Director's Note

This collection represents the concerted efforts of the 2019 batches of Masters and contributions from the first batch of Ph.D students of the Pan African University of Life and Earth Sciences (including Health and Agriculture), University of Ibadan, Ibadan their contributions to research and innovation.

The contributions are from the first seven programmes within the Institute who have graduated students mainly:

- i. Reproductive Health Sciences with Reproductive Health and Reproductive Biology options
- ii. Geosciences with Petroleum Geosciences and Mineral Exploration Geosciences options
- iii. Plant Breeding and
- iv. Environmental Management

These research contributions represents highly robust research efforts targeting the major primary areas of need of the African continent. The contributions are from the research activities of the Masters/Ph.D students. It is hoped that the next publications will see research outputs of most of the Ph.D students and also contributions from the other three programmes whose students have also commenced research activities.

Sincere appreciation goes to the African Union who have recognised the importance of Higher Education and research and have in various dimensions motivated the students. Similarly the African Development Bank has provided the financial muscle to encourage the students and stimulate them to make a difference within the African Scientific and Technical Community within the continent and the Diaspora. The progression in this humble beginning will in future spiral our students into significant scientific and research breakthrough and will engender global competitiveness in the research arena.

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2019

Introduction

The Pan African University (PAU) is the culmination of continental initiatives of the commission of the African Union to revitalize higher education and research in Africa. It is a project that will exemplify excellence, enhance the attractiveness and global competitiveness of African higher education and research and establish the African university at the core of Africa's development. The PAU will greatly boost the population and retention of high-level human resources and quality knowledge outputs and be able to attract the best intellectual capacity from all over the world.

It is noteworthy that this momentous project is being launched as African Union (AU) undertakes the modern evaluation of the Second Decade Education for Africa. Clearly, Africa has awoken to the fact that social and economic development is not possible without substantive investment in a robust higher education and research.

The Institute of Life and Earth Sciences (including Health and Agriculture). University of Ibadan, Ibadan, Nigeria offers Masters and PhD degree in seven thematic areas namely:

Master's Degree (MSc)

Master in Environmental Management Master in Geosciences (Mineral Exploration and Petroleum Geosciences options) Master in Reproductive Health Sciences (Reproductive Health and Reproductive Biology options) Master in Plant Breeding Master in Medicinal Plants Research and Drug Development Master in Sport Management and Policy Development Master in Veterinary Medicine (Avian Medicine; Vaccine Production and Quality Control options)

Doctoral Degree (PhD)

Ph.D in Environmental Management Ph.D in Geosciences (Mineral Exploration and Petroleum Geosciences options) Ph.D in Reproductive Health Sciences (Reproductive Health and Reproductive Biology options) Ph.D in Plant Breeding

2019

Vision

The strategic vision of the Pan African University is to develop institutions of excellence in science, technology, innovation, social sciences and governance, which would constitute the bedrock for an African pool of higher education and research. This would usher in a new generation of leaders properly trained to take the best advantage of African human and material resources, imbued with a common vision of a peaceful, prosperous and integrated Africa.

Mission

To realise the strategic vision, six missions have been defined for the Pan-African University:

- 1. Develop continental-wide and world-class graduate and post-graduate programmes in science, technology, innovation, human and social sciences;
- 2. Stimulate collaborative, internationally competitive, cutting-edge fundamental and development oriented research, in areas having a direct bearing on the technical, economic and social development of Africa;
- 3. Enhance the mobility of students, lecturers, researchers and administrative staff between African universities to improve on teaching, leadership, and collaborative research;
- 4. Contribute to the capacity building of present and future African Union stakeholders;
- 5. Enhance the attractiveness of African higher education and research institutions for effective development and retention of young African talent, while attracting the best intellectual capital from across the globe, including the African Diaspora;
- 6. Invigorate dynamic and productive partnership with public and private sectors

Regional Institutes

The thematic institutes that constitute the PAU are distributed in five geographic African regions. They are as follows:

- The Institute for Basic Sciences, Technology and Innovation (PAUSTI), hosted by the Jomo Kenyatta University of Agriculture and Technology in Kenya (Eastern Africa);
- The Institute for Life and Earth Sciences (including Health and Agriculture (PAULESI), hosted by the University of Ibadan in Nigeria (Western Africa);
- The Institute for Governance, Humanities and Social Sciences (PAUGHSS), hosted by the University of YaoundeII in Cameroon (Central Africa);
- The Institute for Water and Energy Sciences (including Climate Change (PAUWES), hosted by the University of Tlemcen in Algeria (Northern Africa); and
- The Institute for Space Sciences (PAUSS) to be hosted by a University in the Republic of South Africa (Southern Africa).

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Master of Science in Environmental Management

Mangrove Forest Cover Change and Management Practices in Djègbadji, Ouidah, Benin Republic

Vermette TCHEGNON (PAU-UI-0305)

The present annual rate of mangrove forest loss is estimated at over 2% per year. In West Africa Countries such as Benin Republic, efforts of estimating annual loss of mangrove has been very slow due to the inaccessibility of the mangrove terrain. Developments in the field on earth observation and GIS have helped in the quantification of spatiotemporal land-cover changes caused by human activities. However there is dearth of information on the use of GIS for results of land cover change on mangrove. This study was therefore conducted to investigate the change of mangrove forest with a view of assessing the extent of degradation of mangrove vegetation from the year 2000 to 2016. Landsat imagery for Djègbadji mangrove forest for the years 2000, 2008 and 2016 was downloaded from USGS portal and analysed to generate information on land-cover changes. The changes over time were determined using ERDAS image processing and ArcGIS software. Fifty questionnaires were distributed to assess the management practices of the local community in Djegbadji on the mangrove forest. The result indicated growth of the wetland while agriculture lands recorded a decrease. This can be attributed to anthropogenic practices. Statistical data of the area supported by the calculation of spatial structure indices showed that land use has changed profoundly. The main human activities in the study area were: salt production, fishing, river transport, dredging, logging and trade in concentrated saltwater. The results showed that mangrove areas increased by 1.86% from 2000 to 2016. The surface areas of these mangroves are currently abundant for the benefit of the reduced urban areas, plantations, and meadows. The study proves significant changes in land use /land cover in the coastal stretch. Information from this study will be useful to local planners and to aid sustainable development in the study area.

Keywords: Landuse/Land cover, Mangrove, ERDAS, ArcGIS, Djègbadji, Ouidah

Assessment of the Knowledge, Attitude and Practices of E-Waste Workers in Owode-Onirin Scrap Market, Kosofe Local Government Area, Lagos State

Ayodunmomi Esther OLOWOFOYEKU (PAU-UI-0306)

Electronic devices have become essential to our existence which has led to an exponential demand for electronic equipment and a rapid increase in the rate of electronic waste (E-waste) generation. Majority of the E-waste contain both items that can be recovered and utilized for new products as well as hazardous material capable of affecting human health and the environment when improperly managed. E-waste is normally dumped alongside the municipal solid waste stream and subsequently scavenged by workers in the informal sector for recycling using crude environmentally unsound methods like acid leaching of printed wiring boards, unprotected manual

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dismantling and open burning to recover valuable components and precious metals. These crude material recovery processes have given rise to environmental pollution and exposed millions of E-waste workers and other people to toxins. Therefore, it is of utmost importance that the knowledge, attitude and prevailing practices among those that are occupationally exposed be carried out.

A total of 241 Questionnaires was administered, alongside interviews and general observation for data collection. The data collected was analysed using Pearson correlation coefficient to establish the magnitude and direction of the relationship that exists between the knowledge, attitude and practices of E-waste workers. The knowledge of the respondents were limited to the financial and economic value attached to E-waste meanwhile the environmental and health impact of their occupation were not known, neglected or considered unimportant.

The strong social tie that exists among the E-waste workers can be leveraged upon for the transmission of the additional knowledge that bothers on the environmental health impact of their occupation so as to conduct their activities in the safest manner possible.



