC Customs Union put the regional integration process on a new level and it will lay a firm foundation for establishment of the Common

Market, the second phase of the EAC integration process.

75. The Second EAC Development Strategy (2001-2005) focused on the implementation of ongoing regional projects and programmes; and the establishment of the East African Community Customs Union. Preparation of the EAC Development Strategy for 2006-2010 is ongoing.

76. Significant achievements have been made, in confidence building measures and harmonization of Partner States' Policies and Programmes. These include the easing of cross-border movements with, among others, the introduction of the East African Passport.

77. Other positive measures include the convertibility of East African currencies, progressive reduction of tariffs and revival of regional co-operation in research, human resource, science and technology development. Co-operation in political affairs involve activities in the areas of legal and judicial affairs, regional defence and security and co-ordination of foreign policy.

78. The positive development taking place within the region are indicative of the right path being pursued by the EAC in the integration and development process. The people in the region are looking at the period head with great expectations and the realization of tangible benefits of regional integration. They look forward to the dawn of a new era of progress and prosperity.

AFRICA'S EXPLORATION AND PETROLEUM FUTURE

DR. DUNCAN CLARKE, Chairman and CEO Global Pacific and Partners

79. The African Continent is diverse in geo-political, strategic and geo-science character, with many States at different stages of their exploration and development cycle. As a whole, Africa is experiencing an oil and gas renaissance, with high growth in hydrocarbons discovery and new ventures, while much frontier opportunity remains, and new basins have been opened – plus many others (both interior and in deepwater) remain to be tested in the future. More and more countries have opened up acreage opportunity, run Bid Rounds, made Awards, attracted players and induced new exploration interest – in the Maghreb, West Africa, Southern Africa and now increasingly in the Eastern African plays onshore and offshore.

80. Indeed, on a global basis Africa has become the destination of choice for numerous worldwide Independents and the key Super-Majors that have much upgraded investments in fields, development projects, gas-LNG as well as now in exploratory new ventures. Likewise, Africa has attracted the focus on its own National Oil Companies, some stepping-out from traditional domestic environs, as well as many others from foreign States around the world, not just those from Asia that have steadily targeted African oil and gas assets and projects. The forward 25-year upstream cycle for African oil and gas is highly positive, and this will offer a platform for building Africa's economic and social future. There does exist

some critical issues and constraints to be dealt with to make all this happen and for maximal benefit to be derived. Governments in Africa can do a great deal still to improve the opportunities that exist or can be placed on the primary and secondary asset markets.

81. Given that competitive options and potential exist worldwide (e.g. In Latin America, Asia and Middle East), African States need to ensure that this vital window for investment capture is not narrowed. New strategies of partnership, competitive contracts and fiscal terms, systematic openings in prospective acreage, imaginative deal-making, reshaping of National Oil Companies, independent licensing, and active portfolio management, will provide tools for Africa to secure its best hydrocarbons and economic future.

EXPLORATION STRATEGY IN A VIRGIN BASIN –THE ALBERTINE GRABEN

MR. BRIAN SMITH, Vice president Exploration and Production, Heritage Oil and Gas Limited

82. Heritage licensed Bock 3 in the Albertine Graben of Western Uganda in 1997. The Ugandan Government had previously acquired gravity and magnetic data and carried out geological fieldwork that complimented historical fieldwork, and also a shallow exploration well had been drilled in the basin during the 1930's. But to all intents and purposes the Albertine Graben represented in 1997 the very unusual phenomenon of a 'virgin basin.'

83. Starting with geological fieldwork and moving on in 1998 to acquire the first ever seismic data in Uganda, Heritage has steadily progressed its exploration work programme in the Albertine Graben. This work programme has included further 2D seismic surveys, including transition zone seismic data acquisition on Lake Albert and in 2004 Heritage drilled its third well in the basin and acquired an extensive 3D seismic programme. Also in 2004 Heritage both re-licensed Block 3 and licensed Block 1 to the north, in order to further consolidate its acreage position in the Albertine Graben.

84. This ongoing exploration work programme has meant that over the years much has been learnt about this previously virgin basin, and it has been determined that the Albertine Graben contains all the essential elements to make it highly prospective for hydrocarbons. However, the recent production testing last year of heritage's third well has highlighted the risk of carbon dioxide in the basin, which has caused Heritage to re-focus its future exploration strategy.

"RIFT" DEVELOPMENT AND NEW PLAY CONCEPTS

DR. JOHN ROSE, Chief Geologist, Heritage Oil and Gas Limited.

85. The use of seismic data in combination with satellite imagery, field geology and subsequent drilling has lead to a very good understanding of the subsurface structural configuration and the structural/depositional history of the Albertine Graben. Prior to seismic acquisition and drilling, the

structures of the Albertine Graben were expected to be predominantly extensional in origin, developed on normal faults parallel to the basin margin and on transfer zones which may have a lateral, fault component. However, subsequent to acquiring and interpreting seismic data it is clear that the normal fault component is negligible and the basin is shown to have a strike-slip origin developed on conjugate shear trends.

86. Seismic interpretation reveals a number of prospects developed as transpressional rollovers adjacent to and often modified by well-developed flower structures. The tectonic model which gives rise to this configuration is interpreted to arise from an east-west compressional environment caused by Atlantic and Indian Ocean ridge push. Development of the nearby Rwenzori Mountains is thought to have resulted from the strike-slip tectonics.

