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9TH IMGA (NIGERIA) AND 1ST AFRICAN REGIONAL CONFERENCE AND EXHIBITIONS 2026

JACMEDGEO CENTRE, NASARAWA STATE UNIVERSITY KEFFI, NIGERIA

„MEDICAL GEOLOGY IN PUBLIC HEALTH AND SUSTAINABILITY

FOR THE CREATION OF RESILIENTCOMMUNITY SYSTEMS"

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ABSTRACT BOOK

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GEOGENIC FLUORIDE CONTAMINATION AND THE OCCURRENCE OF DENTAL AND SKELETAL FLUOROSIS: AN INTEGRATED GEOSPATIAL, HYDROGEOCHEMICAL, AND MACHINE LEARNING APPROACH

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Abstract

Geogenic groundwater fluoride pollution is a significant societal health issue that impacts a number of millions of people globally, especially in the arid and semi-arid environments that are covered with fluoride-carrying lithologies. Constant ingestion of fluoride-contaminated aquifers causes dental and skeletal fluorosis, which are irreversible degeneration of dental enamel, bone mass and general living conditions. Fluorosis in many developing countries, such as in Nigeria and other sub-Saharan African settings, is significantly underreported, under mapped and under addressed due to the small geospatial risk assessment capabilities as well as the lack of integration of geological and hydrogeochemical and epidemiological data.

The study hypothesises a combined approach to geospatial modelling to assess geogenic fluoride distribution and the risk of fluorosis associated with it, by utilising Geographic Information Systems (GIS), remote sensing, as well as hydrogeochemical diagnostics and modern machine learning approaches.

The research design uses the records of groundwater fluoride concentration, lithological and structural mapping, digital elevation models (DEM), climatic variables, land-use typologies and population exposure indices to generate predictive fluoride risk cartographies. Machine learning models (Random Forest (RF), Support Vector Machines (SVM) and Gradient Boosting (XGBoost) will be trained to learn spatial predictors of fluoride enrichment and suggest high-risk areas of fluorosis. Model validation will be run using groundwater readings of the past and reported fluoride cases data. The products obtained will include high-resolution fluoride hazard and fluorosis risk maps and a GIS-based decision support system that aims at deployers including water resource managers and public health agencies. The expected results include the development of a better understanding of the geogenic control of fluorides and the development of early warning signals to prevent fluorosis.

Keywords

Groundwater fluoride; Pollution studies; Diagnostic modelling; Early warning signals; Nigeria

THE IMPACT OF LIMESTONE QUARRYING ON SOIL QUALITY AND THE ASSOCIATED HUMAN HEALTH IMPLICATIONS

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Abstract

Soil contamination with toxic elements leads to soil pollution causing alteration of soil quality for agricultural practice and adverse non carcinogenic and carcinogenic effects to human health. Soil health influence the quality of crop yield. Characterising human health risk safeguards against the outbreak of epidemics such as soil poisoning and non-carcinogenic and carcinogenic risks in children and adults inhabiting an industrial area. Soil solutions were analysed for acidity (pH) and redox potential (Eh) using pH meter and redox pH meter, respectively. Toxic trace elements such as arsenic (As), chromium (Cr), iron (Fe), cadmium (Cd), lead (Pb), nickel (Ni), and zinc (Zn) were analysed using atomic absorption spectrophotometry (AAS).

Data analysis was by single and multi-element pollution indices such as enrichment factor, contamination factor and geo- accumulation index (I-geo). Human health risk was characterised using non carcinogenic and carcinogenic risk. The pH showed moderate acidity and neutral to weakly alkaline. The Eh obtained a mean value of 243 mv+58.3 mv indicating an oxidising environment. Toxic trace elements concentrations showed that the soil is practically un-contaminated (I-geo<1). Contamination factor (Cf) showed low contamination factor (Cf<1) for Fe, Pb, Zn, Cr and Ni.

Only As and Cd showed considerable contamination (3<Cf<6) and very high Cf (Cf>6) at locations 6, 7, 8, 9 and 10. The enrichment factor (Ef) of Ni, Cr, and Cd showed minor enrichment. Pollution index, modified pollution index and Nemerow index reflect unpolluted, severely polluted and heavily polluted soils. Non-carcinogenic risk such as hazard index, average daily intake (ADI) and hazard risk exist only through dermal contact in children with respect to Cr. There is the possibility of an individual contracting cancer in a lifetime and 1 in 2725 individuals. Cr and Ni showed that in children 1 in 5882 individuals can contract cancer through dermal contact. Cr is the main pollutant causing non carcinogenic risk in children through dermal contact while Cr and Ni have the potential of causing cancer risk in children and adults through ingestion and dermal contact. The soil is suitable for agricultural practice.

Keywords

Soil health; Multi-element pollution index; Soil quality; Non carcinogenic risk; Carcinogenic risk; Exposure pathways

MODELLING THE TRANSPORT OF RADIONUCLIDES IN GROUNDWATER SYSTEM AROUND ACTIVE AND INACTIVE MINES AT DANGE-SHUNI L.G.A, SOKOTO

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Abstract

The presence of radioactive contaminants in groundwater may be caused by natural contaminants or could come from human activities. Due to inaccessible nature of the groundwater, a mathematical model with a numerical method is used to describe the relevant physical processes during radionuclide transport in the groundwater system. A computer programme has been written in MatLab to implement the numerical solution. The activity concentration and the total annual committed effective dose were determined for both theoretical and experimental methods. The average activity concentrations for theoretical method were 6.94 Bq/L, 0.76 Bq/L, 0.71 Bq/L and 15.22 Bq/L for ^{226}Ra, ^{238}U, ^{232}Th and ^{40}K respectively. For experimental analysis the mean activity concentrations were 5.60 Bq/L, 0.86 Bq/L, 0.49 Bq/L and 18.60 Bq/L for ^{226}Ra, ^{238}U, ^{232}Th and ^{40}K respectively. The corresponding average total annual committed effective doses estimated for theoretical and experimental methods were 1.56 mSv/y, 0.871 mSv/y, respectively. The theoretical results compare well with the experimental results since both display total committed effective dose values above the recommended set limit of 0.1 mSv/y. The theoretical results show significant exposure of the public to NORMs from the mining activities in the study area, implying that the mining activities pose significant radiological hazard due to NORMS to the communities who are drinking the water in the study area.

Keywords

Modelling; Transport; Radionuclides; Groundwater and Mining

ECOLOGICAL AND NON-CARCINOGENIC HEALTH RISK OF NITRATE CONTAMINATION IN THE GROUNDWATER OF KUMBA, CAMEROON

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Abstract

Natural and man-made activities can introduce nitrate and hazardous metals into the groundwater, which can affect ecological systems and human health. Kumba is the largest city in southwestern Cameroon and faces significant groundwater contamination by nitrate and trace metals. In this study, groundwater samples from shallow aquifers in Kumba were analysed for their physicochemical parameters, including nitrate, to evaluate their quality and potential risks to human health. Nitrate and analysed toxic trace metals (As, Cd, Pb) concentrations in some samples exceeded the World Health Organisation recommended standard, indicating anthropogenic pollution from sources such as agricultural runoff from applications of chemical fertilisers and pit latrines. Pollution index in groundwater and metal index indices classified most groundwater sources as pure and of low pollution. Similarly, the ecological risk factor indicated that only one site was identified as being of the high ecological risk category, with *Pb>Ni>Cr>Cd>As* as the order of potential ecological risk. Furthermore, based on the estimated nitrate pollution index (NPI), 63.9% of the sites were found to be unpolluted, 9.8% to be slightly and significantly polluted, and 16.4% to be very significantly polluted. Pollution of groundwater by nitrate through time can constitute a serious public health hazard to humans.

