

<http://www.ejournalofscience.org>

# Advances and Challenges of Oil and Gas Developments in Ghana

<sup>1</sup>P. A. Owusu, <sup>2</sup>E.K. Nyantakyi

Department of Civil Engineering, P. O. Box 854, Kumasi Polytechnic, Kumasi, Ghana

<sup>1</sup>[princeappiah@gmail.com](mailto:princeappiah@gmail.com), <sup>2</sup>[emmanuelkwesinyantakyi@yahoo.com](mailto:emmanuelkwesinyantakyi@yahoo.com)

## ABSTRACT

This work explores in some vital detail, the history of early petroleum exploration in Ghana since 1896. After several decades of oil exploration, Ghana finally struck oil in commercial quantities in its off shore Western Atlantic Coast in conjunction with multinational companies in June 2007. Ghana now produces 86,000b/d with natural gas reserves of about 22.7 bnm<sup>3</sup> representing 0.01% of the worlds total production. The many years spent to locate crude oil affected the national plan to produce manpower and comprehensive legal and conceptual frame work for the oil industry. This has affected full local content participation due to lack of requisite skills required to work in the oil industry. The issue has been compounded to the extent that the universities are producing students which lack the necessary skills needed to function effectively in the industry all because of lack of commitment and open door policy of the multinational oil companies to the education institutions. This paper seeks to identify the major challenges of Ghana's oil and gas discovery and the structures to deal with these challenges. It is concluded that there should be proper and enforceable collaboration between the multinational companies and the accredited institutions to the effect that the country's regulations and institutions already in place should be made binding to all stakeholders in the industry.

**Keywords:** Ghana, Oil and Gas, Reserves, Production, Education, Challenges

## 1. INTRODUCTION

After more than five scores and a decade of oil exploration, oil was struck in Ghana in commercial quantities in its off shore oil exploration in conjunction with Kosmos and Tullow Ghana oil companies in June 2007.

With the oil find Ghana is expected to join the few world oil producing countries with a huge impact on its economy. The many years however, spent to discover crude, affected the anticipation of producing manpower for the oil industry by higher educational institutions mandated by law to produce the needed manpower for socioeconomic development of the country.

Hence the industry seems to play into the hands of foreigners, which defeats the vision and the general objective of taking over the management of the resources at all levels by 2020. Coupled with the above, the absence of comprehensive legal and conceptual framework on the general management of environmental concerns arising due to the oil find gives a major concern. This then raises the interest of this paper to look into issues regarding production levels, reserves, challenges and skills that would be required to work in the oil industry and whether universities are producing students with the competent skills.