87. Outcrop and well data confirms that world-class reservoirs may be found throughout the basin and drilling has proven the presence of multiple, oil mature, source rock intervals. The presence of all of the elements required to form a working hydrocarbon system confirms the Albertine Graben as an exciting exploration area.

PETROLEUM SYSTEMS OF EAST AFRICA: PROSPECTS FOR OIL AND GAS

DR. DANIEL M. JARVIE, Humble Geochemical Services

88. Various basins in East Africa have petroleum prospectivity based on the presence of functional

petroleum systems. A petroleum system consists of components and processes and requires complementary timing of events for commercial amounts of oil or gas to be discovered. Evidence of these systems is found in Kenya, Madagascar, Tanzania and Uganda.

89. Expression is via source rocks (e.g., Loperot 1 well in the Lokichar Basin, Kenya), surface seeps (all countries), and recovered oils and gases (e.g., DST oils from Kenya, Songo Songo condensates and gases).

90. Availability of source rocks such as the thick, lacustrine Type I source rocks of the Loperot 1 well in the Lokichar basin as well as the seeps recovered in Kenya, Madagascar, Tanzania, and Uganda allow measurement of the rates of organic matter decomposition. (Kinetic parameters) into oil and gas. Immature source rocks are typically used for such analyses, but asphaltene fractions from oils or seeps are excellent analogs for determination of rates of decomposition. Knowing these rates allows prediction of the timing of hydrocarbon generation under a given burial history. Further, data from partially to moderately biodegraded seeps can be used to infer source rock lithofacies. However, more severely degraded seeps can be matured in the laboratory to generate an oil such as would have been present prior to biodegradation.

100. Comparison of the DST oil from the Shell Loperot 1 well is shown to be similar to oils from the south-central portion of Sudan. Thus, while the Loperot well was a stratigraphic test, other locations in the

Lokichar Basin have much higher thermal exposure and temperatures. Thus, the critical factors become reservoir quality, seal, and trap size.

101. Songo-Songo condensate samples were fingerprinted by high resolution gas chromatography as well as for biomakers. Although the higher molecular weight hydrocarbons are largely absent, aromatic biomakers were used to infer source rock lithofacies. From these data it is suggested that the Songo-Songo condensates are derived from a marine source rock. The light hydrocarbons data suggest that these condensates are part of a fractionated oil system that escaped with gas exsolution from a deeper source or oil pool.

102. Additional work needs to be completed on seeps from these countries to identify, not only likely source lithofacies, but also to use the seep asphsltenes to obtain kinetic parameters for construction of models of hydrocarbons generation and expulsion. Additional work can be used to mature these asphasltenes in the laboratory to assess type of products that would be generated at various levels of thermal maturity.

103. These data suggest that there is high prospectivity for oil in both onshore and offshore basin in these East African countries and future exploration will ultimately tap into these resources.

THE POTENTIAL OF THE ANZA GRABEN SYSTEM.
MR. JOHN EGO, Senior Geologist, National Oil Corporation, Kenya (NOCK).

104. The Anza basin in Kenya is considered to be one of the series of Cretaceous Tertiary failed rifts that trend across the Central Africa Craton from Benue Trough in Nigeria through Chad, the Central African Republic, Sudan and Kenya. The Anza basin in bounded by three segments namely the South Anza basin; the North Anza basin and the Central Anza basin, each of the sub-basins have different structural and stratigraphic histories.

105. Analogue of the Anza basin is the Muglad basin of the Sudan where the oil discoveries have been made. To date 11 exploratory wells have been drilled in the Anza basin with indications of oil and gas, most of the wells penetrated the Cretaceous fluvial lacustrine sediments.

106. In the Sirius-1 well source rocks were identified in the upper Cretaceous with TOC content of over 5%. The potential source in the Sirius well is lacustrine mainly of algae origin and the thermal maturity is interpreted to be in the early oil window. Repeat formation tests in the Upper Cretaceous sediments of the Sirius –1 well produced small amount of paraffinic oil. Good porosity in the well occurred in the Paleogene and Upper Cretaceous with fair porosity in the Lower Cretaceous sediments.

107. Trap types anticipated in the Anza basin are associated with the Cretaceous rifting. The Lacustrine shales may provide source rock in the basin. Sediments south of the Anza basin contain marine incursions and possibly have mature source rocks, which are currently within the oil or gas window.

108. The exploration play trends identified in the Anza basin are echelon anticlines within the Lower Cretaceous and Stratigraphic traps in cretaceous sands associated with lacustrine sources.

THE NEW DEEP WATER PLAYS IN EAST AFRICA

MR. WAYNE CLARK, International Exploration Manager, Woodside Energy Ltd.

109. The East African Margin in its entirety is an under explored province. In particular, exploration in the deepwater areas has to date been largely limited to the acquisition and interpretation of regional two-dimensional seismic data sets. The Simba-1 well, drilled in Kenya in 1977, has been the only drilling foray into the deeper basins.

110. Interpretation and analysis of these seismic data, recent drilling results and the increasing need to test unproven hydrocarbon provinces to provide additional global hydrocarbon reserves, has led to a renewed interest in the East African margin as a frontier exploration opportunity. This has been evidenced by the growth in larger players entering the region. Industry activity over the last few years includes PetroBras and Shell in Tanzania, Exxon-Mobil/Norsk Hydro in Madagascar, Petrobas in Mozambique and Woodside in Kenya.