Prolonged intake of nitrate has been linked to diseases such as gastric cancer, high blood pressure, thyroid issues, and genetic defects. Infants consuming water containing high nitrate levels can result in methemoglobinemia, also referred to as „blue baby syndrome". The chronic health hazard quotient associated with the potential non-carcinogenic risk via oral and dermal contact pathways indicates that exposure to waterborne nitrate poses a potential non-cancer risk to the residents of Kumba, especially infants.

These serious public health hazards and their deleterious environmental implications are rarely appreciated in developing economies like Cameroon. Protective measures include reducing the number of agricultural and non-agricultural nitrogen sources that enter the aquifer as well as the groundwater recharge zones, which should be implemented, especially in the agricultural zones of the study area, to ensure sustainable use of groundwater resources.

Keywords

Toxic Metals; Ecological Risk; Nitrate Contamination; Non-carcinogenic; Health Risk; Kumba; Cameroon

HEALTH RISK CHARACTERISATION OF PHARMACEUTICAL AND PESTICIDE RESIDUES AS EMERGING CONTAMINANTS IN GUBI DAM WATER TRIBUTARIES AND JUXTAPOSED GROUNDWATER

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Abstract

Emerging contaminants in wastewater from municipalities, industries, hospitals, and dumpsites, particularly pharmaceutical residues and pesticides, pose increasing global health risks due to their persistence and long-term environmental impacts. Water samples collected from tributaries draining into Gubi Dam were analyzed to detect pharmaceutical and pesticide residues. High-Performance Liquid Chromatography (HPLC) revealed the presence of multiple pharmaceutical compounds, including carbamazepine (0.23-1.31 µg/L) and trimethoprim (0.39-0.63 µg/L). Their predominance indicates continuous anthropogenic inputs, with carbamazepine linked to neurological and endocrine effects, while trimethoprim may contribute to antimicrobial resistance and gut microbiome disruption upon chronic exposure. Additionally, Pesticide residues in the Dam tributaries were evaluated using Gas Chromatography-Mass Spectrometry (GC-MS), including chlorophenols (1.72-3.65 µg/L), organophosphates (4.15-36.4 µg/L), and organochlorines (up to 63.8 µg/L). Organophosphates impair the nervous system by inhibiting cholinesterase, organochlorines bioaccumulate and cause neurotoxic, reproductive, and immunotoxic effects, and chlorophenols are associated with carcinogenic and endocrine-disrupting impacts. Human Health Risk Assessment (HHRA) of these pesticides revealed Hazard Quotients above one and Carcinogenic Risk values exceeding the acceptable threshold of 10^{-6}, signaling potential long-term health concerns. Although Gubi Dam's physical water quality meets domestic standards, the detection of persistent pharmaceuticals and pesticides highlights an emerging contamination problem that could escalate if unaddressed. The presence of pesticide residues in nearby groundwater further suggests interaction with polluted surface water. Strengthening wastewater management, improving monitoring systems, and implementing effective remediation strategies are essential for safeguarding a safe and sustainable water supply for the local population.

Keywords

Emerging Contaminants; Pesticides; Pharmaceuticals; Risk; Carcinogen

HYDROGEOLOGICAL VULNERABILITY OF QUATERNARY AQUIFERS TO EFFLUENT INFILTRATION FROM NON-EARTHEN FISHPONDS IN THE NIGER DELTA

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Abstract

Fishpond waters are primarily enriched with nitrates ($N0^{3-}$) and phosphates (PO_4^{3-}), which originate from fish feeds and fish excreta. They are either released into the ground surface or injected into subsurface from no-earthen ponds during exchange of pond water. Shallow aquifers have a tendency to become contaminated by the infiltration of enriched fishpond effluents. To investigate the susceptibility of aquifers to the effluents from fishpond, data comprising hydraulic, subsurface geology and chemistry of water were investigated. The results revealed that the concentrations of NO3- and PO_4^{3-} ranged from 4.7 to 19.78 mg/L and 3.25 to 232 mg/L, respectively. The concentrations of biological oxygen demand (BOD) and dissolved oxygen (DO) were 30 to 210 mg/L and 3.6 to 6.7 mg/L, respectively. These values were significantly higher in hand-dug wells compared to boreholes. The subsurface geology comprised sediments of varying grades clayey sands - fine, medium, and coarse sands, which are mantled by thin layers of soil. Water levels ranged from 3.68 to 5.89 m, while the thickness of the clayey sand varied from 2.4 to 12.4 m. Areas with thin layers of clayey sand and low water levels are more susceptible to effluent contamination compared to regions with thicker clayey layers and higher water levels. Additionally, regions exhibiting elevated values of NO^{3-} and PO_4^{3-}, BOD, and DO in groundwater are moderately more vulnerable to effluents from un-earthen fishponds than areas with negligible values. The use of un-earthen ponds for fish farming in the Niger Delta region poses a significant threat to the contamination of shallow aquifers, with serious implications for groundwater quality. The absence of these nutrients in boreholes highlights and reinforces the importance of subsurface geology in the attenuation of contaminants.

Keywords

Vulnerability, Nitrates, Phosphates, un-earthen fishponds, effluents

ASSESSMENT OF AIR AND ENVIRONMENTAL POLLUTION ASSOCIATED WITH QUARRY ACTIVITIES IN MPAPE AREA, ABUJA, NIGERIA

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Abstract

Quarrying activities have become one of the major sources of environmental pollution in rapidly developing urban centres due to continuous rock blasting, crushing, excavation, and transportation processes associated with mineral extraction. In Mpape District of the Federal Capital Territory (FCT), Abuja, intense quarrying operations have raised concerns over air pollution, contamination of water and soil, and associated public health implications among residents living around quarry environments. Despite the economic importance of quarrying to infrastructural development and employment generation, its environmental consequences continue to pose serious challenges to environmental sustainability and human health.

The study concluded that quarrying activities within Mpape have significantly contributed to environmental pollution and deterioration of environmental quality within the surrounding communities. The research therefore recommends regular environmental monitoring, installation of pollution control systems, proper dust suppression measures, treatment of contaminated water sources, enforcement of environmental regulations, and continuous sensitization of quarry operators and host communities on environmental safety practices in order to reduce the adverse environmental and public health impacts associated with quarrying activities.

Keywords

Quarrying; Environmental Pollution; Dust Suppression; Monitoring and Regulation Enforcement; Mpape District

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GEOGENIC FLUORIDE CONTAMINATION OF GROUNDWATER IN ZANGO, NORTHWESTERN NIGERIA: IMPLICATIONS FOR PUBLIC HEALTH AND COMMUNITY RESILIENCE

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Abstract

Fluorosis is a health problem experienced in many parts of the world due to high concentration of fluoride in drinking water sources which causes dental and skeletal fluorosis to humans. Fluoride contamination in the groundwater of Zango Local Government Area, Katsina State, is a worrisome, naturally occurring environmental health concern. Studies revealed that the fluoride concentration from the shallow groundwater sources from hand dug wells in the area exceed the World Health Organization's permissible limit of 1.5 mg/L. Fluoride concentrations during the dry season (0.10 mg/L to 3.16 mg/L), is higher compared to the rainy season (0.10-1.75 mg/l).

The significant drop in fluoride concentration during the rainy season can be attributed to the natural dilution of shallow aquifers by rainwater (dilution effect of rain water). The fluoride contamination in the area is entirely natural, resulting from the weathering and dissolution of fluoride-bearing minerals such as fluorite, apatite, and biotite in the alkaline granitic and volcanic rocks domiciled in the area.