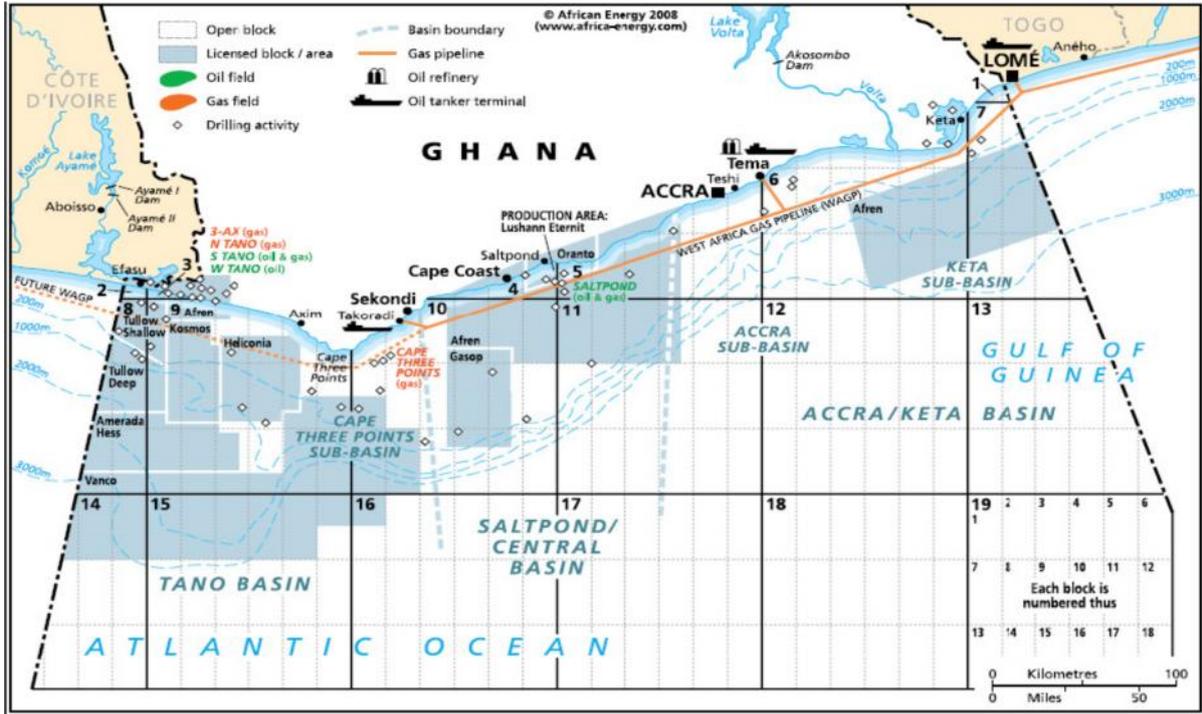
## 2. STUDY AREA

Ghana is a small country with population of about 24 million in the Western part of Africa along the coast of Gulf of Guinea which has been prospecting for oil since 1890 (Samuel, 2008). It shares geographical boundaries with Ivory Coast on the west, Republic of Togo on the east, Burkina Faso on the north and the Gulf

of Guinea on the south. Ghana is located geographically on latitude 8° 00' North of the Equator and longitude 2° 00' West of Greenwich Meridian. In recent history, Ghana has discovered large deposits of black gold also known as hydrocarbon along the coastal belt of the country.

The hydrocarbons deposits are found in four main regions of sedimentary basins: Tano-Cape Three Points Basin (Western Region), Saltpond/Central Basin (Central Region), Accra-Keta Basin (Eastern Region), and Voltaian Basin (Northern Region). Fig 1 shows the map of hydrocarbon basins in Ghana. It equally shows the eleven blocks auctioned in Ghana's offshore waters and the various exploratory wells drilled in those blocks between 2004 and 2008 (Bermudez-Lugo, 2006).

<http://www.ejournalofscience.org>

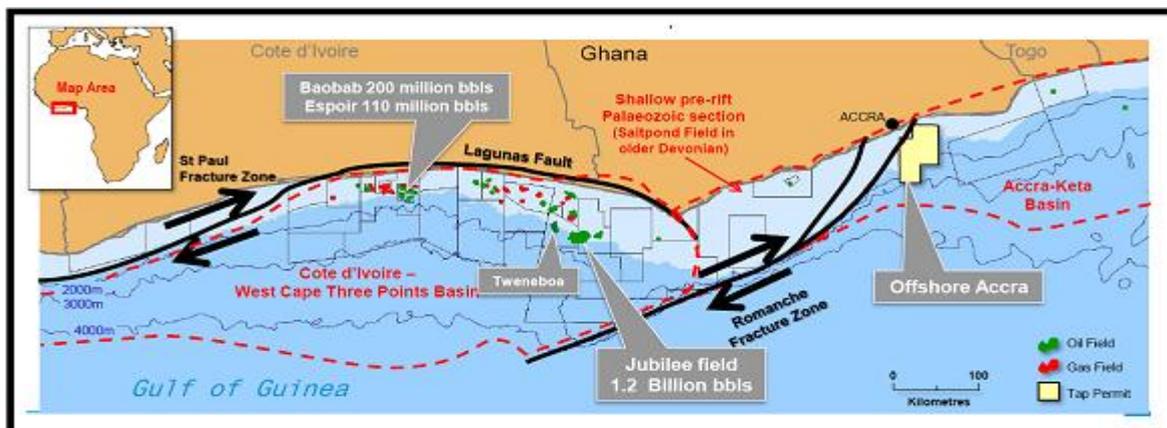


**Fig 1:** Ghana’s hydrocarbon map – onshore processing facilities, offshore oil and gas exploration blocks, drilling activities, and the West Africa Gas Pipeline.

**3. REGIONAL GEOLOGY**

Ghana’s offshore is part of the West African Transform Margin which extends from Sierra Leone to western Nigeria. The three related basins are bounded by major transform faults. Oil-prone source rocks occur in these basins along the whole margin with commercial production established in the Cote d’Ivoire –West Cape and new discovery at Venus-1 in the next basin west side. Accra-Keta sub-basin has the same key elements but is underexplored. This Block is located in a similar setting to the Espoir-Baobab area. Initial targets are in the pre-breakup Albian play with existing 3D coverage.