111. Woodside's interest in East Africa was sparked after a regional study of the entire margin from South Africa to Kenya, including Madagascar was undertaken in 2002. Given the immature nature of this frontier

exploration acreage, technical risks, particularly for charge, are still seen as being relatively high. However, the upside potential of some identified petroleum plays was seen as being significant.

112. The study revealed that the East African margin, in general, is highly structured with a large range of potential trapping mechanisms. These include multiple episodes of thin and thick-skinned extension and compression, oblique slip and salt related structuring. Reservoir presence has been proven by drilling on the continental shelf and seismic evidence suggests that deepwater reservoir systems have been deposited off the margin. The key risk that remains, particularly for the deepwater basins, is the existence of a working hydrocarbon charge system.

113. Woodside's entry into East Africa in 2003 was initiated with the decision to earn equity in seven offshore Production Sharing Contracts in Kenya covering approximately 70,000km2. The strategy of securing large tracts of acreage, with a view to high-grading the most prospective areas is a replication of Woodside's successful entry into offshore Mauritania in 1998. As with Mauritania most wells drilled in the 1970's and 80's were dry, despite numerous good hydrocarbon shows. In addition, no modern exploration techniques have been employed in the offshore basins for over 20 years to take advantage of improved technology.

114. Woodside is the first company in this recent phase of exploration to commit to drilling a deep-water well. We believe that, if successful, this well could herald a new

era of petroleum exploration activity not only for Kenya but the whole East African margin.

PROSPECTIVITY OF THE DEEP-WATER MARGINS OF TANZANIA AS REVEALED FROM RECENT SEISMIC SURVEYS

DR. M. J. COPE, Reservoir Services Western Geco, Schlumberger

115. The deep-water margin of Tanzania extends over some 600km and includes a number of prospective passive margin sedimentary basins. New seismic data over the deepest parts of these basins have revealed more extensive sedimentary sections and more complex tectonics than previously recognized.

116. These basins have been fed by sediments from the Rufiji and Ruvuma river systems for most of their history and consequently the potential for reservoir development is high. Effective reservoirs are interpreted to be present in the Upper Cretaceous, Paleogene, Miocene and Pliocene developed as sand-prone deep-water facies sediments.

117. Significant Neogene tectonic activity has been responsible for the development of a variety of extensional and compressional structures, which provide a number of potential exploration targets. The prospectivity of some of these structures will be reviewed in this presentation.

118. The coastal basins of this margin host several significant gas discoveries and a number of surface oil seeps together with Jurassic and Cretaceous oil-prone

source rocks. Maturity modeling of offshore areas indicates that some of these source rocks are within the oil window at the present day and can charge as yet undiscovered oil plays in the deep-water marginal basins.

TECHNOLOGICAL CHALLENGES FOR THE DEVELOPMENT OF ULTRA-DEEP WATER FIELDS.
MR. JACQUES BRAILE SALIES, R&D Programme Co-ordinator, PetroBras, Tanzania.

119. In 2003, the Petrobras recorded a strong 14% growth in domestic reserves development. Of these reserves, 56% came from water depths between 300 and 1,500 WD and 5% from beyond 1,500m WD. The majority of this activity is located in the Campos Basin with the area holding 79% of the proven reserves (12.6 billion boe) and producing 81% of the total production, 1,791 million boe/d.

120. In view of these statistics, the consideration that the future of Petrobras is tied to the production of ultra-deepwater reserves is indisputable. The company anticipates an estimated domestic production rate of 2.3 million boe/d by 2010, the majority of which will come from this area from deep and ultra-deepwater.

121. To be able to overcome this challenge Petrobras has invested heavily for many years in the development of new technologies for deep and ultra-deepwater. This paper will present some new technologies such as: tethered riser buoy, torpedo wellhead base, MONO BR, multiphase pumping. The paper shows all the design

development, testing, and field trials in the Campos Basin for those new developments.

PETROLEUM POTENTIAL AND INVESTMENT OPPORTUNITIES IN KENYA

MRS. MARY KIMOTHO M'MUKINDIA, Managing Director, NOCK.

122. Kenya has four major sedimentary basins namely Lamu onshore and offshore, Anza, Mandera and the Tertiary Rift. In Lamu basin, several hydrocarbon prospects have been identified and offshore drilling in the licensed blocks is expected in late 2005.

123. Drill Stem Tests carried out on two wells drilled in the Lamu basin tested gas deposits of 3.1MCF/D in Dodori well and 12.7MCF/D in Pandangua well. Recent details project Block L-4 to be one of the most attractive onshore blocks in the Lamu basin due to its gas potential. The ongoing exploration work in the leased blocks offshore Lamu basin has greatly improved the hydrocarbon potentially of the basin.

124. In Anza basin source rocks within the Upper Cretaceous and Lower Cretaceous intervals have been identified in Sirius-1 well, where paraffinic crude oil and natural gas were recovered. Anza basin is believed to correlate with the Muglad Rift Basin of South Sudan where prolific oil discoveries have been made.

125. The Tertiary Rift basin comprises of several sub-basins and the hydrocarbon potential is dependent on individual sub-basins. The basin is relatively under explored with low grid seismic coverage and only two

explanatory wells (Loperot 1 and Eliye spring's wells. In Lodwar South basin sub basin, the existence of two excellent source rocks was proved by the Loperot-1 well drilled in the sub basin where oil recovered during a drill stem test had an API of 29.