These hydrothermal mineral in granite/rhyolite exhibits fast dissolution kinetics, and the fluoride in these minerals finds its way into the groundwater system in the area due to long term rockwater interaction and bedrock dissolution processes. The arid climate, shallow well aquifers, prolonged water-rock interactions, and high alkaline pH levels help to accelerate the release of fluoride into the groundwater system. The communities rely heavily on the untreated groundwater for drinking, and the long-term exposure to these elevated concentrations places the population at risk for dental fluorosis (staining or damaging tooth enamel) and mild skeletal fluorosis (damage to bones and joints). Fluoride removal techniques such as reverse osmosis, activated alumina filters, or activated charcoal methods are recommended.

Keywords

Geogenic Contamination, Fluorosis, Groundwater, Zango, Northwestern Nigeria, Public Health and Community Resilience

GROUNDWATER QUALITY AND HEAVY METAL CONTAMINATION IN NGURU LGA, CHAD BASIN, NIGERIA: A MEDICAL GEOLOGY ASSESSMENT OF DRINKING WATER SAFETY

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Abstract

Groundwater contamination by toxic metals poses significant public health challenges in semi-arid regions where surface water is scarce. This study applies medical geology principles to assess groundwater quality in Nguru Local Government Area, Chad Basin, Nigeria, using the Water Quality Index (WQI) method. Physicochemical parameters and trace metals were analyzed in a total of 60 groundwater samples. Results indicated that 72% of samples had pH below WHO minimum of 6.5. Lead was above WHO limits (0.01 mg/L) in 85% of the samples with maximum levels of 73× the safe limit (0.732 mg/L at Yobe Line). Cadmium exceeded WHO limits (0.003 mg/L) in 45% of the samples with maximum levels of 252× (0.756 mg/L at Nayinawa B. Layi). The strong correlation (r=+0.78) between Pb and Cd suggests a common anthropogenic source. The WQI values varied from 43 to 356 and the groundwater was classified as: Excellent (2%), Good (13%), Poor (47%), Very Poor (28%) and Unsuitable (10%). Six main pollution hot spots were found. Approximately 30,000 people are drinking Unsuitable water and a further 84,000 are at high health risk. The results of this study show that the use of medical geology methods that integrate hydrogeochemistry, WQI, and spatial analysis is necessary to identify geogenic and anthropogenic risks to health. There is a need for immediate urgent interventions, including alternative water supplies, source investigation and public health campaigns.

Keywords

Medical geology, Water Quality Index, lead contamination, cadmium, Chad Basin, Nigeria

ASSESSMENT OF THE RELATIONSHIP BETWEEN SILICA DUST CONCENTRATION AND THE PREVALENCE OF SILICOSIS AMONG ARTISANAL MINERS IN AZARA COMMUNITIES OF AWE LOCAL GOVERNMENT AREA OF NASARAWA STATE, NIGERIA

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Abstract

Artisanal mining remains a major livelihood activity for rural communities in Nigeria, yet it poses significant occupational health challenges, particularly silicosis resulting from prolonged inhalation of respirable crystalline silica dust. This study assessed the relationship between silica dust concentration and the prevalence of silicosis among artisanal miners in the Azara communities of Awe Local Government Area, Nasarawa State. Anchored on the Germ Theory of Disease, the research adopted a documentary research design, relying on existing empirical studies, published reports, and scientific reviews to analyse the association between silica dust exposure and radiographic as well as respiratory health outcomes. Findings from the synthesis of prior studies demonstrate a strong association between personal exposure to respirable crystalline silica and the prevalence of radiographic silicosis, highlighting consistent patterns of abnormal lung function, respiratory impairments, and chronic symptoms typical of silicosis among artisanal miners. Furthermore, evidence reveals that inadequate dust-control measures and limited use of protective equipment exacerbate the risk of silicosis in artisanal mining environments. Based on these findings, the study recommends two critical interventions: first, the implementation of community-based awareness and enforcement programmes that emphasise the importance of dust monitoring, protective gear, and regular health surveillance to reduce radiographic silicosis prevalence; and second, the institutionalisation of medical screening and respiratory health monitoring for artisanal miners to detect silicosis-related impairments early and provide timely interventions. These measures will safeguard the health of artisanal miners, promote sustainable livelihoods, and enhance occupational health standards in mining communities.

Keywords

Silica dust concentration, Silicosis, Artisanal miners, Occupational health, Safety practices.

APPLICATION OF DIATOMITE-BASED SORBENTS FOR FLUORIDE REMOVAL FROM DRINKING WATER

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Abstract

Access to safe drinking water persists as a critical global challenge, primarily due to contaminants such as fluoride, which pose significant health risks. The adverse effects of fluoride exposure, both in Nigeria and globally, have garnered considerable attention. The profound impacts of geomedical diseases, notably, dental and skeletal fluorosis, affect millions worldwide, primarily due to fluoride-contaminated drinking water. While fluorosis is manageable, it remains incurable and expensive to treat making prevention through source treatment essential for rural communities. However, prevention is feasible through source treatment of drinking water. Utilizing alternative geomedical resources such as diatomite, offers a cost-effective, accessible and sustainable means of water treatment, thereby mitigating the widespread impacts of fluorosis. Diatomite, a naturally abundant porous sedimentary rock comprising fossilized diatoms, has emerged as a promising sorbent material for water purification due to its high specific surface area, modifiable surface chemistry, and low cost. The development of diatomite-based sorbents for fluoride removal is crucial for advancing sustainable water treatment solutions. This study presents the application of an aluminum-modified diatomite (Al-D) sorbent for the effective removal of fluoride. The Al-D sorbent was prepared by heterogeneous hydrolysis of aluminum chloride ($AlCl_3 \cdot 6H_2O$) in a diatomite suspension, with the pH adjusted to 9.5 to facilitate the formation of aluminum oxo-hydroxides. Batch sorption experiments were conducted using fluoride concentrations ranging from 5 to 50 mg/L and a sorbent dose of 20 g/L. To ensure maximum efficiency, an acetate buffer was utilized to maintain an optimal pH of 4.75, which promotes the formation of positively charged sites on the aluminum hydroxide surface. Results demonstrated that Al-modified diatomite significantly outperforms raw diatomite in fluoride removal efficiency. Kinetic studies indicated that the system reaches equilibrium within 120 minutes. The experimental data were best described by the two-step Langmuir model ($R2 = 0.984$), suggesting a layer-by-layer filling of the heterogeneous sorbent surface. The primary mechanism of fluoride uptake was identified as ion exchange, where surface hydroxyl (OH^-) groups are replaced by fluoride ions. This research confirms that aluminum-modified diatomite is a cost-effective, sustainable, and highly efficient material for mitigating fluoride contamination in drinking water.

