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most communities in the Niger Delta where oil producing facilities are located. Risk assessment involves the characterization of the nature, magnitude and likelihood of adverse effects on human health or ecosystems from exposure to one or more residual contaminants at a contaminated site through various pathways. This paper evaluates existing or potential adverse impacts resulting from chronic exposure to contaminants at the contaminated site and to communities located less than 50m away. The site had been deeply impacted by an unquantified volume of petroleum hydrocarbons, to depths of about 9m to 10m below ground surface. Water table is shallow and was encountered at less than 0.5m during the peak rainy season when recharge is highest; and crude oil had been found floating on groundwater as observed from monitoring wells installed on site. Seasonal fluctuations of the water table left a smear range of about 3-6m within the soil matrix; and this constituted secondary sources of contamination. Pre-remediation chemical analysis showed soil TPH values ranging from 30,000mg/kg to 160,000mg/kg; while post remediation TPH values though reduced below the (Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN) intervention values of 5,000mg/kg are still higher than the target values of 50mg/kg. BTEX levels reduced from 5mg/kg to less than 1mg/kg in soil and from 400μg/l to <3μg/l in groundwater. Similarly, PAH levels reduced from 700mg/kg to 5mg/kg in soil and from 10μg/l to <3μg/l in groundwater. However, the presence of these contaminants, at these levels, still pose substantial risk to man and the environment.

Application of Electrical Resistivity method to delineate hydrocarbon spill, Case Study at Abesan Estate, Lagos Nigeria

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Contamination due to hydrocarbon is very common and has posed a problem to many communities; one of which is Abesan Housing estate, Ipaja, a suburb of Lagos State underlain by the Benin formation. In view of determining the spacial and depth extent of hydrocarbon pollution in Abesan estate, the electrical resistivity method was adopted. 16 VES stations were occupied with two horizontal profiles; using Schlumberger and Wenner electrode array respectively.

The data obtained were qualitatively processed and interpreted in consonance with the geology of the area. VES curves were generated for the Schlumberger array, while pseudo-section was produced for the horizontal profiles; layer resistivity and thickness maps as well as resistivity maps at depth interval of 1 m to 6 m were produced to monitor the supposed hydrocarbon plume.

Three to four geoelectric layers were delineated. The relatively low resistivity values of layer 2 for VES 11 to 16 within a shallow depth range of 1.5 m to 6 m in the parts that have complained of the problem, are suggestive of hydrocarbon biodegradation. This could be attributed to mature hydrocarbon spill. The result of the study reveal that there is possibility of biodegradation of the hydrocarbon over a long period of time, and the magnitude of the resistivity anomaly depends on proximity to the source of the spill. Integrated geophysical approach using lithologic log, electrical resistivity sounding and profiling, with analysis of physico-chemical samples from drilled boreholes is recommended for further study.

Key Words: oil spill, Environmental Impact Assessment, oil pollution, biodegradation, Electrical Resistivity Method

Environmental Impact of Artisanal Gold Mining around Kataeregi Area, North-Central Nigeria

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The geology and geochemical studies of water, stream sediments and rocks from Kataeregi artisanal gold mining, North-central Nigeria was carried out with the aim of determining its host rock, assessing the impact of such activity on the surrounding and evaluating the suitability of the water in the area for probable uses. The field work involves the collection of representative rock, water and sediment samples along stream, mined and background areas within the location of study. The rock and sediment samples were analyzed for trace element concentrations using X-ray fluorescence spectrometry. Water samples were analyzed for cation, anion and trace elements determinations. The average concentration of these trace elements in rocks and sediments were compared with published average crustal abundances of the elements in upper continental crust and the water compared with Nigerian Standard for Drinking Water Quality (NSDWQ, 2007) and World Health Organization (WHO, 2011) Standards. Geological field mapping show that 60% of the total area is underlain by Migmatite Granite-Gneiss complex while Schist account for 20% and Sandstone 20%. The geochemical analysis of the representative rock samples indicates probable Au-Ag-Hg mineralization with average concentrations of 0.16ppm, 2.53ppm and 0.21ppm respectively. Au is hosted by