126. In Mandera basin, shales intercalated with limestone are potential source rock while marls; claystones and mudstones interbedded with carbonates provide good reservoir rocks. In Mandera basin, an oil seep was reported at Tarbaj Hill. The Mandera basin is virtually under-explored by exploratory wells (Elgal-1 & Elgal-2) and seismic line and vast opportunities remain to be exploited.

127. The presence of the Tarbaj Hill oil seep in Mandera basin and the high total organic carbon content and the favorable thermal maturity in several intervals penetrated by wells in Lamu, Anza and Tertiary rift is good indicator that Kenya sedimentary basins have hydrocarbons potential and that further exploration is required to discover this potential.

128. The Kenya sedimentary basins are divided into 21 exploration blocks. Seven of the offshore blocks are currently leased to oil companies and drilling in the offshore is expected in late 2005/2006. Exploration investment opportunities exist in the 13 open onshore and one offshore block. Kenya has flexible, quick transparent open licensing system with fast data bank to refer to. All the exploration data (seismic lines, well logs & reports, core cuttings, aeromagnetic, gravity, reports,) acquired in the country from the 1960's to date are available to exploration companies.

129. The fiscal and legal regimes for exploration and production investment in Kenya are attractive and are governed by the Petroleum (Exploration and Production) Act of 1986. The Act also includes a model Production Sharing Contract (PSC). The terms for negotiation in Kenya are internationally competitive, flexible and realistic to investors and are based on the prospectivity and terrain of the exploration area.

LEGAL AND FISCAL FRAMEWORK ON PETROLEUM EXPLORATION AND PRODUCTION IN KENYA: A CRITIQUE.

MR. DON R. O. RIAROH, Chief Geologist, Ministry of Energy, Republic of Kenya.

130. Kenya is actively involved in hydrocarbon exploration through which it aims to change its current status, whereby it imports crude petroleum and related finished products. This importation accounts for nearly 20% of Kenya's annual import Bill. This paper presents an analysis and evaluation of the Legal and Fiscal Regimes obtaining in the country. It provides important information that may act as a guide to potential investors in Kenya.

131. The primary focus of this presentation is to show that Legal and Fiscal Regimes were developed in Kenya with the view of providing incentives, and for creating a conducive and encouraging environment for stimulating investment in Kenya.

132. The administration of the Legal and Fiscal framework and the conduct of Petroleum Operations are discussed in the Paper. Fiscal provisions on Taxation, Exchange provision are also highlighted. Aspects pertaining to ownership, access to land, compensation and arbitration of disputes have also been discussed. A brief background on past exploration initiatives is discussed as a basis for consideration of the limitation of these regimes. The Paper concludes by noting that the flexibility of the Production Sharing Contract (PSC), which encourages negotiation of nearly all aspects of the contract including, such important aspects as minimum work obligations, financial obligations, recovery of investment costs (Cost Oil) and Profit Oil equities etc, act as an important incentive that will continue to attract investment in Kenya, for a long time.

THE POTENTIAL AND DEVELOPMENTS IN UGANDA'S UPSTREAM PETROLEUM SECTOR

MR. ERNEST RUBONDO, Assistant Commissioner, Petroleum Exploration and Production Department, Uganda

133. Aeromagnetic surveys carried out in Uganda revealed the presence of four sedimentary basins namely; the Albertine Graben, Hoima Basin, Kyoga Basin and Kadam-Moroto Basin. Subsequent geological mapping together with ground gravity and magnetic surveys indicated that the Albertine Graben is most prospective in consideration of its depth to basement, source rock and oil generation potential together with reservoir development. The Graben was later subdivided into five Exploration Areas based on geometry of the basins identified therein.

134. Data acquired during these surveys has been used to promote the Albertine Graben to the industry resulting in the licensing of three out of the five Exploration Areas. Heritage Oil and Gas limited Energy Africa (now Tullow Oil) and Hardman Resources Ltd. Are currently holding acreage in the Graben. These companies have progressed the search for oil and gas in the country by investing in the acquisition of seismic data both on shore and over Lake Albert.

135. The seismic data has confirmed the presence of depocentres with sediment thickness in excess of 6km in the Graben, and drillable prospects have been mapped across the area where the data was acquired. Interpretation of the data has demonstrated that extension and thrust tectonics have combined to generate traps with the potential to hold large hydrocarbon accumulations.

136. Test drilling of one of the prospects, TURACO, encountered hydrocarbons at several depths. The wells also penetrated over 500 metres of high quality lacustrine source rocks. High quality reservoir sandstones with porosities of over 30% and permeabilities of up to 1.5 Darcies outcrop in the Semiliki basin and sandstones with similar characteristics have also been encountered at depth. Subsequently good flow rates were achieved in a drill stem test recently undertaken. The test also indicated the presence of carbon dioxide at one level of the prospect.

137. The presence of a petroleum system in the Albertine Graben has been confirmed together with the potential for significant hydrocarbon accumulations. The licensed companies are pursuing this potential by evaluating the mapped prospects in their respective acreage. Two exploration Areas in the Albertine Graben are yet to be licensed although expression of interest for their acquisition has been received.