Keywords

Fluoride, Diatomite, Water treatment, Sustainable solution

AEROMAGNETIC INVESTIGATION OF THE JOS PLATEAU VOLCANIC PROVINCE, NORTH-CENTRAL NIGERIA: IMPLICATION ON EVALUATING THE ORIGIN, DISTRIBUTION AND MEDICAL POTENTIALS OF NATURAL OCCURRING ZEOLITES

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Abstract

This study presents a quantitative interpretation of high-resolution airborne total magnetic intensity (TMI) data acquired over Sheets 190 (Pankshin Sheet, 7°26′30″E - 8°2′E, 9°8′N - 9°36′N) and 168 (Naraguta Sheet, 8°36′E - 8°54′E, 9°6′N - 9°54′N) of the Jos Plateau Volcanic Province, north-central Nigeria. The aeromagnetic data, acquired by the Nigerian Geological Survey Agency (NGSA) as part of the national high-resolution aeromagnetic programme, were processed and analysed to delineate subsurface magnetic structures, lithological contacts, and hydrothermal alteration zones pertinent to the genesis and spatial distribution of natural zeolites. Total magnetic intensity maps reveal a complex mosaic of high-amplitude magnetic anomalies (up to 8,100 nT) associated with mafic intrusives and Younger Granite ring complexes, juxtaposed against broad magnetic lows (7,882 nT) interpreted as deeply weathered volcanic tuffs and pyroclastic sequences that constitute the primary host environment for zeolite mineralization. In Sheet 190, a prominent NE–SW-trending linear magnetic gradient defines a major crustal shear zone that facilitated hydrothermal fluid migration, while a large diphasic anomaly in the south-central portion is attributed to a concealed mafic intrusive with strong remanent magnetisation. Sheet 168 is dominated by a conspicuous oval-shaped, deep-seated magnetic low (15 km × 20 km) in its central sector, interpreted as a collapsed volcanic caldera or resurgent dome structure surrounded by pyroclastic aprons, a setting that, by analogy with global zeolite provinces, is highly conducive to diagenetic and hydrothermal zeolitization. The spatial coherence of magnetic lows with mapped Tertiary–Quaternary volcanic tuffs, basalts, and pyroclastics, combined with inferred permeability pathways along structural lineaments, suggests that subsurface hydrothermal circulation systems have generated the alkaline geochemical conditions necessary for the crystallisation of clinoptilolite, chabazite, and mordenite. These findings establish a robust geophysical framework for targeting zeolite exploration across the Jos Plateau and provide critical subsurface context for ongoing petrological, mineralogical, and biomedical investigations of locally occurring zeolites.

Keywords

Aeromagnetic interpretation; Total Magnetic Intensity; Jos Plateau; Zeolite; Mineralisation; Younger Granite Province

GEOCHEMICAL EVALUATION OF ROADSIDE SOILS ALONG IWO-ROAD, OLODE HIGHWAY AND LAGOS–IBADAN EXPRESSWAY, IBADAN METROPOLIS, SOUTHWESTERN NIGERIA

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Abstract

Rapid urbanisation and intensified vehicular traffic along major arterial roads in Nigerian cities have substantially increased the risk of heavy metal accumulation in roadside soils, yet systematic geochemical assessments remain sparse for Ibadan metropolis. This study evaluated the concentration and spatial distribution of selected heavy metals - Fe, Cr, Pb, Co, Ni, Cu, and Cd in topsoil (0–15 cm) and subsoil (15–30 cm) collected along three major transport corridors: Iwo Rd., Olode Highway, and the Lagos–Ibadan Expressway. A total of 28 soil samples were systematically collected at 200 m intervals and analysed for physicochemical parameters (pH, electrical conductivity, and total dissolved solids) and elemental composition by atomic absorption spectrophotometry (AAS). Geo-environmental contamination indices including the geo-accumulation index (Igeo), enrichment factor (EF), contamination factor (CF), pollution load index (PLI), ecological risk factor (Ei), and ecological risk index (RI) were computed and benchmarked against crustal background values and Nigerian regulatory thresholds. Soil pH ranged from 7.61 to 8.30 (topsoil) and 7.41 to 8.14 (subsoil), indicating slightly to moderately alkaline conditions conducive to metal retention. Elemental concentrations followed a descending order of Fe > Cr > Pb > Co > Ni > Cu > Cd. Lead and chromium showed the most significant exceedances of both background and regulatory thresholds, with Pb topsoil concentrations reaching 533.5 mg/kg - over six times the NUPRC acceptable limit of 85 mg/kg. Pollution indices indicated moderate to very strong geo-accumulation for Pb and Cr, significant enrichment, and high to very high ecological risk at several sampling locations. The findings underscore the pressing need for remediation planning and regulatory enforcement along high-traffic road corridors in Ibadan.

Keywords

Atomic absorption spectrophotometry, contamination factor, enrichment factor, geo-accumulation index, heavy metals, Geochemical evaluation, Physicochemical parameter

BUILDING RESILIENCE: REDUCING VULNERABILITIES, CUBING OPEN DEFECATION AND FINDING WHAT WORKS FOR THE URBAN POOR IN WARMER-DRIER CLIMES OF NIGERIA

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Abstract

Optimising public welfare with a balanced economic growth that ensures social equity, affordable housing, and climate resilience is the bane of development process. How this has fared ought to be evaluated in tangible terms from time to time in order to determine progress. What works here may not work elsewhere and that affects adaptation in different eco-domains. Nature is believed to have all it takes to adapt to changes inherent and communities should be groomed to sustainably adapt to the local conditions of soil, water resources, landscapes and climate. The outcome of Sustainable development is a sustainable society that engage in best practices, reduce risks and adapt to impacts of climate change. Extreme weather, melting ice and rising sea levels with the attendant health risks are direct impacts of global warming associated with greenhouse gas emissions, unchecked deforestation, strip mining, fossil fuel combustion. Rising temperatures lead to more frequent and intense heat-waves, droughts, floods, and severe storms. Remote sensing tools served in identifying the vulnerable urban poor who are at the receiving end of poor economic and development policies. The urban poor are vulnerable to a wide range of problems including disease causing pathogens (due to sanitation and hygiene factors of their living condition), flood risk and heat. Remote sensing captures physical and environmental reality of impoverished urban landscapes without ground surveys. Physical vulnerability parameters used include building density, distribution of public facilities, slope, and land use. With GIS, environmental and socio-economic data were plotted into actionable vulnerability maps. This geospatial approach identifies informal settlements, evaluates exposure to hazards like flooding, and assesses adaptive capacity to guide targeted urban resilience interventions. Building resilience through design and supply of smart toilets for the urban poor addresses the hygiene and sanitation factor and in turn cub open defecation. Open defecation, a common problem facing the urban poor compounds sanitation problems increasing environmental and public health risks. With recurrent diseases epidemics, the world cannot watch this trend continue as it will spread from the poor to the rich neighborhoods. And no one is safe in such circumstances.

Keywords

Resilience, Remote sensing, Sustainable society, Vulnerability, Risks

APPLICATION AND HEALTH IMPLICATION OF AGROCHEMICALS ON SOIL AND WATER BY FCT FADAMA PROJECT CROP FARMERS

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Abstract

The Fadama Project in the Federal Capital Territory (FCT), Nigeria, has significantly improved crop production through the increased use of agro–chemicals [NPK Fertilizer, Urea Fertilizer, Herbicides (Glyphosate) and Pesticides]. While these Input enhance agricultural productivity and reduce crop losses, their excessive or improper application poses serious environmental and public health concerns for the resident of the FCT. Agro-chemicals applied on farmlands can accumulate in soils, alter soil pH, reduce beneficial microbial populations, impair nutrient cycling, and decrease long-term soil fertility. Persistent Agro Chemicals residues may also remain in the soil, affecting bio-diversity and ecosystem stability.

The impact identification matrix from Environmental and Social Audit conducted for 6 sampling in each Area Council shows that Fadama activities are highly significant with positive impact. The negative impacts however showed significant (<20) and as a result they can be easily be mitigated.