Heavy Metals Concentration in Road Dust and Perception of Road Side Workers on its Health Risks in Ikorodu, Lagos State, Nigeria

Mumuni Debo AJENIFUJA (PAU-UI-0307)

People usually trade by the sides of roads, especially in urban areas in Nigeria. Prolonged exposure to unsafe concentrations of heavy metals through inhalation may lead to accumulation of heavy metals in humans causing disruption of numerous biochemical processes. The aim of this study was to determine the levels of heavy metals in the road dust collected from roads in Ikorodu. The roads are one major road (Ikorodu-Sagamu road) and three minor roads (Ijede, Igbogbo, and Ebute road). The study also sought to assess the knowledge, attitude and perceptions of road workers on the health risks posed by road dust. Heavy metal (lead, cadmium, zinc and copper) concentration in samples collected determined using Atomic Absorption Spectrophotometer analytical method. Traffic count was carried out using tally counting method for 12 hours in three days in a week. A descriptive cross-sectional survey was carried out to assess the knowledge, attitudes and perceptions of people working by the road. The analytical data was subjected to statistical tests of significance using ANOVA and post hoc analysis by LSD test (P < 0.05) to determine whether there was any significant difference between the roads with respect to heavy metal concentration.

Pearson Correlation was used to establish the association between traffic density and the concentration of heavy metals. Chi square was used to determine if there were associations between the study variables in the survey. The research found that the road dust under study had low levels of Cu, Zn, Cd while they had higher levels of Pb but lower than maximum allowable levels. Pb, Zn and Cu showed a positive association with traffic density was significantly negative. Pb and Cu showed positive association while Zn, Cd, and Cu showed negative association

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with one another. The road workers had adequate knowledge about the health risks posed by road dust which was significantly associated with the level of education ($\gamma 2 = 7.467$ df = 1P < 0.05). A significant association between level of education and perception was also revealed ($\chi = 7.161$, df=1, p<0.05). Insignificant associations between age and the number of years the participants had worked by the road were found for the variables of knowledge, attitude and perception. Allocation of stores in Ikorodu should be liberalized so that road traders can return to the market places. Government should be imposed a considerable setback for road traders to minimize the exposure risk to road dust.

Keywords: Heavy metals, Traffic count, Road dust, Perception



Wetland Encroachment and Its Management in Kapkatet Wetland, Kenya

Ronald KIBET (PAU-UI-0308)

Wetlands are very rich in ecological goods and services which support the socioeconomic activities of humanity. About 29.83 million km² of the global land surface is under threat from human activities. Wetlands for a long time have been perceived as biomes of no value, hence treated as wastelands which have resulted in the global loss of about 50% of their acreages since 1900. The efforts to address most of the wetland encroachment issues by international, regional and local governments have concentrated on urban wetlands, those along the major watercourses and Ramsar sites neglecting the community-based wetlands which support the majority of the population living in rural areas like in the case of the study area. The aim of this study was to determine the extent through which Kapkatet wetland has been encroached and evaluate the management strategies with the purpose of highlighting the changing pattern of this ecosystem, economic factors of encroachment, perception of the cultural significances among the socio-demographic groups and the need to sustainably manage it for the benefit of the present and future generations. The social survey research design was used for this study. Purposive sampling was used to identify villages and simple random sampling technique used to select 100 participants living within a radius of = 2km from the wetland. A representative of the local and national government in Bomet County was interviewed. Satellite imagery was used to establish encroachment pattern and wetland use wetland cover change over the years between 1986, 2000 and 2019. A chi-square statistical tool alongside cross-tabulation analysis was used to ascertain the inherent variations existing among the socio-demographic groups on the perception of factors of encroachment and cultural significances (a=0.05). The results indicated that there has been a decline in the wetland cover by 24.77% since 1986. The study also found out that there was no significant variation in the encroachment factors among sociodemographic groups.

Furthermore, the study found out that there were significant variations in cultural significances among the socio-demographic groups except for gender. The major driver of encroachment in the area was land conversion with water withdrawal having minimal impact. Economic activities contributing to the wetland encroachment according to

level of impact was found to be crop cultivation with vehicle washing having minimal impact.

Livestock grazing was listed to have had the most profound effect on wetland vegetation amongst other economic activities. Wetland management bills had already been formulated by Bomet County Government but not enforced. The reluctance in the enforcement of existing laws and policies at the grassroots level by both the National and Local government agencies are to be blamed for the continuous loss of this wetland.

Keywords: Encroachment, Wetland change, Management, Cultural activities, Kapkatet



Generation and Management Practices of Municipal Solid Waste in Cowfield Community, Liberia

Fallah NYUMAH (*PAU-UI-0309*)

Waste is contemporaneous with living. Waste Management will continue to be of challenge to humanity, development, health and environment. The proper management of solid waste requires up-to-date information on the generation, composition, management practices and challenges for effective planning and policy making. Data on municipal solid waste generation, composition, management practices and challenges in Liberia are not up-to date. This study was conducted to provide empirical data on the generation, composition, management practices, challenges and strategy at the household level.

The aim of this study was to determine the waste generation rates, management practices, challenges and needed strategies at the households' level in the Cowfield Community in Liberia. Questionnaires, weighing of waste, and field observations were used to collect primary data. Data were analyzed using Statistical Package for Social Sciences version 20 and Excel. 60 households were selected from four blocks of the community using Multi-stage random sampling technique. Waste collection was done over a seven-day period. A total of 1125.2kg of waste was generated with Sunday generating the highest of 24.7% of the total waste. The average households waste generation rate was 3kg per day with per capita generation rate of 0.41kg/cap/day. The waste fraction was mainly composed of organic (53%), Plastic (11%), Textile (6%), Metal (2%), Glass (1%), Paper and cardboard 4% and others (22%). Solid waste management practices are very rudimentary. Burning (53.7%) and Open Dumping (30%) were found to be the most commonly used method of disposal with very limited collection service (33.3%). The door to door collection is mainly done by CBEs once a week by means of a Tricycle. Waste segregation is not a common practice by households either due lack of bins or behaviour. The community lacks communal area /public bin and old bucket (53.3%) was mainly used for temporary storage. The most challenges faced by households are storage bins, communal area and waste service providers.

Keywords: Municipal solid and management, Waste generation and composition

Assessment of Awareness and Practice of Medical Waste Management among Healthcare Providers at University Teaching Hospital Of Kigali, Rwanda

Violette MUKARUGEMA (PAU-UI-0310)

This study was conducted in University Teaching Hospital of Kigali (CHUK), from April to June 2019, with the main aim of determining the rate of medical wastes generation, assessing the level of awareness of the challenges of medical waste management among healthcare providers as well as assessing the practices of medical waste management among the healthcare providers. The study involved quantitative and qualitative data collected using questionnaire, interviews and direct observation method. The data were collected from a total number of 384 healthcare providers. The quantitative data were analyzed using SPSS software version 23 while the qualitative data were analyzed systematically. The study revealed that frequent types of medical wastes produced from CHUK includes general wastes which are 75.3% of the total wastes produced from the hospital, pathological wastes (10.4%) radiological wastes (0.8%), chemical wastes (2.6%), the infectious 15.4\%, sharp waste (4.9%) and the pharmaceutical wastes 2.3%. CHUK produce an average of 13.5kg/day of medical waste by inpatient and outpatient. The major source of medical waste come from maternity and internal medicine wards. More than 83.9% of healthcare providers at CHUK possess knowledge on medical wastes management and this is a good indicator towards a better management of medical wastes. In addition, the medical wastes management, in CHUK, becomes a team work in order to increase the efficiency. About 88.7% of the respondents wish that the hospital organizes continuous training to upgrade the existing knowledge on medical wastes management. Colour coding is key issue which helps waste segregation. During this study, 85.4% of the respondents have knowledge on the colour coding of wastes collection bins. However, 49.2% do not follow correctly the colour coding during medical waste segregation. Generally, 90% of the wastes collection bins have trolley. The study recommended CHUK to raise the awareness and training on medical wastes management and to establish effective practices of medical wastes management. In addition, to minimize the risks which arise due to the poor management of sharp objects, head of the departments in hospital have to take a lead to demonstrate awareness on the aspects of medical wastes management.