Geologically, the Jubilee Field is a santo man fan system (<http://ghanaoilinfo.com/?page=facts>). Fig 2 shows the map of regional geology. Petroleum play types are exceptionally favourable, with convergence of regional geological factors on the Ghana margin. The margin has rich source rocks deposits matured for oil. Well developed and widespread Albianage reservoirs are contained in major fields such as Baobab and Espoir. World class turbidite reservoirs are deposited in giant stratigraphic traps, example in Jubilee, Tweneboa and Odum fields with highly effective seals to preserve oil and gas for discovery and development (<http://ghanaoilinfo.com/?page=facts>).



**Fig 2:** Map of regional geology of West African Transform Margin. (Source: Tullow Oil).

#### 4. HISTORICAL OVERVIEW OF GHANA'S OIL AND GAS INDUSTRY

Historical records of petroleum exploration in Ghana dates beyond 100 years ago. West Africa and Fuel Company (WAOFCO) in 1896 initiated petroleum exploration in the then Gold Coast of Africa (today Ghana). Even though it is difficult to agree on the pioneer role of WAOFCO per the available data, their contribution is traced to the five (5) drilled wells in onshore Tano fields in the Western part of Ghana between 1896 and 1903 (Osei, B. D. 2011).

In 1980, a minor discovery and subsequent production by Saltpond Oil Company led to the production of oil in quantities but this fell short of domestic demand.

The Ghana National Petroleum Corporation (GNPC) Act, 1983 was enacted with a mandate to; promote the exploration and development of the petroleum resources of Ghana. Lack of technical and financial capacity thwarted the effort of (GNPC) to undertake petroleum exploration on its own thus its collaboration with international oil companies such as Kosmos, Tullow, Anadarko and Sabre Oil. On June 18, 2007 Kosmos Energy, a relatively small Dallas-based exploratory company in a press release announced that the exploration well offshore the Republic of Ghana in the rich West Cape Three Points Block has discovered significant oil accumulation based on the results of drilling and wire-line logs, and a sample of the reservoir fluid.

#### 5. METHODOLOGY

This section presents the methodology employed in the writing of the paper. The technique adopted in this paper among others includes assessing database of the main players in the industry and interviews. Relevant literatures were reviewed and the paper also drew on Local Content Programme document designed by the Ministry of Energy.

#### 6. DISCUSSIONS

##### 6.1 Natural Gas Consumption

Natural gas is the world's third largest energy source, accounting for 21% of total primary energy use. The available data shows Ghana is registering appreciable increase in the consumption of the commodity about 4000 barrels per day in recent history representing an average of 24% ([www.indexmundi.com/commodities/market](http://www.indexmundi.com/commodities/market)) year on year increase Fig. 3. With the oil find and the associated natural gas reserves of about 22.7bm<sup>3</sup> which represents 0.01% of the world's total as at 1st January, 2010, the country's energy base will largely be enhanced, leading to industrialisation and the general well being ensuring safe and sustainable environment. Again the regular demand of importation of gas with a huge burden on Ghana's economy will have sigh of relief. However, this may be a mirrage if the necessary infrastural arrangement for the smooth take off is not given the needed boost as information indicates that the resources is being flared on the field currently a situation which can jeopardised the wells.