Laboratory analysis indicates that the indictors investigated were within acceptable limits of WHO and FMEnv.. But In Fugbe Community in Kwali Area Council, there are concentration of toixic heavy metals Lead (Pb) in water (0.33g/kg) above limit of 0.01 and Cadmium (Cd) in soil 0.003mg/L at exact limit of WHO and FMEnv due to runoff and leaching from treated farmlands and transportation of agrochemical residues into rivers, streams, ponds, and groundwater sources commonly used by rural communities. Such Pb and Cd contamination degrades soil and water quality, promotes eutrophication, and exposes humans and aquatic organisms to toxic substances. Pesticides enter water bodies mainly through surface runoff and infiltration, especially during rainfall events. The implications of Phosphorus include nutrient loading of water bodies, The Health Implication of Glyphossate inhalation and dermal contact may include eye irritation, skin irritation, nausea, vomiting , respiratory symptoms and acute poisoning from direct exposure during mixing and spraying,. Long-term exposure leading to Bioaccumulation dosage increasing beyond threshold limit and also leading to Biomagnification causing threat in the body. This study highlights the need for sustainable agrochemical management among FCT Fadama farmers through proper training on the use of Agro- Chemicals, adherence to recommended application rates, use of personal protective equipment (PPE), integrated pest management (IPM), and regular monitoring of soil and water quality. Adoption and mitigation measures will help minimize environmental pollution, protect public health, and ensure sustainable agricultural production

Keywords

Agrochemicals; Fadama Project; Soil Contamination; Water Pollution; Pesticides; Fertilizers; Bioaccumulation; Biomagnification; Crop Farmers; Public Health; Environmental Impact; FCT Nigeria

HEAVY METAL CONTAMINATION AND HEALTH RISKS FROM ACID MINE DRAINAGE IN ABUJA MINING SITES

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Abstract

Acid mine drainage (AMD) and heavy metal contamination from quarrying activities pose serious environmental and public health risks in Nigeria. This systematic literature review assesses the levels of heavy metals – specifically arsenic (As), cadmium (Cd), lead (Pb), and mercury (Hg) – in soil and water near Nigerian quarrying sites. The concentrations are compared against the safety thresholds of the World Health Organisation (WHO) and the National Environmental Standards and Regulations Enforcement Agency (NESREA).

Additionally, this review evaluates the effectiveness of remediation strategies, including chemical precipitation, constructed wetlands, and bioremediation. A systematic search was conducted across academic databases and institutional repositories for studies published between 2010 and 2025. Data were synthesized qualitatively through thematic analysis and quantitatively using descriptive statistics to evaluate metal concentrations and removal efficiencies.

The findings reveal significant soil and water contamination near quarrying sites in Abuja and Akamkpa, with lead and cadmium levels frequently exceeding WHO and NESREA limits. AMD lowers water pH and increases the mobility of toxic metals, threatening drinking water, agriculture, and human health. While chemical precipitation using lime demonstrated an 80–90% removal efficiency for lead and cadmium and successfully raised pH levels to WHO compliance, it faces challenges regarding high operational costs and toxic sludge disposal. Constructed wetlands and bioremediation offer sustainable, low-cost alternatives but require further development and localized field trials.

This study concludes that quarrying-related AMD and heavy metal pollution present major health risks, including neurological disorders and cancers. It recommends stricter NESREA enforcement, extensive field trials for eco-friendly remediation methods, and expanded data collection on arsenic and mercury levels in Abuja. Ultimately, this research contributes to the field of medical geology and supports the United Nations Sustainable Development Goals (SDGs).

The findings support sustainable remediation strategies for building resilient mining communities in the FCT.

Keywords

Medical geology; Acid mine drainage; Heavy metals; Public Health; Abuja

THE BENEFICIAL APPLICATION OF GEOLOGICAL MATERIALS AND PROCESSES IN HUMAN HEALTH: A MEDICAL GEOLOGY PERSPECTIVE FROM NASARAWA STATE, NORTH-CENTRAL NIGERIA

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Abstract

Medical geology is an interdisciplinary field that investigates the relationships between geological materials, geochemical processes, and the health of humans, animals, and ecosystems. Although considerable attention has been devoted to the adverse health impacts of geological hazards, geological resources also provide numerous benefits that contribute to disease prevention, nutrition, therapeutic treatments, pharmaceutical production, and public health sustainability. This review examines the beneficial applications of geological materials and processes in human health, focusing on Nasarawa State, North-Central Nigeria. The state possesses diverse geological formations comprising the Precambrian Basement Complex and

sedimentary sequences of the Middle Benue Trough, which host economically important minerals, clay deposits, saline springs, groundwater resources, and trace-element-bearing rocks. These geological resources serve as sources of essential nutrients, therapeutic minerals, medicinal clays, construction materials for healthcare infrastructure, and mineral waters with balneotherapeutic potential. Attention is given to the medical significance of kaolin, bentonite, limestone, gypsum, natural salts, an groundwater enriched with essential elements such as calcium, magnesium, iron, zinc, selenium, copper, and manganese.

The review further highlights the therapeutic importance of the Awe warm saline springs and the influence of geological processes on water quality and human nutrition. Despite the abundance of health-supporting geological resources in Nasarawa State, significant research gaps remain regarding their bioavailability, therapeutic efficacy, and integration into healthcare planning. The study concludes that the geodiversity of Nasarawa State represents a valuable natural asset capable of supporting public health, pharmaceutical innovation, preventive medicine, and sustainable development. Strengthening interdisciplinary collaboration between geoscientists, health professionals, and policymakers is necessary to maximise these benefits and advance medical geology research in Nigeria.

Keywords

Medical geology, human health, geodiversity, therapeutic minerals, groundwater, trace elements, balneotherapy, Nasarawa State

EVALUATION OF THE IMPACT OF MUNICIPAL SOLID WASTE DUMPSITES ON THE CONCENTRATIONS OF RARE EARTH ELEMENTS (REE) IN SOILS AND GROUNDWATER AROUND THESE DUMPSITES IN PARTS OF JOS-BUKURU AND ENVIRONS, NORTH CENTRAL NIGERIA

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Abstract

The impact of solid waste disposal on soils is gaining importance worldwide due to seepage of potentially harmful elements into the soil strata. Urbanization, industrialisation and changes in our life styles have compounded the problem of solid waste management in Nigeria. Poor waste management threatens the health of humans and animals, particularly those living close to these pollution point sources. This is due to the fact that most of these metals unlike some other pollutants are not biodegradable.

The study area covers Jos-Bukuru and environs in North Central Nigeria which lies at the focal point of the Younger Granite province. This study was aimed at investigating the impact of solid waste dumpsites on the concentrations of rare earth elements in soils and groundwater around these solid waste dumpsites and the effects of these elements on the environment.

Five (5) major dumpsites were sampled for this study. Forty-five (45) soil samples and ten (10) water samples were collected and prepared for geochemical analyses. A radial sampling technique was adopted for sampling the soils. Rare earth elements were analyzed for using the Inductively Coupled Plasma Mass Spectrophotometer (ICPMS) for both soil and water samples.

Results of the analysis from the five different dumpsites show that rare earth elements are enriched in soils of the study area most especially the light rare earth elements (LREE) and their sources are mainly anthropogenic additions. The concentrations of the analysed rare earth elements within the study area vary from one dumpsite to another based on the differences in the composition of the dumpsites. Generally, most of the elements show high concentrations at the foot of the dumpsite but reduces in concentration as distance increases away from the dump, Results of the water analysis show very low concentrations of REE in the groundwater. This study shows that different dumpsites have impacted differently on the soils in their different environments. There is the need to curtail the excesses of dumping waste in these areas so as not to add to the exiting contents of these rare earth elements in the soils.

Keywords

Municipal Solid Waste Dumpsites, Rare Earth Elements, Soil, Water and Health.

DISTRIBUTION OF STRONTIUM IN THE GROUNDWATERS OF PARTS OF CENTRAL PLATEAU, NORTH CENTRAL NIGERIA

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Abstract

Although the WHO has no guidance for the concentration of strontium in drinking water, consumption of strontium in drinking water and foods has received attention due to its adverse human- health effects. This study was carried out to determine the concentration and distribution of strontium in drinking water in parts of central Plateau State, North Central Nigeria. The 65 groundwater samples collected for this study showed no significant variation of strontium with regard to both rock types and drinking water sources. A significant correlation between strontium and the major cations indicates possible feldspar weathering as mineral leaching strontium into the waters. The highest value of strontium in the area was 1.06 mg/l. About 94% of drinking water sources in the area have strontium concentration below the global strontium in the freshwater level of 0.5–1.5 mg/l and 100% below the health-based screening level benchmark of 4 mg/l. It is clear that strontium in the waters of the study area is not adequate for bone development, especially for children. No literature has, however, reported bone-related problems in the area indicating that calcium may be adequate in the waters to supplement strontium in waters and foods. This has been confirmed by the 68% of water sources having calcium and strontium ratio of 100 and above.