Potential of Agro-Waste Briquetting for Domestic Heating and Cooking as an Environmental Management Strategy in Rushinga, Zimbabwe

Gordon Tinaye MADAMOMBE (PAU-UI-0312)

As much as 90% of people in developing countries have challenges in accessing modern energy for domestic use. In Zimbabwe, only 10% of the rural population is not reliant on biomass for energy, hence the high rate of forest loss (1.78%) relative to regional countries (0.48%). Most of the rural households depend on agriculture for sustenance and in the process generate substantial amounts of agro-residues which often contribute

to pollution. To this end, the research sought to assess the briquetting of agro-residues for complementing wood fuel in Rushinga, Zimbabwe, to reduce deforestation and pollution. Peanut and wastepaper were briquetted using manual agglomerators by participants who volunteered to participate in the study The briquettes were characterised by themogravimetry using the LECO TGA 701 machine and the participants' willingness to pay was inferred through a questionnaire survey administered six (6) months after the project inception. The proximate analysis results were; moisture content 7.33%, volatile mater 76.51%, fixed carbon 20.24% and ash content 3.26.63% (n=30) of the respondents expressed willingness to pay for and use the briquettes. This indicates that briquettes have the potential of being used for domestic heating and cooking.

Keywords: Bio-briquette, Physico-chemical parameters, Themogravimetry, Willingness-topay



An Assessment of Food Wastes in a Farming Community and Development of a Food Wastes Composting and Utilization Strategy in Buea, Cameroon

Marcelle Carole NGASSAM PAMI (PAU-UI-0313)

Buea experiences insufficient waste treatment facilities, insufficient collection equipments, decreased capacity of the existing landfill, and the monopoly of the waste management company Hygiene et Salubriete du Cameroon in Buea, which essentially concentrates its activities on collection and dumping of solid wastes. This research aimed at assessing the nature and amount of food wastes generated by a selected farming community and capacity building through participatory food waste compost development and use for selected food crops in an agricultural community.

Composting was carried out for three months (January to March 2019) to produce a readily usable organic fertilizer. During this process, fourteen physico-chemical parameters (bulk density, porosity, water retention capacity, moisture content, organic matter, organic carbon, compost temperature, leachate temperature, pH, volatile solids, C : N ratio, relative humidity, air temperature and total dissolved solids); agronomic content of compost; heavy metals in leachate soil and compost were monitored, evaluated and analyzed to appraise the maturity evolution of the compost and three main phases were observed: the mesophilic; thermophilic and the maturation phase. The compost was used to grow hurkleberry and okra in comparison with inorganic fertilizers and control soil in a test farm for a period of four months.

It was noticed that compost efficiency is limited to some plants which include leafy vegetables. Its efficiency in Okra production was more observed in the growth of stems rather than on the growth of fruits. Moreover, the heavy metal concentrations of compost were far below the EU and USA standards. Besides, the following heavy metals in leachate: Cu, Zn, Cr, Pb and Ni were below while Cd, Fe and Mn were above the WHO guidelines for irrigation water. The agronomic content of compost was determined;

however, the permissible guidelines don't exist we had, organic carbon 31.4 %, nitrogen 28.2%, phosphorus 21.9% and potassium 4.00%. A training of agribusiness students on food waste composting was organized to raise awareness, build capacity towards sustainable farming practices, and empower them to disseminate knowledge.

Compost is a good soil amendment and should be used to promote sustainable agriculture in Buea.



Production and Characterisation of Fuel Briquette from Polyethylene Terephthalate Plastic Wastes and Biomass in Southern Addis Ababa, Ethiopia

Abate Haileyesus ZEMETE (PAU-UI-0314)

Plastic pollution is currently one of the biggest environmental concerns, especially in developing countries. One of plastic waste management is converting plastic wastes into fuel briquette. The objective of the study was, therefore, to develop a method of recovery and processing of Polyethylene Terephthalate (PET) plastic wastes for briquette production which can be used for household cooking, the fuel source for hotels and restaurants and other domestic heating purposes.

The study was designed to investigate developing and modifying the optimum proportion of waste PET plastic with sawdust and coffee husk for briquette production. The samples were combined between 0 - 100% PET-char and 100 - 0% biomasses with 10% PET-char deviation. Based on the proportion a total of eleven sample briquettes were produced with J. K. briquetting press machine at the temperature range $400 - 450^{\circ}$ C and at the pressure of 3MPa. The Physico-chemical properties of briquettes produced were tested at Geological survey of Ethiopia laboratory centre by using ASTM analytical standard methods. Minitab 18 statistical package was used for the analysis of the data which included One-Way ANOVA and Tukey method. Comparison of variances, multiple R and R² values were carried out in this study. Similarly, a comparison of the result of briquette produced properties was carried out with other biomass products.

The result revealed that it is possible to produce successfully fuel briquette from waste PET plastic materials combined with biomasses. This indicates that plastic wastes can be managed by converting into fuel energy. The analysis shows that increasing PET-char on sample combinations was statistically significant. This implies that the Physico-chemical properties of briquette produced are affected with increases of PET-char. Calorific value, moisture content, fixed carbon and density properties of briquette samples were highly affected by PET-char increment. The other properties which are Volatile matter and Ash content were not adversely affected by PET-char. This indicates that no matter the quantity of PET-char added could not be highly affected volatile matter and density properties of briquette produced. Concerning the comparative study of plastic briquette produced with other biofuel products, it is found that plastic-biomass briquette produced had low gaseous emission level of CO_2 viii, CO, NO_2 and SO_2 .

In general, the results revealed that it is possible to produce fuel briquette from waste PET plastics and biomasses. The findings also show that increasing PET-char on sample

combinations can significantly affect the properties of briquettes produced. The study also shows that produced briquette has low gaseous emission level as compared to other biofuel products.

Keywords: PET plastic, PET-char, Sawdust, Coffee husk



Effects of Climate Change on Hydroelectric Power Generation in Selingue Dam, Mali

Kadiatou CISSE (PAU-UI-0315)

Sélingué dam is a hydroelectric power generation dam that is located on the Sankarani river, Tributary of Niger River in the Sikasso region of Mali. The dam provides 44MW of electricity which is distributed to Bamako and some other regions of Mali. Knowing that climate change is defined as changes in weather parameters, is actually impinging on water cycle while directly affecting parameters such as water vapor concentrations, clouds, precipitation patterns and stream flow patterns, which are all inter-related. The concern the significance of the relationship between water cycle and hydropower generation in Sélingué dam, which depends on the runoff that increases as the rainfall quantity does. The vulnerability to climate change is of great interest as electricity production by hydropower is the most widely used form of renewable energy. This investigation was carried out to determine the effects of climate change on hydroelectric power generation in the dam using rainfall, evaporation and amount of power generated on the period of thirty years (1988–2018).

The mean monthly values of rainfall and evaporation given by the meteorological station of Sélingué as well as the one of power generated over the years were computed to show the trend patterns of each parameter and the energy generated. Data (Evaporation, Rainfall and energy) were analyzed using Pearson correlation coefficient, to determine the linear correlation between the different variables and to test the hypothesis.

The study revealed that was no significant correlation, in other work a very weak relationship exists between the weather parameters (rainfall, evaporation) with 0.077 and 0.043 correlation coefficient respectively and the energy generated in Selingué which might suggest that there are other factors contributing to hydropower energy generation in Sélingué dam.

It is recommended that the government should invest in new dams since Mali is endowed with a great hydrological potential, in order to meet the increasing energy demand of the population and avoid the use of alternatives not environmentally friendly. Also, further study should be done in order to assess other factors contributing to energy generation in the study area.