PETROLEUM GEOCHEMISTRY OF THE ALBERTINE GRABEN

MR. AMEED GHORI, Senior Geologist, Geological Survey of Western Australia, Messrs. S. ECHEGU, J. LUKAYE, and C. B. IRUMBA, Petroleum Exploration and Production Department, Uganda.

138. The Hohwa, Kibiro, Kibuku and Paraa oil seepages indicate active petroleum systems within the Albertine Graben, yet their source and likely charge volume remain elusive. Biomarkers and carbon isotope data from these seepages indicate varying maturation, biodegradation, and source maturity, but all are sourced from lacustrine source pods possibly of Cretaceous Tertiary age but older sources are possible. The interpretation of these data is complicated due to high level of biodegradation and differences in analyses carried out, as well as varying sampling and analytical procedures by different laboratories.

139. Total organic carbon determinations (164) headspace-gas analyses (128), and paleontology (5) of cuttings samples from Turaco-1 are first subsurface source rock data from the Albertine Graben. Organic-rich shale beds are present between 1965 – 2110 m and 246 –52487 m within the Upper Miocene Kasande-

Kakara Formation. Organic richness of these beds is up to 4.8% TOC and palynofloras from four samples indicate a mature, non-marine, oil-prone lacustrine facies of Miocene age. The cumulative thickness of source beds within the upper Kasande-Kakara Formation is about 115 m, whereas over 22m are present in the lower part of the unit in which Turaco 1 was terminated at 2487.7 m.

140. These organic-rich shale beds demonstrate the presence of a high quality oil-prone source within the basin, which are in the early stages of the oil-generative window in Turaco 1. Such beds could have generated significant quantity of oil and gas in deeper parts of the basin, where they should be at peak maturity, and imply a Miocene petroleum system within the Albertine Graben.

THE LEGAL AND FISCAL REGIMES FOR PETROLEUM EXPLORATION AND PRODUCTION FOR UGANDA

MR. FRED KABAGAMBE-KALIISA, Permanent Secretary Ministry of Energy and Mineral Development

141. The Government of Uganda has mandated the Ministry of Energy and Mineral Development to administer the legal and fiscal framework for petroleum exploration and production. The main legal framework is contained in Petroleum Exploration and Production Act 1985.

142. This paper discusses incentives for investors in the sector, what is required before the Minister issues a license, reserve ownership, rights and obligations of all

the parties, period of exploration licenses and relinquishment.

143. The Petroleum (Exploration and Production) (Conduct of Exploration Operations) Regulations, 1993 gives operational guidelines on exploration and production, health; safety and environment of reporting mode. The paper also discusses key elements in the model Production Sharing Agreement that include work programme commitments, records, data and inspections, training obligations and employment.

144. The model Production Sharing Agreement highlights the key fiscal terms of royalty, cost recovery, profit oil shares, taxes and surface rentals. The paper concludes by highlighting investment opportunities in the sector, available acreage and incentives extended to investors.

TANZANIA LEGAL AND FISCAL REGULATORY FRAMEWORK FOR THE PETROLEUM SECTOR

MR. BASHIR MRINDOKO, Commissioner for Energy and Petroleum Affairs Ministry of Energy and Minerals.

145. The legal and fiscal framework governing exploration and production in Tanzania is set out in the Petroleum (Exploration and Production) Act of 1980. The Act sets out the framework and procedures under which exploration and development licenses are applied for, granted, extended, modified, cancelled or relinquished. It defines the terms under which the contracts are negotiated. In this context the Act also defines the rights and obligations of all parties involved in the exploration and production of petroleum.

146. The Act defines the administrative and the powers of the Minister and the Commissioner of Petroleum Affairs, including those of formulating regulations. In view of the development of the Songo Songo gas field, new regulations covering the transportation and storage of oil and natural gas are expected in the near future.

TANZANIA'S MODEL PRODUCTION AGREEMENT

MR. YONA S. KILLAGANE, Tanzania Petroleum Development Corporation

147. Tanzania signed its first Production Sharing Agreement (PSA) in 1970 as an amendment to a service agreement that was entered into between the Government and AGIP Spa in 1969. This was done in order to accommodate the Tanzania Petroleum Development Corporation (TPDC) to become a party to the Agreement. TPDC was created in 1969 to oversee, among other things, the exploration operations that were being carried out by AGIP. A decade later, other Production Sharing Agreements were signed following the enactment of the Petroleum (Exploration and Production) Act 1980.

148. The Model Production Agreement (MPSA) was prepared in order to streamline the process of negotiating Production Sharing Agreements with international oil companies and is structured such that companies can easily react to each and every article in the given format and come up with a draft proposal. It allows the standardization of provisions and portrays public transparency.

149. The articles in the Model Production Agreement are negotiable and are intended as a guide providing general direction, which the negotiating parties can follow. The MPSA has been periodically updated in response to changes in laws and also changes in the oil industry climate form the need for relaxed fiscal terms and more recently the opening up of deep sea exploration demanding a completely different legal and fiscal regime. The Tanzanian Model PSA has articles and annexes developed from part three of the Petroleum (Exploration and Production) Act 1980, which is included at the end for reference.