Keywords

Strontium, Groundwater, Central Plateau, North Central Nigeria

SPATIAL DISTRIBUTION OF POLISH HEALTH RESORTS UTILIZING NATURAL MEDICINAL WATERS AND THEIR IMPORTANCE FOR REHABILITATION

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Abstract

Natural therapeutic waters represent valuable geological resources that have been used for centuries in health promotion, disease prevention, treatment, and rehabilitation. Their occurrence is closely associated with geological and hydrogeological conditions, making them an important subject of medical geology. In Poland, health resort medicine is strongly linked to the utilisation of mineral, thermal, sulphide, brine, and carbonated waters, which constitute a significant component of the national healthcare and rehabilitation system. The aim of this study was to analyse the spatial distribution of Polish health resorts utilising therapeutic waters and to assess their relationship with the geological structure of the country using Geographic Information Systems (GIS). Data regarding officially recognized health resorts and therapeutic water resources were obtained from publicly available national databases and scientific literature. Spatial analyses were performed in a GIS environment to identify regional patterns and visualize the occurrence of therapeutic water resources in relation to the major geological units of Poland. The results indicate a distinct concentration of health resorts in southern Poland, particularly within the Carpathian and Sudeten regions, where geological conditions favor the occurrence of mineral and thermal waters. Additional clusters of health resorts are located in selected lowland areas characterized by specific hydrogeological structures. Sulphide waters, brines, carbonated waters, and thermal waters were identified as the most commonly utilised therapeutic resources. These waters are widely applied in the treatment and rehabilitation of musculoskeletal, cardiovascular, respiratory, dermatological, and neurological disorders. Therapeutic waters also play a significant role in supporting the rehabilitation of patients with musculoskeletal conditions, constituting an important component of comprehensive spa treatment programs. The spatial distribution of health resorts reflects the direct influence of geological factors on healthcare infrastructure and access to natural therapeutic resources. The findings highlight the importance of therapeutic waters as a sustainable natural resource supporting public health, rehabilitation services, and regional development. The study also demonstrates the usefulness of GIS-based approaches for integrating geological and health-related data, thereby supporting evidence-based management of therapeutic water resources. In the context of medical geology, the presented analysis emphasizes the significant role of geological resources in building resilient healthcare systems and promoting sustainable health interventions. The integration of spatial analysis with the assessment of health resort resources may contribute to more effective planning, conservation, and utilization of therapeutic waters in Poland and beyond.

Keywords

Medical geology; Therapeutic waters; Health resorts; GIS, Public health; Sustainable healthcare; Balneotherapy; Rehabilitation; Poland

NATURAL MINERAL BRINES AND MUSCULOSKELETAL HEALTH: THE ROLE OF CIECHOCINEK BALNEOTHERAPY IN KNEE OSTEOARTHRITIS MANAGEMENT

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Abstract

Background

Knee osteoarthritis (KOA) is one of the most common musculoskeletal disorders worldwide and a leading cause of pain, disability, and reduced quality of life among older adults. As populations continue to age, there is an increasing need for effective, sustainable, and non-pharmacological approaches to disease management. Medical geology highlights the relationship between natural geological resources and human health, including the therapeutic use of mineral-rich waters. Ciechocinek, one of the largest spa centers in Central Europe, is renowned for its natural brines rich in sodium chloride, iodine, bromine, calcium, magnesium, and other trace elements.

Objective

To present the potential role of natural mineral brines used in Ciechocinek spa therapy as a component of comprehensive rehabilitation for patients with knee osteoarthritis and to discuss their relevance within the framework of medical geology and public health.

Methods

A narrative review of the literature was conducted using PubMed, Scopus, and Web of Science databases. Publications addressing balneotherapy, mineral water therapy, rehabilitation, musculoskeletal disorders, and knee osteoarthritis were analyzed. Additionally, the therapeutic applications of Ciechocinek brines in rehabilitation practice were reviewed.

Results

Available evidence indicates that balneotherapy using mineral-rich brines may contribute to pain reduction, improvement in joint mobility, enhancement of physical function, and better quality of life in patients with knee osteoarthritis. The beneficial effects are attributed to thermal, mechanical, and chemical properties of mineral waters, which may support anti-inflammatory processes, improve circulation, and facilitate physical rehabilitation. Integrating balneotherapy with physiotherapy may enhance treatment outcomes and promote healthy ageing.

Conclusions

Natural mineral brines represent an important geological resource with significant health-promoting potential. The experience of the 22nd Military Health Resort and Rehabilitation Hospital in Ciechocinek demonstrates how medical geology, rehabilitation, and public health can be integrated to support sustainable healthcare strategies. Further research is warranted to strengthen the evidence base for spa therapy in musculoskeletal disorders and to explore its role in building resilient and healthy communities.

Keywords

Medical Geology; Balneotherapy; Mineral Brines; Knee Osteoarthritis; Rehabilitation; Public Health; Healthy Ageing; Sustainable Healthcare

ENVIRONMENTAL DETERMINANTS OF NEURODEVELOPMENT AND MOTOR FUNCTION IN CHILDREN: IMPLICATIONS FOR PHYSIOTHERAPY PRACTICE

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Abstract

Background

Environmental factors play an important role in child health and development. Exposure to air pollution, heavy metals, and other toxic substances during prenatal and early childhood periods may affect central nervous system maturation, cognitive development, and motor function. Despite growing scientific evidence, environmental determinants remain insufficiently considered in physiotherapy practice and clinical reasoning.

Objective

The aim of this study was to summarize current evidence regarding the impact of environmental exposures on neurodevelopment and motor function in children, with particular emphasis on findings from Polish research, including the Polish Mother and Child Cohort (REPRO_PL) and the NeuroSmog project, and to discuss their relevance to physiotherapy practice.

Materials and Methods

A narrative literature review was conducted using PubMed, Scopus, Web of Science, and Google Scholar databases. Publications from 2010–2025 addressing environmental determinants of child development were analyzed. Particular attention was given to Polish cohort studies and environmental health research projects.

Results

Findings from the REPRO_PL cohort indicate that prenatal and early-life exposure to lead, mercury, and environmental tobacco smoke may negatively affect cognitive and psychomotor development in children. Studies have also demonstrated a potentially protective role of adequate selenium status during pregnancy. Results from the NeuroSmog project suggest that exposure to particulate matter ($PM_{2.5}$ and PM_{10}) may influence brain development, attention, and cognitive functioning in children. These findings are consistent with international research demonstrating associations between environmental pollution and adverse neurodevelopmental outcomes. From a medical geology perspective, naturally occurring and anthropogenic contaminants present in soil, water, and air may contribute to environmental exposure pathways affecting child health. Medical geology provides valuable tools for identifying environmental sources of exposure, including contaminated soil, groundwater, mining activities, and industrial emissions.

Conclusions

Environmental factors represent an important and often underestimated determinant of child neurodevelopment and motor function. Findings from Polish studies support observations reported in the international literature and highlight the need to incorporate environmental history into physiotherapy assessment. Such an approach may facilitate the identification of risk factors and contribute to more comprehensive and preventive child healthcare. Medical geology offers a valuable interdisciplinary framework for understanding environmental exposure pathways and their potential impact on child development. Greater awareness of environmental determinants among physiotherapists may support earlier identification of at-risk populations and strengthen preventive healthcare strategies. Strengthening collaboration among physiotherapists, environmental health specialists, and public health professionals is also warranted.