Master of Science in Geosciences

Mineral Exploration Option

Lithology Gold Mineralization Potential Mapping Using GIS and Remote-Sensing: A Case Study of the Mineralization Potential of the Kibi-Goldfields Concession, Kibi-Winneba Gold Belt, Ghana

Daniel Yaw Antwi BOATENG (PAU-UI-0207)

Gold exploration, just like searching for a needle in a haystack, the zones of favorability are quite rare. A small favorable area is of much suitability than a large exploration area (Karikari, 2002). The research therefore aimed at establishing the bedrock mineralization potential through the generation of a mineral potential map for the Kibi-Goldfields, Osino concession which has been likened to the prolific gold producing but yet to produce bed rock sourced gold. This was achieved by integrating weighted exploration evidential themes (hydrothermal alteration, soil geochemical data, structures and lineaments data) within a GIS environment. Hydrothermal alterations (i.e. hydroxyl, iron oxides and ferrous mineral alterations) were mapped using the Crosta Principal Component Analysis Technique of analyzing the spectral response of these alterations on the Landsat 7 ETM+ images of the area. Lineaments were automatically extracted from ASTER DEM images using the line extraction algorithm in the PCI Geomatica software. These and other evidential themes, after reclassification, were assigned weights based on knowledge on exploration in the area, similar gold belts of Ghana and integrated to generate the Mineral Potential Map (MPM) of the area. The MPM of a predictability rate of 93% delineated 8.5% of the total area (46 sq. Km) as highly favorable for hosting gold mineralization. However, from the distribution of the high potential zones, mineralization may not be associated with the major fault on the eastern section of the concession, but has a correlation with the metavolcanicmetasediment contact and the highly silicified metagreywackes of the area. Again, mineralization may be associated with pyrite, limonite and suspected sericite-containing metavolcanics closer to the contact, as some areas showing iron-oxide alterations had pyrite, box-works of pyrite and limonite containing outcrops. With the high predictability rate (~93%) of old mineralized points, this GIS and Remote Sensing technique are therefore deemed a powerful and cost-effective tool which can be utilized to delineate zones of mineralization and eliminate barren areas during mineral exploration programs.



Integrated Geophysical and Geochemical Exploration for Gold Deposit around Iperindo in Ilesha Schist Belt, Southwestern Nigeria

Ahmed Kehinde USMAN (PAU-UI-0288)

Gold is a precious metal of high commercial value and great economic importance with reported occurrences in alluvial and eluvial placers and as primary veins in several parts of the Schist Belts in the northwest and southwest of Nigeria. Thriving artisanal mining

of the resource have been reported around Iperindo axis of Ilesha Schist Belt, southwestern Nigeria. However, dearth of relevant geoscience information has limited the full development in terms of mining and production of this nature endowed resource.

Integration of Frequency Domain Electromagnetic (FDEM) and Electrical Resistivity Tomography (ERT) geophysical investigation techniques combined with geochemical exploration method were employed to evaluate the gold mineralization potential of the study area. Six FDEM and five ERT profiles were occupied using Geonics EM34-3 conductivity meter and SuperSting R8/IP/SP resistivity meter, respectively. Purposively collected nine soil samples and eleven stream sediments analyzed at the Bureau Veritas Minerals Laboratories, Vancouver, Canada were used for geochemical mapping. The acquired apparent resistivity data from the ERT profiles were inverted, using RES2DINV inversion software. The inverted ground resistivity and apparent conductivity data were sorted and gridded to generate 2D conductivity/resistivity sections, maps and 3D subsurface models, employed to characterize the subsurface. The generated geochemical data were processed using MS Excel, SPSS and R software packages to generate different plots.

Three distinct conductivity units comprising of relatively low conductivity (5 - 11)mS/m) top soil/overburden layer which is about 10 m in thickness, relatively high conductive zone (14 - 22.12 mS/m), suspected to be possible mineralized zones and low conductive un-weathered basement complex rocks were delineated from conductivity distribution across the study area. Also, three distinct georesistivity units comprising of relatively low to high resistivity (463.72 – 5516.24 Ω m) top soil/overburden layer which is about 10 m in thickness, relatively low resistive zone $(137\Omega m - 469\Omega m)$, suspected to be possible mineralized zones / ore bodies and high resistive un-weathered basement complex rocks were delineated from resistivity distribution across the study area. Geochemistry results revealed Au concentration ranges from 0.2 - 5.4 ppb with a mean of 1.36 ppb in soil samples and ranges from 0.4 - 3.1 ppb with a mean of 1.2 ppb in stream sediments and the calculated background values for Au in both soil samples and stream sediments for the study area were 1.3 ppb each. The maximum Au contents recorded in the analyzed soil and stream sediments were observed to have higher values than the computed statistical threshold values used for discriminating background from Au anomalies in the study area as well as the strongly positive correlation with Arsenic (As), a pathfinder element for Au, suggests Au anomalous concentration in the study area.

Gold is likely to occur within some of the identified veins in the delineated middle conductivity/georesistivity unit.



Geological Setting and Petrographic Features of Iron Ore Deposit around Sanje Area, Central Zambia

Mathews NGULUBE (PAU-UI- 0289)

Sanje iron ore is located 50 km west of Lusaka, at the north-eastern margin of the Pan-African granitic Hook batholith. Polymetallic oxide occurrences in the area have been known for many of years, but more recent geophysical and geochemical investigations led to the discovery of a iron rich hydrothermal system, mostly associated with late-stage syenite intrusions of the Hook batholith in the carbonate rocks. In view to understand the possible genesis of Fe mineralization and determine whether the deposit is of skarn origin, geochemical and petrographic studies were carried out.

A total of 14 representative fresh samples were collected during geological sampling for geochemical analysis and 14 for petrographic studies comprising of syenite, gabbro, dolomitic limestone, and phyllite and iron ore. The analysis for major elements was conducted using ICP -AES whereas trace and rare earth elements using ICP-MS. Geological map was generated using Q-GIS.

During geological field work, minor structural features such as folds and faults were observed in the carbonate rocks. Calcite and dolomite are the main minerals found in the veins of marbles while Calcic -silicate mineral such as quartz are found in veinlets of massive iron ore. With the help geochemistry results, several diagrams have been plotted for rock classification, tectonic setting and mineral enrichment. Total alkali versus silica (TAS) diagram $(Na_2O + K_2O vs SiO_2)$ classified plutonic rocks whereas Na_2O+K_2O -CaO vs SiO, diagram shows syenite plots in alkali field. Some of the few trace and rare earth elements used to plot diagram include Rb vs Y+Nb which plots plutonic rocks in within plate granite (WPG), Sr/Ba vs. Sr/Rb indicating the carbonates in the study area are deposited in continental margin environments whereas Al-Fe-Mn ternary diagram iron ore plot in the field of hydrothermal indicating the source of Fe mineralization. The REE data of iron ore reveals poor content in rare earth elements and shows decrease in concentration from LREE to HREE. PAAS pattern Eu anomalies Eu anomaly (Eu/Eu* = 1.26 avg.) signifying that the solutions which brought iron oxide were from a reducing environment while Ce anomalies as indicative of the oxidation of Ce, and therefore oxidative conditions during the ore mineralization processes.

The petrographic studies conducted on all the rock samples shows mineral composition highly altered due to severe hydrothermal alteration and supergene processes. Therefore, Sanje hill underwent metasomatism and skarnification occurred as a result of hydrothermal alteration.

Keywords: Granitic hook batholith, Continental margin environments, Sanje hill, Skanification, hydrothermal alteration



Geochemical and Structural Control of Sn-Ta-Nb Mineralization in Numbi Area, Eastern D.R Congo

Parfait MUPENGE MUTIYAMUOGO (PAU-UI-0290)

Numbi area, Eastern Democratic Republic of Congo is one of the few areas identified to host Sn-Nb-Ta mineralization however, very little informations are available on the geology of this area to ascertain the various lithological units and Sn-Nb-Ta mineralization. Therefore, this study was carried out to contribute to a better

understanding of the structural and geochemical control of Sn-Nb-Ta mineralization in the Numbi area.

Geological mapping and petrographic studies on selected samples were carried-out and a total of 21 samples comprising fresh representative basement rocks and saprolite pegmatites rocks were analyzed for major, trace and rare earth elements using ICP-MS/AES. Structural imprints were identified, marked and described on the field. Structural analysis was carried out using rose plots.