THE GEOLOGY AND HYDROCARBON POTENTIAL OF TANZANIA

MR. KEJO H. KAJATO, Tanzania Petroleum Development Corporation

150. The Tanzanian Sedimentary Basins were formed as a result of several phases of rifting starting with the fragmentation of the Gondwanaland Supercontinent in the late Carboniferous to Permian times. This was followed by Triassic to Lower Jurassic rifting, sea floor spreading in the Bajocian and Lower Miocene rifting. Dominant structural features are the NE-SW Selous fault trend, combined N-S and NW-SE trending Coastal Basin and Modern Rift and the E-W Rufiji fault systems.

151. Associated with these faults are four cycles of stratigraphic sequences separated by major unconformities at the onset of each rifting phase. These are Karoo synrift (Late Carboniferous-Triassic fluvial deltaic and lacustrine and occasional marine,

and fluvial/lacustrine) sediments, Bajocian-Oligocene marine to shallow marine deltaic sediments and turbidities and Miocene to recent marine and continental fluvial-lacustrine sediments. These cycles were also associated with major transgressions and regressions. Thick sediments deposited under different environments have sourced and are believed to have accumulated hydrocarbons in a variety of structural and stratigraphic traps. Source rocks deposited in a rift setting include lacustrine, restricted and semi restricted marine shales deposited throughout the Coastal and inland basins.

152. A number of plays and play concepts have been developed and these are the Rift basin and Passive basin plays, which include those for the Deep-sea forming a special category. The two commercial gas discoveries in Songo Songo and in Mnazi Bay and a good number of live oil seeps and oil shows in wells attest to the presence of active petroleum systems.

ONSHORE GEOLOGY OF SOUTHERN COASTAL TANZANIA: LESSONS FOR OFFSHORE EXPLORATION

DR. CHRISTOPHER NICHOLAS, Department of Geology, University of Dublin, Ireland

153. Over the past seven years a team of International researchers from the U.K, U.5.A., Ireland and the Tanzania Petroleum Development Corporation (collectively known as the 'Tanzania Drilling Project', or 'TDP') has produced a new high resolution integrated bio- and litho-stratigraphy of the onshore mid Cretaceous to Recent sediments of southern coastal Tanzania.

154. This has allowed a re-assessment of the depositional and structural evolution of this margin during the past 85 Ma. Continuous coring of shallow boreholes between Kilwa and Lindi, allied with new detailed field mapping has shown that the sedimentary package is dominated by clays and claystones, punctuated by turbiditic sandstones and benthic foraminiferal event beds. Within this interval there are now several recorded occurrences of oil as traces in Eocene cores, residual spots in Cretaceous outcrop or as oil seeps at the surface.

155. The presence of hydrocarbons at such a high level in the stratigraphic succession is likely to be linked to an abrupt change in structural and depositional style along the coastal zone since the Early Miocene. From this time, the laterally continuous passive margin sequences of the Upper Cretaceous and Paleogene divided into localized depocentres controlled by compressional normal and wrench fault reactivation.

156. Cores across these fault zones demonstrate that oxidizing fluids have percolated along the fractures during or post movement. Thus the faults may have been temporarily sealed or unsealed and allowed remigration of hydrocarbons into higher reservoirs within the seismic 'transparent zone' of Cretaceous and Tertiary clays, or to the surface. Faulting can be demonstrated in the field to have continued up to at least the last 100 000 years or even more recently. The cause of this coastal zone compression is still unclear but may be due to stretching across the East African Rift System causing a corresponding

compressive shearing of the coastal zone against the stationary Davie Ridge offshore.

TRANSPARENCY AND PREDICTABILITY IN PETROLEUM MANAGEMENT

MR. FAROUK AL KASIM, President Petroleum, Norway

157. By international consensus, the ownership and management of natural resources is vested in the host nation where the resources occur. The role of governments is to manage the resources to the best benefit of the nation. In the majority of cases the expertise and risk capital of the oil companies will be required to ensure efficient petroleum operations. The interest of the host country is therefore best served by licensing exploration and production to carefully selected oil companies that have the right expertise and capital to explore for and develop petroleum resources on behalf of the nation. To select the best licensees however, an orderly process of competition among interested oil companies will be required.

158. Open competition will be preferable in most cases. Moreover, it is essential that the rules for competition in the licensing process are clear to all participants. Equally important is the transparency of the licensing process. This is required in order to assure not only applicants but also the public in the host country that the selection process is effective and above all fair. In the final analysis, clarity and mutual trust between the host government and the oil companies are the cornerstones for positive co-operation, which in turn ensure optimum benefit to the host nation.

THE CHALLENGE OF REVENUE MANAGEMENT

MR. SIGBJORN ATLE BERG, Director, Central Bank of Norway

159. Petroleum revenues are not permanent and they are bound to fluctuate over time. Proper management of revenues thus requires both a savings and a buffer function. History has numerous examples of countries that have not been able to manage large resource based revenues to their best advantage. Many have been hit by what is now known as the Dutch Disease, making them worse off after depletion of the resource than they would have been without those extra revenues. Optimal spending of petroleum revenues is a challenging task. It should always be solved as a closely integrated part of a prudent fiscal policy. Countries that spend large revenues independently of core fiscal policy run a very large risk of inefficient use of revenues and of creating instability in the economy.

A REGULATING FRAMEWORK FOR GOOD ENVIRONMENTAL PRACTICES – THE CASE OF PETROLEUM AND ITS PRODUCTS.