the Schist rocks found within the central portion of the study area while Ag and Hg occur in both Migmatite Granite-Gneiss complex and the Schist rocks. Geochemistry of the sediment samples revealed the sediments are enriched with elements such as Au (0.23ppm), Ag (2.59ppm), Hg (0.21ppm) and Mo (1.14ppm). Findings from water analyses and Langguth trilinear diagram revealed the water to be earth-alkaline fresh water with high alkaline content, and mostly sulphate type. The elevated Pb content in water is attributed to the influence from local geology and gold mining activities while the Fe and SO_4 could results in input from oxidative weathering of pyrite associated with the gold mineralization in the area. These trace metals like Hg in rocks and sediments, and Pb in water from the study area can get consumed directly or indirectly through food chain. They are potential toxic elements that can render water unfit, causes slow growth rate in plant and respiratory, nervous and reproductive disorder in man. Regulations should be put in place to curtail excessive ground opening during mining, environmental friendly and scientific usage of mercury in gold processing encouraged, and indiscriminate mined waste disposal discouraged. However, it is advisable to explore and exploit for Ag to complement Au exploitation in the area.

Keywords: Geology, Artisanal gold mining, Sediment Geochemistry, Water Quality, Kataeregi, North-central Nigeria

Electrical Resistivity Survey of Closed Open Solid Waste Disposal Sites in Port Harcourt

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Increasing concern for the impact of anthropogenic activities on the environment has informed government to be proactive in the control and containment of polluting activities, including the closure of open solid waste disposal sites in Port Harcourt. Despite the closures, the effect of the wastes on these hitherto unengineered landfill sites remain unknown. This work was therefore carried out to assess the subsurface conditions of soils and groundwater at 10 locations in Port Harcourt, which , until closure, were major solid waste receiving pits. Both 1D and 2D electrical resistivity survey methods were used in the field investigation employing both Schlumberger and Wenner electrode configurations. The sites are located in terrains varying from swamps to dry flatlands. Water table depth ranges from 2 to 13m. 1D surveys yielded 4 to 5 layer geoelectric and AQ type curves interpreted as mainly sand. Generally, from 2D electrical studies, resistivity values indicate that leachate from the wastes may have percolated to the water table in some locations, and the pollutant plumes are moving and spreading by advection and diffusion processes respectively. Site specific impacts are highlighted in the report. Sanitary landfills are proposed for the management of these unsegregated municipal wastes to ensure that there is no further hydraulic connection between the wastes and groundwater in order to protect public health and safety.

Chemistry of Groundwater from Mud Volcanoes in Parts of Upper Benue Trough, North Eastern Nigeria

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Mud volcanoes grouped into 14 fields are found in southern Gombe, part of the Cretaceous Upper Benue Trough filled with Early Cretaceous continental deposits and Late Cretaceous marine deposits, with a history of magmatism dating from Albian to Pleistocene. They are mostly of small sizes, having cones not exceeding one and half metres in height and diameters ranging from 0.5 m to 8 m at base, as well as pools with muddy water and mudflows were encountered. Results of the study showed that the cationic and anionic concentration varies as follows: Ca^{2+} (22.8 mg/l), Mg^{2+} (5.1 mg/l), Na^{+} (783.1 mg/l), K^{+} (30.1 mg/l) Fe(1.4 mg/l), HCO_3^- (1047.3 mg/l),Cl^- (297.0 mg/l), SO_4^{2-}(13.4 mg/l), CO_3^{2-} (224.3 mg/l) and SiO_2 (21.7 mg/l). The study also revealed that the water issuing from the mud volcanoes is highly alkaline ($7.94 = pH = 8.99$), saline ($140 = TDS = 1620$ mg/l), very hard ($102 = TH = 1180$ mg/l) and belong to five hydrochemical facies namely: Na-HCO_3, Na-HCO_3-Cl,Na-Ca-HCO_3, Na-Cl-CO_3 - HCO_3 and Ca-Na-HCO_3. The dominant hydrochemical facies is Na-HCO_3 while Ca-Na-HCO_3 is the minor water type.Statistical correlation revealed positive correlation between most of the parameters. With the exception of Ca^{2+}, Mg^{2+} and SO_4^{2-}, all other parameters have concentrations above the World Health Organisation standards for drinking water. These waters are mineralised and are not considered to be suitable for drinking and domestic purposes, but may be considered for therapeutic purposes.

Keywords: Upper Benue Trough, mud volcanoes, hydrochemical facies, pH, cations, anions, Nigeria.