Keywords

Child development; Neurodevelopment; Physiotherapy; Environmental health; Medical geology; Heavy metals; Air pollution; REPRO_PL; NeuroSmog

ASSESSMENT OF MICROBIAL CONTAMINANTS AND ITS HEALTH RISK IN SELECTED TYPES OF RICE PURCHASED IN MAJOR MARKETS WITHIN IBADAN METROPOLIS

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Abstract

Background

Rice (Oryza sativa L.) is a widely consumed staple food and an essential contributor to food security in Nigeria. However, its susceptibility to microbial contamination during production, processing, and storage presents significant food safety concerns. This study assessed microbial contaminants and its health risks in selected rice varieties purchased in major markets within Ibadan metropolis.

Methodology

A laboratory-based experimental study was conducted using seven rice varieties including local and imported samples collected from selected markets. Total aerobic bacteria, yeasts, and molds were enumerated using standard plate count methods. Aflatoxin residues (AFB1, AFB2, AFG1, and AFG2) were extracted and quantified using High--Performance Liquid Chromatography with UV detector (HPLC-UV). Quantitative human health risks were evaluated using Estimated Daily Intake (EDI) and Incremental Lifetime Cancer Risk (ILCR) models.

Results

Bacteria contamination was detected in all samples, with pathogens including Escherichia coli, Bacillus cereus, and Staphylococcus aureus identified. Total aflatoxins were present in 100% of samples, ranging from 27.55 ppb (Maharani parboiled basmati rice)to 870.06 ppb (ofada rice), exceeding the recommended safety limit. AFB1 was detected in 85.71% of samples, Calculated ILCR values (2.77×10^{-4} to 8.73×10^{-3}) vastly exceeded the US EPA safety threshold of 1×10^{-4}. which exceeded acceptable risk thresholds.

Discussion

The findings indicate post-harvest hygiene failures and fecal contamination, coupled with agricultural drying practices that promote massive toxigenic Aspergillus proliferation. Consequently, high consumption of these grains poses severe carcinogenic risks, particularly hepatocellular carcinoma to consumers.

Conclusion

Immediate regulatory enforcement, improved market storage mechanisms, and modernized agricultural milling protocols are urgently required to safeguard the public health.

Keywords

Rice; Microbial contaminant; Aflatoxin; Health risk; Food safety

BEYOND RESOURCE ESTIMATION: APPLYING GEOSTATISTICAL AND SPATIAL MODELLING TECHNIQUES TO ENVIRONMENTAL AND PUBLIC HEALTH CHALLENGES

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Abstract

Mineral resource estimation relies heavily on geostatistical and spatial modelling techniques to quantify the distribution, grade, and uncertainty of mineral deposits. These methodologies, including variography, kriging, conditional simulation, and machine learning, have applications extending beyond traditional resource evaluation into environmental and public health domains. This presentation explores how resource estimation approaches can be adapted to characterize the spatial distribution of potentially harmful geological materials, including potentially acid-forming (PAF) waste, sulphide-rich lithologies, and environmental contaminants. Particular focus is given to the assessment of acid mine drainage (AMD) risk through the integration of geological, geochemical, and spatial datasets to predict the occurrence and variability of acid generating materials. Through examples from mining-affected regions, the study demonstrates how geospatial modelling can support mine planning, waste rock management, environmental monitoring, contaminant risk assessment, and public health protection. The presentation highlights opportunities for integrating mineral resource estimation, medical geology, environmental geochemistry, and environmental risk assessment to address the environmental and societal challenges associated with mineral extraction and processing.

Keywords

Mineral resource; Geospatial modelling; Acid mine drainage; Public health; Addressing challenges

EVALUATION OF GROUNDWATER CHARACTERISTICS OF PARTS OF BWARI AREA, NORTH-CENTRAL NIGERIA

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Abstract

Communities within the study area are still plagued with issue that MDGs sought to combat. These include but not limited to inadequate supply of potable drinking water, indiscriminate refuse dumping and open defecation issues. Failure to address these challenges may lead to public health crises with its attendant consequences. Hence, this research is conceptualised to review relevant past geophysical survey reports, conduct surface geologic, structural and hydrogeological mapping and also conduct electrical resistivity surveys so as to provide qualitative and quantitative information of the groundwater resource of the area. The study area comprises of Gaba and Sabon--Gari Bwari communities in Bwari Area Council, Abuja, Central Nigeria. It is bound between latitudes 9° 15′N and 9° 18′N and longitudes 7° 19′E and 7° 25′E. The area is underlain by rocks of the Precambrian Basement Complex of North-Central Nigeria. The lithological units include the Migmatite-Gneiss Complex and granitoids. Hydrogeological mapping was conducted to acquire information on the characteristics of hand-dug wells and borehole in the area. Places of potential contaminants were also noted. Water samples from some of the wells were taken and their physical parameters were measured at the site. Thereafter, the samples were taken to the laboratory for chemical analyses for cations, anions and trace elements. Bacteriological analyses were also conducted. Vertical electrical sounding was conducted in selected areas. Results from chemical analyses revealed that most of the waters were within acceptable limits while some are deemed contaminated. All samples of waters showed presence of coliforms. VES results revealed that the area is mostly made up of four geoelectrical units with the top soil having resistivities ranging from 35 – 180 Ωm, having a depth range of 1 – 2 m, the partly weathered geoelectric layer have a resistivity range of 150 – 450 Ωm and depth range of 10 m. The fresh basement has resistivity range of over 3000 Ωm. It is recommended that prospective contractors must be licensed and water well drilling consultants meet the stipulated requirements. Borehole designs must also meet the approved standard parameters for chemical and biological analyses.

Keywords

Groundwater; Electrical resistivity; Basement Complex; Geochemical analyses; Bacteriological analyses; Bwari Area Council

GEOGENIC AND OCCUPATIONAL LEAD EXPOSURE AND ASSOCIATED HEALTH RISKS IN LEAD-ZINC MINING SITES IN NIGERIA: EXAMPLES FROM NIGER, PLATEAU, NASARAWA, TARABA AND ZAMFARA STATES

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Abstract

Lead exposure remains a major environmental and occupational health concern in mining communities, in Nigeria particularly where mining activities occur indiscriminately near homes, water sources, and agricultural land. While geological processes contribute to elevated background concentrations of lead in Pb-Zn mineralized terrains, mining, and ore-processing activities significantly heighten environmental dispersion and human exposure. This study examines geogenic and occupational lead exposure and associated health risks in selected lead-zinc mining sites of Nigeria, with detailed investigation from Abuni, Awe Local Government Area, Nasarawa State, and supporting evidence from mining communities in Niger, Taraba, Zamfara and Plateau States.

A cross-sectional environmental assessment involving field surveys, environmental sampling, laboratory analysis, geospatial interpretation, and human health risk assessment was conducted. Twenty-eight water samples, twenty soil samples, and airborne dust samples were analyzed for lead contamination using standard analytical procedures. Risk assessment was performed using Average Daily Dose (ADD) and Hazard Quotient (HQ) models. Results revealed elevated lead concentrations in environmental media. Water samples from Okonde (0.449 mg/L), Abuni (0.411 mg/L), and Dutse (0.409 mg/L) exceeded the World Health Organization guideline value of 0.01 mg/L. Soil samples from Multiverse Drainage (29,590.4 mg/kg), Angwan (2,319 mg/kg), and Companin Dan China (1,669.7 mg/kg) greatly exceeded the United States Environmental Protection Agency residential soil limit of 400 mg/kg. Airborne dust samples from active mining areas also showed elevated lead concentrations. Hazard Quotient values exceeded unity in several locations, indicating potential non-carcinogenic health risks to miners and nearby residents.