Geological mapping revealed four lithological units defined as schist, granite, diorite and amphibolite. Pegmatite is mostly found as veins under saprolite form. Petrographic studies revealed according to the level of abundance a mineral assemblage of plagioclase (15-55%), hornblende (8-55%), biotite (10-40%), quartz (5-40%) and muscovite (0.1 - 17 %). The major chemical compositions of sampled pegmatites shows that the average in percentages are as follows: SiO₂ (58.79 %), Al₂O₃ (24.56 %), Fe₂O₃ (3.4 %), K₂O (3.14 %). The MgO, Na₂O, MnO, CaO and TiO₂ are generally low being less than 1% in each case. It also revealed high average concentration of 117.85 ppm, 365.45 ppm, 189 ppm and 114.15 ppm, 691.25 ppm, 76.90 ppm for Nb, Ta and Sn in respectively in the analyzed granitic rocks and saprolite pegmatites samples whereas other analyzed samples show moderate to low concentration. Na₂O+K₂O vs SiO₂binary diagram, revealed granodiorite and diorite rock types belonging to the tholeiite series or calcalkaline series for the samples rocks. The trend of enrichment was in order of Sn >> Ta >Nb. Geochemical relationship such as K/Rb vs. Rb, Ta vs. Ga, Ta vs. Cs indicated that the analyzed rocks and saprolite pegmatites have high level of rare metal and rare earth element mineralization with very low K/Rb values (0.025 and 0.003) in rocks and saprolites indicative of high fractionation levels and mineralization. Structural assessment of the rocks revealed two main tectonic phases; the ductile tectonic phase (T1), that shows mineral lineation with an NE-SW trend and brittle tectonic phase (T2) characterized by the occurrence of veins and joints.

Results obtained showed that he mineralization is found in the rocks that display dioritic composition and the Sn-Ta-Nb mineralization was precipitated in structurally controlled locations, together with the alteration of the host-rocks.

Keywords: Geochemical, Lithology, Diorite, Sn-Nb-Ta mineralization, Numbi



Geology and Mineralization Style of Gold Bearing Deposits: A Case Study of Tulu Kapi Area, Western Wollega Zone, Oromia Region of Ethiopia

Geleta Warkisa DERESSA (PAU-UI-0291)

Tulu Kapi area is situated within Western Ethiopian Shield (WES) and known by hosting gold mineralization and is the most targeted area in Ethiopia. However, the geology of this area in terms of wall rock geochemistry, alterations, mineralization style and structural control of gold mineralization is not fully determined. Thus, the main objective of this study is to constrain the controls of mineralization, determining the

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petrogenesis of host rock, discriminating the alterations and determining mineralization style of gold-bearing deposits. Field investigation, structural analysis, geochemical and petrographic study were used for this study. Twenty-five chip and core samples were collected for laboratory analysis. Ten, four and eleven chip and core samples were collected and subjected to detail petrographic, ore microscopic and geochemical analysis respectively.

The study area is characterized by low-grade metamorphic rock with extensively faulted and emplaced by felsic to mafic intrusions. They are weakly metamorphosed from lower greenschist to lower amphibolite facies, intensely sheared linked with mineralized albitized haloes and basement structures trending NE-SW. Field observation and structural measurements indicate that the presence of undifferentiated fractures and foliations trending NE within Birbir domain and later deflecting the main fracture towards NW trending direction. Closely spaced fractures and foliations manifest the highly deformed area which is part of the identified NE-SW trending structures with dipping towards NW and minor SE dipping fractures.

The petrographical analysis reveals that the mineralogical compositions of Mafic Syenite which is composed of Albite 30%, Actinolite 20%, Microcline 15%, Biotite 10%, Feldspar 10%, Epidote 5%, Opaque minerals 5% and Quartz 5%; Sheared diorite comprising of Chlorite (25%), Plagioclase (15%), Epidote (15%), Opaque (15%), Biotite (10%), Sericite (5%), Muscovite (5%) and Hornblende (5%) and the host rock (AlbitizedSyenite) which is dominantly comprised of K-Feldspar (25-35%), Albite (30-45%), Altered Epidote (10-15%), Plagioclase feldspar, (20%) and Opaque (5%). The results from geochemical analysis indicate that the samples fall within both peraluminous (S type) and metaluminous (I type) that are situated within the VAG+Syn-COLG and few samples are plotted within the WPG.

The indication of Peraluminous compositions revealed that the source of rocks in the area are evolved from partial melting of metasedimentary and crystal fractionation of calc-alkaline materials during magmatic differentiation at volcanic arc magmatism and Syn-collisional associated with subduction environments. They have a chondrite normalized REE distribution pattern with enriched light REE (LREE) and depleted heavy REE (HREE) pattern with variable Eu anomalies. The mineralization in Tulu Kapi is associated with alterations such as albitization, pyritization, sericitization and propylitic assemblages (chlorite+epidote+calcite). The gold mineralization in the area is mainly hosted and localized within the albitizedSyenite and shear hosted quartz veins. Predominantly gold mineralization is associated with pyrite II at contact between pyrite, magnetite, chalcopyrite, galena and arsenopyrite filling the fractures. This indicates that the gold is deposited after deformation and the presence of prevalent lenses of orebodies along brittle-ductile overprinted structures and splay faulting along the shear zone suggesting the gold mineralization in the study area is both structurally and lithologically controlled.

Keywords: Mineralization, Alteration, Structural control, Sulphide



Geological Studies and Evaluation of Gold Mineralisation in TagotiebGossan (Derudeb Area), Northeast of Sudan

Alawed Hassan Altayeb MOHAMMED (PAU-UI-0292)

The Derudeb area is located in the Red Sea State, northeast Sudan in the southwest part of the Red Sea Hills. It is about 320 km from the city of Port Sudan and about 640 km from Khartoum.

It lies between latitudes: $17^{\circ} 14' \text{ N} - 17^{\circ} 52' \text{ N}$ and the longitudes: $36^{\circ} 00' \text{ E} - 36^{\circ} 15' \text{ E}$. The gossan of Tagotib is located close to the town of Derudeb. This study focuses on Tagotiebgossan in Derudeb area, there are two gossans, the Small gossan and the JebalMalakitgossan.

Field studies were conducted and 20 representative rock samples were collected from study area based on variation of rock. Thin section Analysis was conducted on those samples to detect their mineral composition. Those samples were used to create detailed geology of the study area. Data containing gold analysis and lithology for 17 boreholes were collected to do correlation between those boreholes to detect subsurface structure; also these data were used to estimate the reserve of the ore.

The analysis showed that the study area is dominated by granitoids as younger intrusion and acidic metavolcanics. It also showed that most of the boreholes have low grade of gold (0.1 ppm) and the high concentration of gold mainly founded in boreholes DH (008, 014 and 018). Correlation of the boreholes is not accurate because of lateral variation is too big and the body of gossans are small.

Keywords: Correlation, Estimation, Boreholes



Mineralogy, Geochemistry and Provenance of Geophagic Materials from Mfensi-Adankwame in the Ashanti Region of Ghana

Rasheed Mohammed ABDUL (PAU-UI-0293)

Geophagic practice is very common in rural areas of Ghana. However, this practice is gradually gaining wider popularity in the urban centres. Though, the natural geochemical and mineralogical characteristics of such soils portend health risk to geophagic individuals, the causes of diseases associated with ingestion of geophagic materials are often not obvious to the public health workers. This study, therefore sought to assess the mineralogical and compositional characteristics of geophagic materials from Mfensi-Adankwame in the Ashanti Region of Ghana, with the view to determining the provenance of the clays and addressing the possible health implications on the geophagic individuals.

Twenty samples were collected, comprising *in situ* samples from a clay mine pit (depth 1.5 metres; n=4); clays from processing site (n=12); and geophagic clay balls from vendors at the market (n=4). The samples were prepared (dried, pounded, sieved, bagged and labelled) and sent for geochemical analysis using Ultra Trace Aqua Regia ICP-MS

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analytical technique. The mineralogical phases in the *in situ* samples were also determined using Qualitative X-Ray Diffraction analysis (XRD Qual).