PROF. RATEMO W. MICHEKA, PHD, EBS Director General, National Environment Management Authority, Kenya

160. Petroleum is known to have potential significant impacts on air through emissions, contamination of water, soil and food as well as adverse impacts on health including poisoning of food, mental retardation, and cases of cancer.

161. Waste oil/used oil in Kenya is currently disposed in landfills, dumpsites, sewerage systems, water courses/systems, ground and roads. Additionally,

some chemicals found in petroleum are known to have potential significant impacts on the environment and health. For example, persons exposed to benzene often suffer from leukemia. Those exposed to Sulphur dioxide may suffer from asthma. Sulphur dioxide is also associated with acid rain and rusting of iron sheets. Lead is added to gasoline to enhance combustion. When inhaled, lead causes very serious health problems. At high levels it is neurotoxin and can cause blindness, damage the liver and kidneys, brain damage, convulsions, cancer and can even cause death. Even at very low levels lead is a major health hazard to children. It can cause learning disabilities, loss of memory, reduced retention span, and reduced intelligence, hearing loss and hyperactivity.

162. In view of the above health and environmental concerns associated with petroleum, its products and byproducts, their proper management is now a priority concern. Effective management of petroleum and their products is facilitated by development and implementation of appropriate policies, quality standards and regulations. Some of the measures needed are phasing out of leaded gasoline; strict control of air pollution associated with motor vehicles; proper management of waste/used oil; and the need to levy petroleum dealers in order to pay for pollution.

163. These policy and legal instruments are effectively and efficiently implemented by properly configured institutional framework, which must be managed by well trained personnel. There must be an implementation strategy facilitated by a focused managerial team and an enabling political will.

ENVIRONMENT MONITORING

MR. SANJAY GANDHI Director Nutek Solutions

164. One of the primary objectives of undertaking an Environment Impact Assessment (EIA) Study is to minimize the potential adverse impacts associated with proposed projects and to enhance its overall quality. Environmental monitoring during project implementation provides information about key environmental aspects of a project especially the environmental impacts and the effectiveness of mitigation measures.

165. Environmental monitoring of projects (both new and ongoing) is essential for continuing EIA inputs to management. In East Africa just like in other countries it has generally been observed that the predictive accuracy of the mitigation measures is limited partly due to the scarcity of environment. To partly overcome this issue, the environmental lead agencies within the three East African States are in the process of developing national environmental compliance in future. In the absence of national standards, the environmental lead agencies in Kenya and Uganda have the mandate to adopt and apply international environmental standards for environmental compliance monitoring.

166. Several companies operating locally in the three East African states do not have systematic and structured environment monitoring programs and multinational or local petroleum companies are no exception. This may be attributed to the low level of awareness amongst Project Proponents about the objectives of

environmental monitoring, responsibility and accountability for environmental performance, the lack of local environmental standards and the lack of compliance enforcement. Conversely most if not all development partner or internationally financed projects respectively in this region require Project Proponents to submit annual Environment Action Plans (EAP).

167. The environment monitoring section of the EAP typically contains:

- A specific description and technical details of monitoring measures, parameters to be monitored, methods to be used, sampling locations, frequency of measurement, detection limits and definitions of thresholds; and
- Monitoring and reporting procedures.

This short presentation will endeavor to provide an insight into the process of implementing effective environmental performance monitoring measures of petroleum related projects in East Africa.

SONGO SONGO OPERATIONS AND GAS DISTRIBUTION

MR. PETER CLUTTERBUCK, President and CEO, East Coast Energy.

168. Natural gas is now supplying East African power and industrial markets for the first time in history, from the Songo Songo field offshore Tanzania. This is the first step of a development of a gas driven economy, a potential gas export hub.

169. Toronto listed East Coast Energy (ECE) is the owner of PanAfrican Energy Tanzania, which operates the gas field, and owns the reserves jointly with the Tanzania Petroleum Development Corporation. The development produces gas for Songas, mainly to the principal thermal power station in Dar-es-Salaam, operated by Songas, which has been converted to gas. Industrial markets are being supplied by ECE through its wholly owned and operated Gas Ring main in Dar, which is operating and being expanded.

170. As operator of the Songo Songo field and associated infrastructure, ECE has focused on the development of the Tanzanian production operations staff, none of whom had any previous experience in oil or gas. Focus has been on high HSE standards, and operational efficiency.

171. Benefits to Tanzania include environmental improvement from reduce fuel oil usage and reduce deforestation for cooking fuels; less dependence on unreliable seasonal rainfall for hydro-power; a source of revenue for the Government from gas sales, improvement in balance of trade, and the potential to place Tanzanian industry in a very competitive position for industrial export markets. Further development anticipate more gas-fired power station, more industrial expansion, Compressed Natural Gas, (CNG) for vehicles, and gas for domestic use.

EXPLORATION: AN OPPORTUNITY FOR GROWTH IN AFRICA, A SHELL PERSPECTIVE.

planned to acquire approximately 1, 500km of data mainly in EA2 and the adjacent EA2 with some lines extended into the DRC.

175. Large steamers had operated on the lake in the past but currently the largest vessels are motorized, wooden canoes. Prior to the seismic survey there was very limited bathymetric data and little information on the weather and sea conditions.