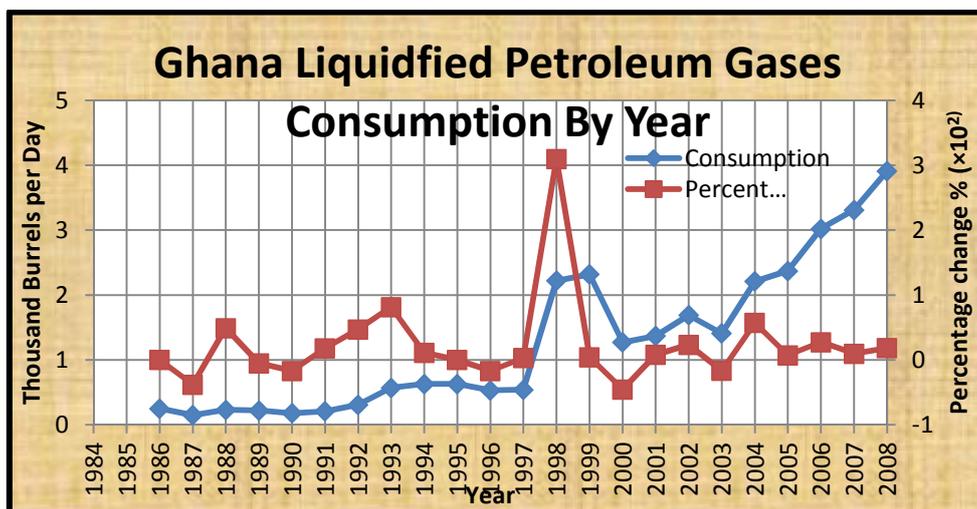


Fig 3: Consumption of liquefied petroleum gas in Ghana

##### 6.2 Oil Production Across the World

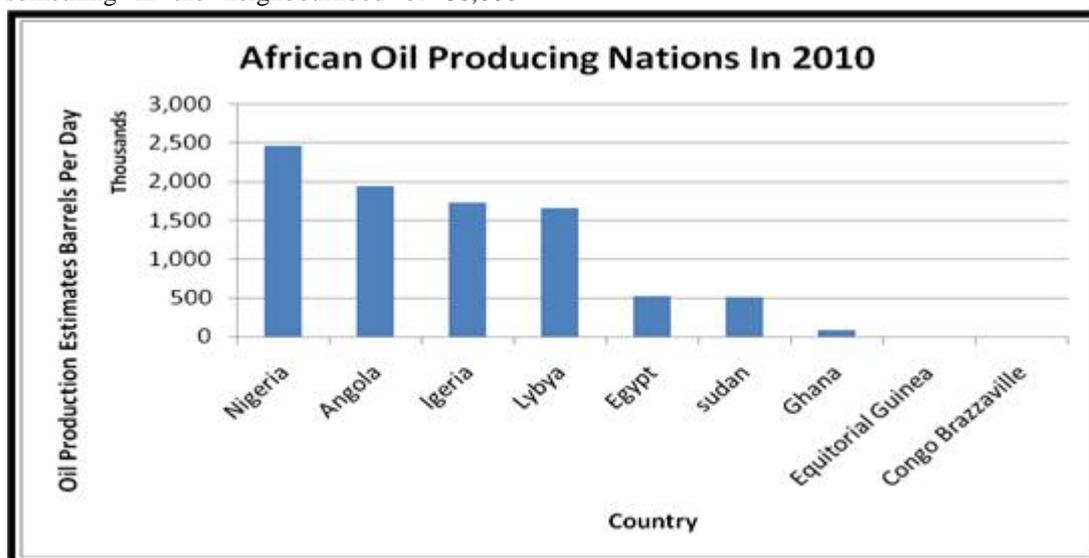
At present oil production is dominated by US, Russia and the Middle East. US have decreased from 18.6 to 17.6 million barrels per day since 1981. Russia production figure of 10,120,000 barrels per day (bbl/day)

as of 1<sup>st</sup> January 2011 makes it the world's largest oil producer. Africa's oil giants include Nigeria, Angola, Algeria, Libya, Egypt, Sudan, Equatorial Guinea and Congo Brazzaville (arranged in descending order) with Ghana emerging as the toast of the oil world production,

<http://www.ejournalofscience.org>

Fig. 4. Africa contributed an average of 9,997,000 barrels per day (bbl/day) of produced crude oil including lease condensate in 2010 full year estimates. At present Ghana produces something in the neighbourhood of 86,000

barrels of oil per day. This is expected to shoot up to about 120,000 barrels with the new discoveries in the Tweneboa and Odum fields.



**Fig 4:** Oil producing countries in Africa

### 6.3 Excellent Oil Potential Reserves

Ghana' offshore area is located in an emerging oil province on the West Africa Transform Margin, along the northern Gulf of Guinea. A number of discoveries have been made in analogous geological settings along the Margin, including the Espoir and Baobab producing fields in neighbouring Cote d'Ivoire.

In 2007, the Jubilee field which covers an area of 1,957.05 square kilometers was discovered by Kosmos Energy and Tullow Oil (one of the largest oil discoveries in the world in 2007) establishing a new deepwater play offshore Ghana. According to Tullow Oil, recoverable oil reserves for the Jubilee field are estimated to be 1.2 billion barrels. Subsequent discoveries (Tweneboa and Odum) have further demonstrated the significant potential that exists along the Margin a potential reserve of about 3 billion barrels.

Several moderate risks but high reward structures have been identified on existing 3D seismic data in shallow-moderate water depths in the offshore Accra, each of these is considered to have potential to contain in excess of 100 million barrels of prospective resources ([www.tapoil.com.au](http://www.tapoil.com.au)).