The results revealed quartz as the abundant mineral in the clay samples (average, 54.30%), with subordinate kaolinite (average, 25.98%) and muscovite (average, 19.78%) with traces of Anatase, Rutile and Sodium plagioclase. The chemical analysis revealed depletion of macro minerals such as (Na, Mg, K, Ca, P and S); micro minerals such as (Co, Cr, Cu, Fe, Mn, Mo, Se and Zn); and toxic trace elements such as (As, Pb, Cd and Hg) when compared with known standards in terms of elemental concentrations in clayey soils. Based on the estimated Health Risk Index of 0 to > 1, it can be inferred that the ingestion of the geophagic clays may not have negative health effect to the geophagic individuals, except for Pb and Cr. However, the presence of substantial amount of quartz in the clays may damage the dental enamel during mastication.

The provenance of the clays, inferred from Chemical Index of Alteration (average, 89.5%) and Chemical Index of Weathering (average, 96.8%) indicated the geophagic materials to have formed as a result of intense weathering from the source materials. In addition, geochemical plots for provenance showed that the clays are of metasedimentary source.

Keywords: Geophagic clays; Mfensi-Adankwame; Provenance; Chemical Index of Alteration; Macro mineral



Geochemical Study of Gold-Bearing Rocks around Kouba-Nimbere Area, Northwestern Benin Republic

Bertrand ANAGONOU (PAU-UI -0294)

Gold mineralization has been reported by earlier studies in the Kouba-Nimbéré area within the Atacora Unit. Previous studies did not elucidate the source of the gold in the area, their prospects and style of mineralization. The aim of present study is to determine the mineralogy and geochemistry of the gold-bearing rocks in Kouba-Nimbéré area within the Atacora Unit of the Pan-African Dahomeyides belt in the northern part of Bénin republic.

Geological mapping of the area was carried out on a scale of 1:25,000. Thin sections were prepared for petrographic studies in the Department of Geology, University of Ibadan. Major, trace and rare-earth elements contents 20 representative samples of the rocks were determined by the inductively coupled plasma-mass spectrometry. Fire assay and gravimetric methods were used for the concentration of gold and loss on ignition, respectively. The geochemical analyses were carried out at the Activation Laboratories Ltd, Canada. Geochemical data obtained were interpreted using discrimination diagrams.

The investigated area is underlain by metasedimentary rocks (schists and quartzites) hosting milky to white vitreous quartz veins. The rocks are weathered to lateritic clay cover of between 2 and 5m thick. The CaO (0.34), Na₂O (0.19) and Sr (51.6) concentrations are significantly depleted with regard to average Neoproterozoic upper

crust whereas $K_2O(1.7)$, Rb (66) and Ba (504.4) are enriched and close to the upper crustal value. The high field strength elements and transition metals concentrations are generally similar to those of Neoproterozoic upper crustal with exception of Zr and Hf that are significantly enriched. The normalized chondrites showed LREE enrichment, significant negative Eu anomaly and generally flat HREEs. On the basis of La/Sc (8.69), Th/Sc (3.40), La/Co (5.68), Th/Co (1.28), Zr/Sc (54.34) and La/Th (0.36) ratios, Eu/Eu* values (0.62), and high Zr (2400) and Hf (62.2) concentrations, the source rocks are believed to be composed predominantly of felsic recycled sedimentary rocks. Gold pathfinder elements, notably As, Ag, Ni, Zn, Cu, Pb, Mo and Bi concentrations in the rocks are below their detection limits. The quartzites showed traces of gold (0.4ppm), however the metasedimentary rock samples have high concentrations of Ba (1123 ppm), W (1190 ppm) and Zr (2400 ppm), which could indicate Ba, Zr and W ore mineralization. The gold concentration in the saprolite are (0.2-1.7ppm) indicating secondary gold from infiltration and supergene enrichment.

The Kouba-Nimbéré area within the Atacora Unit of the Pan-African Dahomeyides belt in the northern part of Bénin republic is composed of quartzite and quartz schist. Primary gold is not found in the schists and quartzites in the area, however there are prospects for Ba, Zr and W ore.

Keywords: Quartzites, Gold, Atacora Unit, Kouba-Nimbéré, Dahomeyides



Assessment of Trace Elements in Abandoned Ponds of Lead-Zinc Mining Districts of Wase, North-central Nigeria

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Extensive mining of Pb-Zn occurs in Gimbi and its environs in Wase, North Central Nigeria, has led to the occurrence of many mine ponds which have become water reservoirs for domestic purposes in many cases. This study assessed the concentration of trace elements in mine ponds, to determine the level of contamination due to mining activities in the area with the aim of identifying the principal contaminants.

A total of twenty-four abandoned mine ponds, one active mine pond, a stream and a borehole were analyzed for their trace elements content using Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The contamination level was estimated using evaluation indices such as; Contamination Factor (CF), Geo-accumulation index (Igeo), and Pollution Load Index (PLI). The data were subjected to Principal Component Analysis (PCA), Pearson's Correlation and Factor Analysis, to establish the relationship between the elements and decipher their sources.

The mean concentrations of Arsenic (As), Boron (B), Barium (Ba), Chlorine (Cl), Copper (Cu), Iron (Fe), Sodium (Na) and Nickel (Ni) were within the World Health Organization (WHO) and Nigerian Standard for Drinking Water Quality (NSDWQ) allowable limit for drinking water.Aluminium (Al), Magnesium (Mg), Manganese (Mn), Zinc (Zn), Cadmium (Cd) and Lead (Pb) mean concentrations exceeded the WHO

standard for drinking water. The level of contamination according to the CF and Igeo is Cd>Pb>Mn>Al>Zn>Mg>Fe>Ba>Na>Ni>As>U>B>Cu. The results of the CF also revealed that contamination is highest in the active mine pond, the CF values indicated very high contamination for Cd and Pb, moderate contamination for Al, Mg, Mn and Zn, while As, B, Ba, Cl, Cu, Fe, Na and Ni show low contamination. The elements Pb, Cu, Fe, Cd, Mn, Zn and Ni display a strong positive correlation suggesting similar sources (anthropogenic) probably due to the mining activities. Na and Mg also have a strong positive correlation indicating they are from geogenic sources.

The active mine pond was found to be highly contaminated with toxic elements. Control measures should be put in place to avoid contamination of ground water systems in areas around the active mine and potable water sources have to be provided for the inhabitants use, to replace the mine ponds.

Keywords: Wase districts, Mine ponds, Trace elements, Contamination Factor, Contamination



Mineralogical and Geochemical Characteristics of Sangaredi Bauxite Deposit, Boke Region, Republic of Guinea

Abdourahamane Diogo BARRY (PAU-UI-0297)

Sangarédi is one of the few areas identified to have Bauxite Mineralization in Republic of Guinea. However, detailed information about the source(s) of the mineralization, processes responsible for its formation and economic viability in the study area are lacking. There are insufficient data on the geology, mineralogy and geochemistry of Sangarédi bauxites deposit.

In this study, geological field mapping, mineralogical and geochemical investigations were carried out on the different types of bauxites (sedimentary, lateritic in-situ and chimogen) in the Sangarédi plateau. Mineralogical and geochemical studies were done by using the X-ray diffractometry (XRD) and Inductively Coupled Plasma Atomic Emission Spectrometry (ICPAES) methods.