176. The first plan for the seismic survey was to use a vessel purpose-built for research seismic and other surveys in lakes of the East African Rift and elsewhere in the world. This catamaran vessel could be disassembled and packed into a 20 ft container. New equipment was acquired for the survey: a 1,600 m digital streamer and recording system to better image the exploration targets and an additional air compressor to maintain higher production rates. The targets were expected at depths of 1,200-2,500 m but streamer length was limited by the towing capacity of the vessel. The 120 cu in airgun source array was limited by the size of compressors and airguns that could be carried by the vessel.

177. An Environmental Impact Assessment and EH&S plan were prepared to industry standards to ensure the conversation values of the lake were unaffected; the impact on local fishing communities was limited and that all contractors, including the university crew and camp and security providers were working safely and with respect for the environment.

MR. THEO DE NATRIS, Exploration Manager, New Ventures Organization Cluster, Shell International Exploration and Production B. V.

172. Shell has been active in Africa for over a century and has offices in most African Countries with interest in exploration and production ventures in more than 10 countries at present. The paper provides an update on the exploration activities in some key areas and also gives an overview of some of the key elements for growth seen from a shell perspective.

EXPERIENCE OF WORKING IN FRONTIER AREA EXPLORING LAKE ALBERT

MR. BOB CASSIE and MR. JUSTYN WOOD Hardman Resources Limited

173. Hardman Resources and Energy Africa (now Tullow Oil) hold a Production Sharing Agreement with the Republic of Uganda for exploration Area 2(EA 2) over northern Lake Albert in 2001. EA 2 is located in the Albertine Graben, in the western arm of the East African Rift, and showed a number of positive characteristics including magnetic and gravity data indicating more than 5, 000 m of sediment and the presence of a number of oil seeps. One of the best seeps demonstrates the presence of a mature, rich algal source.

174. Most of the basin within EA2 is located beneath Lake Albert, which is approx. 140 km long and 35 – 40km wide. The border between Uganda and the democratic Republic of Congo (DRC) runs along the centreline of the lake for most of its length. The first exploration work was to be a marine seismic survey that was

178. The survey and support teams mobilized to the lake in early 2003. During reassembly of the vessel a bathymetric survey of the programme lines was conducted and all the main fishing villages were visited to explain the operations and establish contacts. During that work we realized that storms on the lakes were capable of generating high winds (up to 40 knots) and significant waves and swell with little warning. As the new equipment arrived we became concerned that the vessel was potentially overloaded and unsafe in those conditions and conducted an independent review. When the vessel was launched it was clear the situation was worse than expected and we suspended operations rather than risk the crew.

179. After an extensive search the Victoria III, a fishing boat from Lake Victoria, was selected, modified and transported overland to Lake Albert. The equipment for the first survey was installed and operated by an experienced crew of marine seismic personnel assembled by Hardman, assisted by members of the university team.

180. Remoteness was the greatest problems in conducting the operations. As well as transporting the vessel to the lake as the various systems were commissioned problems arose that required discussions with, and shipment of spares, from suppliers in the US.
Many days were lost, underlining the importance of reliable systems, communications and critical spares.

181. A total of 1,589 km of seismic was acquired over the whole Lake, including 1,483 km in Ugandan waters and two prospect grids in EA2 over leads identified on

the initial grid. Maximum recording rates of 75-80 km/day were achieved but the average was much less as a result of bad weather and consequent poor sea conditions.

182. Data quality was variable. The small source gave very good penetration in some areas to approximately 3 seconds (coincident with the base of the rift sequence) but in other areas penetration and data quality was severely limited probably as a result of high biogenic gas content in younger sediments. This was particularly bad in the south, near the Semiliki delta and around the mouth of the Victoria Nile in the far northwest. The relatively short streamer also made velocity determination difficult.

183. The data provides good information on the rift section but we were unable to determine whether there is an older pre-rift sequence. The data clearly shows a large structural trend, aligned with the gravity and magnetic data that possibly represents a major cross-basin transfer fault. This trend contains a number of smaller fault-bounded structures and a large potential trap formed against a major fault separating the deep basin from the shallow Kaiso-Tonya block. This potential trap and the continuation of the trend onshore are the targets for a 2D onshore and transition zone survey currently underway.

184. The survey is designed to delineate the downthrown fault trap and identify any closures onshore in the Kaiso-Tonya block. Oil seeps at the eastern bounding fault of the Kaiso-Tonya block demonstrate that oil has

migrated out of the deeper basin, across the block to the bounding fault.

185. If the new survey is successful it will delineate a very large trap that could be drilled from the shoreline, and other shallower prospects onshore. An initial drilling program could include a vertical test shallow target on the Kaiso-Tonya block followed by a deviated well into the large trap, which would significantly reduce the drilling cost and the potential risk of operating in a offshore location. Success in the initial well will make it easier to justify the significant cost and effort of safely drilling offshore in such a remote environment.

RECOMMENDATIONS

186.

i. The Government to speed up the ratification of the Law of the Sea before the worldwide time expires; this will help in the acquisition of an extra deep sea exploration;

ii. The government should increase budgetary allocation to the National Oil Corporation of Kenya (NOCK); Owing to the expensiveness of the exploration exercise, there is need to allocate enough funds to the National oil Company.

iii. The Ministry of Energy to speed up amendment to the Petroleum (Exploration and Production) Act The NOCK is given authority on regulation of the oil and gas industry;

iv. The government to initiate internal promotional activities on the petroleum and other minerals exploration and production;

v. The government should increase exploration and prospecting activities to find more viable natural resources which economically explored.