### 6.4 Current Situation on the Exploration Fields

Currently, among all the oil companies which have made major discoveries, Tullow Oil Ghana is in advanced stage of commercial production. Tullow Oil is not into direct production but has subcontracted production to other oil field service companies such as

Baker Hughes Ghana, Schlumberger, Modec and ENI (HRM GNPC).

### 6.5 Local Content and Local Participation Policy Framework

The key discoveries of oil in Ghana have again called upon the government to put in place measures to control production and its associated benefits in the interest of the people of Ghana. This is to control production and marketing of oil. It is stated that, government of Ghana is committed to indigenizing knowledge, expertise and technology through participation of Ghanaians in the ownership, operations, control and management to achieve at least 90% local content and local participation in all aspects of the oil and gas value chain by 2020 which is believed to lead to the creation of self- sustaining and buoyant economy' (MoE, LCDP document).

### 6.6 Employment and Training of Citizens

The operators in the petroleum sub-sector are by law should ensure that opportunities are given as far as possible for the employment of Ghanaians having the requisite expertise or qualification, experience and competence required to carry out the required work in the various level of operations (MoE, LCDP document). 50% of the management staff should be Ghanaians from the start of operation and this number shall increase to at least 80% within five years after the start of the petroleum activities.

<http://www.ejournalofscience.org>

That at least 30% of the core technical staff should be Ghanaians at the start and within five years the number should increase to 80% and 90% within 10 years. Other staff should be made of 100% Ghanaians (MoE, LCDP). Measures therefore should be put in place by the operator to provide such training locally or elsewhere within a reasonable time so as to cope up with the facing global shortage of labour. Whether Ghana is going to suffer the same problem in its new oil industry depends on the institutional reforms that would be adopted to blend training with industry.

### 6.7 Oil and Educational Curricula Reforms in Ghana

As a result of the urgent need of the country to take over the operation at both upstream and downstream in the future, there are many reforms in educational institutions to meet the demand. Major universities have revised their academic curricula by introducing oil related programmes. KNUST is running courses such as Chemical Engineering and Petrochemical Engineering.

MSc Geosciences and Bachelor of Engineering (BE) Oil and Gas have been introduced in University of Ghana and All Nations University respectively (Tuah, T.W 2010).

The response of students across the universities is high due to the prospects the industry has to offer. Available records indicate that demand for the oil programmes have increased tremendously Fig. 5. Lack of facilities has placed limitation on the number of qualified applicants than can be admitted and only 30% are admitted (Tuah, T. W. 2010). Notwithstanding the educational reforms, students lacked the requisite practical know-how due to unwillingness of multinational companies to open their doors for teaching and learning. Hence there is the need for proper collaboration between the universities and MNCs to improve knowledge and skills.

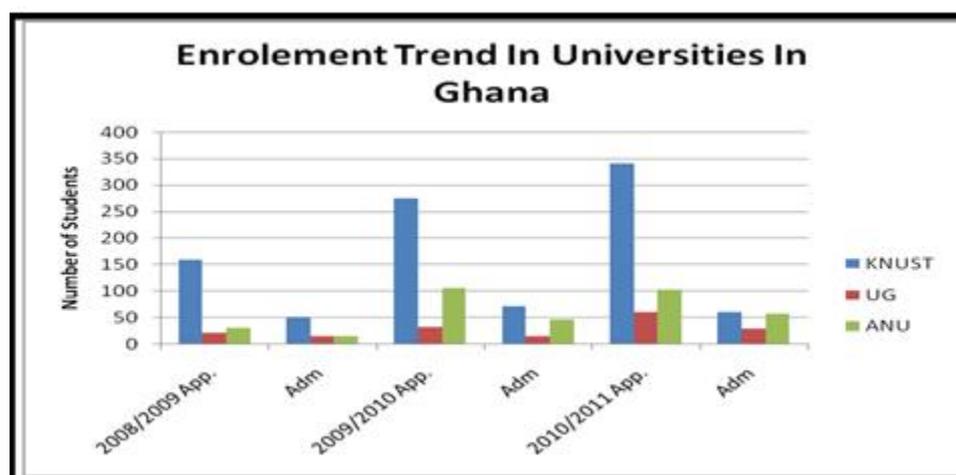


Fig 5: Enrolment trends in Tertiary institutions

### 6.8 Challenges from Oil Discovery

Oil discoveries and its development across the world has largely bedeviled with environmental concerns. The environmental impact in oil developing economies has been more damaging, making it more of a curse than a blessing. The task is will Ghana be able to develop and manage the benefits of its hydrocarbon resources bearing in mind the environmental impacts in a more sustainable manner for the benefit of posterity. The development and production of the resources in developing economies has been identified to be a detriment to the survival of our ecosystems and livelihoods.