Mineralogical analysis and petrological study revealed that the mineralogy is almost identical in the three bauxite types of the Sangarédi plateau. Gibbsite and boehmite are the dominant aluminium minerals with an average concentration of 91.85% and 3.3%, respectively; Gibbsite is very high in all the bauxite samples. Goethite is the major iron mineral, with average concentration of 1.35%. whereas haematite shows lower contents (average of 0.7%). Quartz and kaolinite are mostly responsible for the silica content of the bauxites. Diaspore, dawsonite, rutile and anatase occur in low amount in bauxites (< 1%). The abundances of several elements are highly correlated due to their association with specific elements, such as Ti, and Na in residual ilmenite grains. Geochemical analyses of all bauxite samples show that the main components of the bauxitic ore are Al₂O₃ (55.63–68.92%), Fe₂O₃ (1.44–8.89%), SiO₂ (0.47– 5.68%), and TiO₂ (2.48–5.45%). Trace elements investigation indicate that the bauxite samples have high

values of Sc, Ga, Nb, Sr, Th, V, Zr, Y, La with Ce. Zr (399.3 - 984.7ppm) as the most abundant trace element in the bauxite samples.

The mineralogical and chemical properties of Sangarédi bauxite deposits were compared with those of other large bauxite deposits in Republic of Guinea and overseas. Sangarédi deposit differ from other deposits in Guinea and those in many other parts the world. This is because it is very rich in alumina (56 - 69%), very low in silica (0.47-5.68%) and in iron oxide (1.46-8.89%). The bauxites from Sangarédi plateau have been classified as sedimentary, lateritic insitu and chimogen types.

Keywords: Sedimentary bauxites, Lateritic bauxites, Chimogen bauxites, Sangarédi deposit, Fouta Jallon plateau



Masters in Petroleum Geosciences

Cost Study of Drilling Activities of Rawat Basin, Sudan

Mosab Mohammed Ahmed MOHAMMED (PAU-UI-0298)

Drilling of wells is a major expense for the upstream petroleum industry. In literature, there is no published data available on the drilling costs in Sudan, because of the confidentiality clauses. This thesis aims to study the technical and commercial performance of petroleum wells drilled in the Rawat basin. Commercial performance is measured by well cost while technical performance is measured by Drilling Time.

The data collection process included Daily Drilling Reports (DDR) for four wells and Daily Drilling Cost (DDC) for three wells in the Rawat basin for both Rawat field and Wateesh field. The data source was from the Sudanese Petroleum Corporation. Exponential Regression and exponential equations were used for the cost study.

Using the coefficient of determination (\mathbb{R}^2) revealed that there has been a high correlation between drilling days and drilled interval in the Rawat basin, as well as a high correlation between drilling interval and well cost in the Rawat basin and based on that correlations were made to estimate drilling days and well cost.

Results of this study give a general idea about drilling cost and drilling days in Rawat basin A future study using more wells is needed.

Keywords: Well cost, Regression analysis, Coefficient of determination, Drilling days, Drilled Interval



Sedimentary Characteristics of Marine Deposits of Khor Eit Formation in the Sudanese Red Sea Coastal Plain, Portsudan, Sudan

Omer Mohamed Abubaker MOHAMED (*PAU-UI-0299*)

Depositional environments of the outcropping sections base on vertical and lateral profiles of Sudanese Red Sea coastal plain are reflected from the textural properties, sedimentary structures, fossil contents, diagenetic processes among others in the sedimentary rocks. In this study, an attempt was made to deduct the depositional environment from the sediment's characteristics and fossil contents in the samples and thin section.

Field studies and observations were conducted base on the geology features and representative rock samples were collected for laboratory analysis. Field observations have shown that sediments comprise of fossiliferous limestones (coquina limestones, skeletal limestone, etc.), dolomites, sandstones, shales among others.

These observations suggested that the sediments were deposited in a shallow open marine environment. Petrography study of the carbonates rocks has also revealed lime mud dominated lithology and presence of bioclasts, these indicated a low energy shallow water environment below storm wave. Besides, the variety and size of bioclasts are indicative of deposition in an open shallow marine setting. Therefore, the occurrence of bioclasts in the sediments can also deduce an open shallow marine depositional environment. The carbonate sediments in the study areas contained several macrofossils that were found to help reconstruct the depositional environment of the sediments. The identified macrofossils include brachiopods, Bivalves, gastropods, corals, etc. These fossils are typical of near-shore, agitated shallow-water environments. The occurrence of gypsum evaporite deposits in the study area also gives a significant contribution to the depositional environment. In a few locations, the gypsum was seen in good thickness and underlying the limestones, the presence of gypsum suggested a lake environment where evaporation could occur. Based on field lithological observations and petrographic studies, the sediments are deposited in a shallow open marine to coastal shelf environment.

Keywords: Calcareous Sandstone; Calcite Grains; Bioclasts Bivalve; Red Sea Coastal plan, Port Sudan



Geochemistry and Mineralogy of Clastic Sediments from Selected Cores, Eastern Dahomey Basin, South Western Nigeria

Olukolade Temiloluwa OLUGBEJE (PAU-UI-0300)

A total of 23 core samples of clastic sediments from four boreholes namely Gbokoto, Soderu, Agbon and Igbeme in Eastern Dahomey Basin were subjected to geochemical and mineralogical analyses with a view to characterise the provenance, depositional

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environment, tectonic setting, weathering history, paleoclimatic condition as well as the dominant clay mineralogy of the study area. The techniques applied include core lithodescription from the four shallow onshore wells as well as laboratory analyses which include X-ray diffraction (XRD), Inductively Coupled Plasma Mass Spectroscopy (ICP-MS) and Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). These analyses allow for the determination of clay mineralogy, major oxides, trace and rare earth elemental composition of the sediments.

Lithologic description of the core samples indicate shale as the dominant rock type, intercalated with thin limestone beds containing phosphatic noodles in some parts. The intercalation of limestone with shale is an indication of shallow to deep marine setting. The shales are generally well laminated, fissile, well consolidated and range from grey to black in colour suggesting the presence of organic matter in varying amounts. Results obtained from mineralogical studies using x-ray diffraction analysis revealed dominance of kaolinite and montmorillonite peaks with relative percentages of 40.71 and 11.34 each indicating that the clay mineral assemblage is largely of detrital origin and suggests cool or dry climatic conditions favouring mechanical erosion of source rocks. The average values obtained for some of the major oxides obtained include SiO, (44.41%), Al₂O₃ (14.5%), Fe₂O₃ (5.75%) and CaO (4.52%) and this make up for over 65% of the bulk chemical composition. The values of the Chemical Index of Alteration (CIA) and Chemical Index of Weathering (CIW) range from (1.7-92.2), (avg 75.45) and (1.794.7), (avg 77.5) respectively, this suggests a moderate to high degree of weathering in the source area. The discriminant function plots characterized the sediments as being derived from mafic igneous rock and quartoze sedimentary provenances while plots of K₂O against SiO₂ and the discriminant function plots indicate that the sediments were deposited within the passive margin, also AKF ternary plots revealed that the sediments are derived from continental environment. La/Th vs. Th/Yb plot show more mafic character for the sediments while Th-ScZr/10 Plots suggests that the sediments were deposited in a continental island arc tectonic setting. High TiO₂ values ranging from (0.06-1.12) and Rb/K₂O values ranging from (42.27–74.87) also suggest that the shale and clay samples were matured. Geochemical parameters such as U, U/Th, Ni/Co and Cu/Zn ratios with average values of (2.47, 0.24, 2.66, and 0.08) O/Na, indicated that these shales were deposited in oxic conditions and a passive-margin tectonic setting was adduced for the sedimentary sequences.

Conclusively, the results shows that the clastic sediments consist mainly of kaolinite and montmorillonite as the dominant clay minerals suggesting cool or dry climatic conditions favouring mechanical erosion of source rocks, the sediments been subjected to moderate to high degree of weathering and were deposited under oxic conditions with a passive margin tectonic setting and were derived from mafic to quartzose sedimentary to mafic igneous rocks.

Keywords: Dahomey Basin, Geochemistry, Lithostratigraphy, Mineralogy, Provenance and Tectonic setting

Petrophysical and Reservoir Evaluation of the Lower Cretaceous Strata (Bentiu Formation) in Neem Oil Field, Muglad Basin, Sudan

Mohammed Osman Saeed MOHAMMED (PAU-UI-0301)

The study area lies in the North-Eastern part of the Block-4 in Neem field of the Muglad Rift Basin, which is the largest and most important oil production basin of Sudan.

The Petrophysical characteristic using interactive Petrophysics software (IP) of the Bentiu formation has been studied to evaluate their hydrocarbon potential with following Petrophysical parameters; porosity, water saturation, reservoir thickness and volume of shale were estimated for each hydrocarbon-bearing zone delineated for each well.

A comparison study of water saturation on Neem wells was carried out using four different saturation models (Archie, Indonesian, Simandoux, and Dual-water), the results from the study have shown that the average water saturation values from Archie model ranging from 25.9% to 39.4% were higher than that of shaly models and Simandoux model yields average water saturation value from 23% to 43% which is close to that given by Archie model.

The result from the Dual-water model from 9.6 % to 27.6 % which is slightly lower than that of Archie model but close to Simandoux model from the Indonesian model, it is clear that the average Sw is relatively lower compared to other two shaly models and it is not close to that of the Archie model, so this model is most useful for the study area.

The findings after the petrophysical evaluation by using the results from Indonesian model indicate that the wells penetrated formations with good reservoir quality in terms of porosity, with value that ranges from (18.5% - 24.3%), clay volume (11.3% - 29%), water saturation (6.9% - 30%). In relation to hydrocarbon saturation and porosity, two of the wells (NE-03 and NE-06) gave better results suggesting that they were drilled through the productive part of the reservoir. The contour maps of these parameters, which are needed for the formation evaluation, were prepared to reflect the general lateral distribution throughout in these study for Bentiu reservoir. The results also reveal that the average volumes of shale decrease from the southeastern part of the field towards the northwestern; while the average porosities and water saturations increase from the Northwestern through the southeastern part of the study area.

Keywords: Volume of shale, Porosity, Water saturation, Net pay, Petrophysical analysis, Reservoir, Wireline log, Neem Oil field



Geochemical Fingerprinting of Oil Impacted Soil and Water Samples in Some Selected Areas within the Niger Delta

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With over fifty years of oil exploration and exploitation in the Niger Delta, there has been an increasing rate of environmental degradation due to hydrocarbon pollution. Efforts have not been made to characterise the Polyaromatic Hydrocarbon (PAH) and Aliphatic Hydrocarbons (AHs) contents of water and soil media as practiced in other climes. This study is therefore aimed at tracing the sources of the oil spills and the distribution of pollutants in selected communities in the Niger Delta using geochemical techniques.

A total of sixteen samples made up of ten (10) crude oil-impacted soil samples taken at a depth of 30cm, two (2) water samples; each from boreholes and burrow pits and two (2) surface water samples; one from a river and rain harvest as control, were obtained. Organic pollutants were separated from the soil and water samples using ultra sonic extraction and separatory funnel respectively. The extracts were fractionated into the AHs and PAHs fractions by eluting with n-hexane and dichloromethane respectively. The identification and quantification of Ahs and PAHs were performed with an Agilent 7890B Gas Chromatograph Flame Ionization Detector (GC-FID). Diagnostic ratios of AHs and PAHs were used to deduce the sources and of the pollutants. The AHs including pristine and phytane, together with seventeen priority PAHs, were identified. The values of AHs and PAHs in the water samples ranged from 0.13mg/l to 5.78mg/l and 0.09 mg/l to 1.109 mg/l respectively while that for the soil samples ranged from 22.52mg/kg to 929.44mg/kg and 10.544 mg/kg to 16.879 mg/kg respectively. The predominance of 3ring (36%) and 4-ring (21%) PAHs across the samples are indicative of recent deposition and persistence of high molecular weight fractions in the environment. The abundance of n-alkanes showed that the effect of degradation has been minimal. PAHs diagnostic ratios suggests petrogenic sources, with minor contribution from combustion for the pollutants. Diagnostic ratios of aliphatic hydrocarbons revealed the Niger Delta crude oil as the source of hydrocarbon contamination. The PAH concentration in the soil samples were 10.54-16.89 times higher than the threshold of 1 mg/kg, proposed by the Department of Petroleum Resources and are classified as heavily polluted.

This study demonstrated that geochemical fingerprinting of oil impacted soil and water media in the Niger Delta provides an opportunity to monitor environmental degradation. Best practices coupled with regulatory measures are hereby proposed to prevent the region from turning into pollution sources.

Keywords: PAH, Aliphatic Hydrocarbon, N-alkanes, Fingerprinting, Soil, Water, Niger Delta



Sequence Stratigraphy and the Prospectivity Assessment of the Campanian Section, West Tano Basin, Offshore Ghana

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The quest for Ghana to optimally expand, explore and exploit its Hydrocarbon reserves has led to several exploration activities in the prolific Tano Basin. Understanding of the depositional trends in the context of prospectivity assessment of some part of Tano Basin has not been well established. As such, the objective of this study is to apply the principles of sequence stratigraphy in order to understand the depositional trends and assess the Hydrocarbon prospectivity of the Campanian interval of the West Tano Basin. The dataset includes; a 3D seismic data, well logs and biostratigraphic data from a study area in the West Tano Basin. Petrel 2015 and other geoscientific software were used for the interpretation of the data set. Well correlation was done with offset wells in the Tano Basin using logs signature and tied the information to the 3D seismic section to identify regional makers, generate time structural maps and time slice for the Campanian interval.

This application indicates that the Campanian interval was dominantly a lowstand fan unit from biostratigraphic analysis with the recovering of fresh water algae. Seven mega sequences were delineated on the seismic scale in response to the transgression and regression cycle. Also, comparative seismic study shows that the study area is more erosive – a possible indication of strong energy of deposition with slope instability. The depositional systems in the Campanian interval revealed by seismic attribute extractions are submarine fans deposited in the middle and lower bathyl. Spectral decomposition analysis further revealed the architecture of the depositional elements as channel systems (channel-fills, sinuous channel and levee), frontal splays and lobes.

The hydrocarbon assessment of the Campanian interval is prolific with possible reservoir sands as revealed by the channel system, frontal splay and lobes.

Keywords: Depositional trend; Campanian interval; Submarine fans; Tano Basin

Reservoir Evaluation and 3D Static Modelling Of the "Baris Field", Onshore Niger Delta, Nigeria

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Three-dimensional (3D) static modelling of reservoir is the most accurate method used to understand the reservoir architecture and its properties through integration of wireline logs and 3D seismic data. In order to re-evaluate "BARIS Field" in the Niger Delta Basin, Nigeria, wireline logs of four wells (BARIS_2, 3, 5 and 6) and 3D seismic data of the field were obtained.

Petrophysical analysis, seismic interpretation and 3D static reservoir modelling was carried out by integrating the well logs of the four wells and 3D seismic data of the study

area using Geographix software suite and Petrel 2015.

Sand and shale were the main lithologies encountered in the field and petrophysical analysis of the four reservoirs of interest (reservoirs A4, B2, B5 and C9) show that the field consist of good quality reservoirs; porosity ranging from 21 to 23%, permeability ranging from 235 to 1220mD and water saturation ranging from 16 to 34%. Seismic interpretation revealed the presence of six listric faults; two major faults (1 and 2 trending in the northwest – southeast direction) and four minor faults (3, 4, 5 and 6). Faults 3, 4 and 5 trends in the same direction as the major faults, while, fault 6 trends in the northeast – southwest direction. The four horizons identified, correspond to the reservoir tops (A2_top, B2_top, B5_top and C9_top) and revealed the presence of roll-over anticlinal structures between the two major listric faults, and all the four wells targeted this structure.

The root mean square seismic attribute revealed the presence of stratigraphic traps as prospects. The 3D static model of reservoir C9 revealed that the central part of the field consists of good reservoir properties and most of the wells were drilled in this region. The quality of the reservoir deteriorates in the south and southeastern direction.

3D reservoir modelling of "BARIS Field" has proven to be effective for understanding of the spatial distribution of the facies, petrophysical properties, and production behavior of the reservoirs.

Keywords: Reservoir quality; Facies; Listric faults; stratigraphic traps; 3D static reservoir model