This will lead to national habitat fragmentation, pollution, destabilization of local economic, insecurity, conflicts and accidents. The way forward should include but not limited to complement and augment the limitations of the current environmental framework and

management tools. This should lead to development of petroleum industry specific environmental protection guidelines and appropriate regulatory infrastructure, including monitoring equipments, compliance enforcement networks and also sanctions regime coupled with swift national emergency response unit. Local communities as custodians should be engaged at all levels in order to ensure sustainability of the process.

## 7. CONCLUSION

The discovery of oil and gas resource across the world has always come with mixed feelings; either curses or blessings albeit how it is managed. The management of the resources in Ghana as at now is largely in the hands of westerners. Findings show that there is lack of the entire requisite human and technical know-how. Students are handicapped in the practical aspect of their training and are much worried about their chances in contemporary

---

<http://www.ejournalofscience.org>

competitive labour market. Multinational companies (MNCs) are said to have closed their doors to universities, lecturers and students as a results stifling teaching and learning. Though the nation has come out with a development policy on oil and gas, this has little or no effect on the attitude of MNCs towards teaching and learning regarding accessibility to their rigs and facilities for practical training.

The solution is through training and development of human resource and these calls for stronger collaboration with MNCs, GNPC, ministry of Manpower and Employment as well as ministry of Education to have an open door policy which will create the enabling environment for training and development of students which will feed the industry. The national policy on the local content and transfer of technology should be strengthened through introduction of programmes in our educational institutions to produce competent skills for the petroleum industry. Finally legal framework and clear policy guideline lines should be made binding to all stakeholders.

## REFERENCES

- [1] Bermudez-Lugo, Omayra. "2006 Mineral Yearbook: The Mineral Industry of Ghana." *US Geological Survey*. May 2008, pg. 18.2.
- [2] CIA World Fact book also available at: [http://www.photius.com/countries/ghana/economy/ghana\\_economy\\_petroleum\\_exploratio~113.html](http://www.photius.com/countries/ghana/economy/ghana_economy_petroleum_exploratio~113.html). Accessed: August, 2012.
- [3] Osei, B. D. 2011, A Concise History of Oil and Gas exploration in Ghana
- [4] Doe S. A. 2008, Participating In Emerging Oil Industry -Time to Develop Skills In Petroleum – Daily Graphic General News. Source: <http://www.indexmundi.com/commodities/market> Accessed: April, 2012.
- [5] Tuah, T. W. 2010, Human Resource Development for Upstream Operations in the Oil Industry in Ghana

- [6] Ministry of Energy Local content Participation Document
- [7] The GNPC website: <http://www.gnpcghana.com/aboutus>. Accessed: April, 2012.
- [8] The Kosmos Energy website: [http://www.kosmosenergy.com/press/kosmos\\_PR\\_071807.pdf](http://www.kosmosenergy.com/press/kosmos_PR_071807.pdf). Accessed: April, 2012.
- [9] [http://www.escapeartist.com/OREQ18/Offshore\\_Oil\\_Rig\\_Employment.html](http://www.escapeartist.com/OREQ18/Offshore_Oil_Rig_Employment.html). Accessed: Oct, 2012
- [10] <http://www.nytimes.com/2010/07/24/us/24hearings.html?pagewanted=2>. Accessed: April, 2012.
- [11] <http://ghanaoilinfo.com/?page=facts>. Accessed: April, 2012.
- [12] <http://www.tapoil.com.au>. Accessed: April, 2012.

## AUTHOR PROFILES

**Prince Appiah Owusu** is a Lecturer at the Civil Engineering Department of Kumasi Polytechnic, Kumasi, Ghana. He holds an MSc in Water Resources Engineering and Management. His research areas are Hydraulics of Fluid Flow through porous Media, Oil and Gas Reservoir Simulation, Reservoir Petrophysics, Reservoir Engineering and Oil Field Development. He is a Member of Society of Petroleum Engineers (SPE).

**Emmanue Kwesi Nyantakyi** is a Lecturer at the Civil Engineering Department of Kumasi Polytechnic, Kumasi, Ghana. He holds an MSc in Road and Transportation Engineering. His research areas are oil and Gas Storage and Transportation, Seismic Interpretation, Oil and Gas Deposition and Distribution. He is a Member of American Association of Petroleum Geologists (AAPG).