Comparative evidence from other mining districts in Plateau, Taraba, Niger, and Zamfara States demonstrates similar patterns of environmental contamination, occupational exposure, and adverse health outcomes linked to artisanal and small-scale mining activities. The study shows that the combined influence of geogenic enrichment and anthropogenic mining practices together intensify the pathways by which people are exposed to lead. It concludes that lead contamination in Nigerian mining communities constitutes a significant environmental and public health challenge requiring integrated environmental remediation, occupational safety measures, routine biomonitoring, and stronger regulatory enforcement.

Keywords

Lead exposure; geogenic contamination; occupational health; lead-zinc mining; artisanal mining; environmental pollution; human health risk; heavy metals; Nigeria; Nasarawa; Plateau; Taraba; Niger; Zamfara

LAND COVER CHANGE AND SOIL QUALITY IMPLICATIONS FOR ENVIRONMENTAL HEALTH AND COMMUNITY SUSTAINABILITY IN OLUYOLE LOCAL GOVERNMENT AREA IN IBADAN SOUTH-WESTERN NIGERIA

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Abstract

Land cover transformation has become an increasingly significant environmental concern with far-reaching consequences for soil integrity, ecosystem function, and public health in rapidly urbanising Nigerian contexts. This study investigated the effects of land cover change on soil quality and environmental sustainability across four representative sites - Oluyole, Egbeda Tuba, Podo, and Abanla - in Oluyole Local Government Area, Ibadan, Southwestern Nigeria, encompassing forest, agricultural, grassland, and built-up land cover types. Selected physicochemical soil properties were determined using standard laboratory procedures.

Findings indicated predominantly sandy soils with near-neutral pH values (6.22 - 7.12); however, total nitrogen, organic carbon, and potassium concentrations were generally deficient across most sites, reflecting declining fertility attributable to vegetation clearance, urban encroachment, and unsustainable land management. Heavy metal concentrations remained within permissible thresholds, indicating negligible contamination risk. The study established that land cover transformation drives soil degradation, nutrient depletion, erosion vulnerability, diminished water retention capacity, and broader ecosystem instability - with attendant implications for food security and community resilience. Afforestation, organic matter enrichment, conservation agriculture, and systematic soil monitoring were recommended to enhance environmental sustainability in the study area.

Keywords

Land cover change; soil quality; environmental health; sustainability; resilient communities

BACTERIOLOGICAL CONTAMINATION AND PROFILING OF ANTIMICROBIAL RESISTANCE GENES IN SELECTED HAND-DUG WELLS AROUND GEGE COMMUNITY, IBADAN SOUTH-WEST LOCAL GOVERNMENT AREA, OYO STATE

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Abstract

Background

Safe groundwater access is still a major public health issue for people in low- and middle-income countries in peri-urban areas. Hand dug wells are the main water sources in areas where the water supply is not piped and can be easily contaminated by faeces and harbour Antimicrobial Resistant Genes (AMR) genes. This study determined the bacteriological contamination and profiled the presence of antimicrobial resistance genes in hand dug wells of Gege community, Ibadan South-West Local Government Area, Oyo state, Nigeria.

Methods

The methods used were descriptive cross section with laboratory and field techniques. A total of 28 water samples were collected from 7 hand-dug wells during 4 consecutive weeks. Bacteriological analysis comprised nutrient agar (heterotrophic plate count) and MacConkey agar (total coliform count). Bacterial isolates were identified using Gram stain and typical biochemical tests. Antibiotic susceptibility was tested by Kirby-Bauer disk diffusion method using seven antibiotics: meropenem, cefepime, ceftriaxone, Augmentin, amikacin, levofloxacin, co-trimoxazole and interpreted by the CLSI 2024 breakpoints. Multiple Antibiotic Resistance Index (MARI) was used to quantify multidrug resistance. Four resistance genes (bla_{TEM}, bla_{NDM}, bla_{CTX-M}, *sul1*) were screened by PCR. The study recruited 344 community residents who were administered with a structured questionnaire to evaluate their water use behaviours, sanitation practices, antibiotics use and awareness of AMR.

Results

All wells exceeded WHO permissible limits, with HPC ranging from 3.658 ± 0.549 to 4.797 ± 1.474 $\log_{10}$ CFU/mL and total coliform counts from 3.051 ± 0.301 to 4.266 ± 1.562 $\log_{10}$ CFU/mL. Gram-negative organisms were dominant (69.01%) and Enterobacter spp. (70%) was predominant, followed by Pseudomonas spp. (24%), and *Salmonella* spp. (6%). These were identified in 50 characterised isolates. The highest resistance rates were to cefepime (96%) and meropenem (86%), and the lowest resistance rates were to levofloxacin (8%) and amikacin (24%). High-risk antimicrobial exposure was observed in all three genera with values of MARI > 0.2. bla_{TEM} was detected in *Pseudomonas* spp., *Enterobacter* spp., and *sul1* was detected in *Enterobacter* spp., while bla_{CTX-M} and bla_{NDM} were not detected by PCR. The results of the survey showed that 53.2% of the participants never treated the well water before use, 87.2% had never heard about antibiotic resistance and only 9.9% always finished their prescribed antibiotic courses.

Conclusions

Groundwater in Gege community is unsafe and contains microbes and antimicrobial resistance determinants. The results indicate that there is a critical need for sanitation infrastructure, well protection, community health education on the proper handling of water, in addition to antimicrobial stewardship. The monitoring of environmental waters should be incorporated into the national AMR monitoring systems.

Keywords

Groundwater quality; antimicrobial resistance; resistance genes; peri-urban; Nigeria; bacteriological contamination

MICROPLASTICS IN THE ENVIRONMENT AS POTENTIAL CARCINOGENS

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Abstract

Microplastics, pervasive pollutants in the environment, have garnered increasing concern regarding the potential health effects that continuous exposure to environmental microplastics may cause on humans due to their potential carcinogenic effects. Due to their persistent nature, microplastics may accumulate in different organs and tissues and may induce in the long term the development of cancer. This study aimed to review the existing literature on the carcinogenic potential of microplastics. It synthesizes current knowledge on the sources and types of microplastics, emphasising their ubiquitous nature in our various ecosystems. Human exposure pathways are examined, highlighting ingestion, inhalation, and dermal contact as primary routes.

The bioaccumulation and distribution of microplastics in human tissues are discussed, revealing their presence in vital organs and the potential for long-term health impacts.

The toxicological effects of microplastics are explored, focusing on oxidative stress, inflammation, and genotoxicity, which may contribute to carcinogenesis. Mechanistic insights into how microplastics induce cancer are provided, supported by epidemiological and experimental evidence. Mitigation strategies, including physical methods such as coagulation, flocculation, flotation, granular filtration, and membrane processes, chemical methods which includes advanced oxidation processes such as photodegradation, photocatalytic degradation, electrochemical degradation, Fenton-based processes, and ozone degradation, and biological methods includes biodegradation by microorganisms such as plants bacteria, fungi, and algae, are reviewed to address microplastic pollution. Current research gaps and challenges in understanding the carcinogenic potential of microplastics are identified, underscoring the need for comprehensive studies. Regulatory and policy frameworks are evaluated to provide a roadmap for effective implementation. This review concludes by highlighting the urgency of addressing microplastic pollution to safeguard human health and the environment.

Keywords

Microplastics, Cancer and Environment

HEAVY METAL CONTAMINATION AND HEALTH RISKS FROM ACID MINE DRAINAGE IN ABUJA MINING SITES

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Abstract

Acid mine drainage (AMD) and heavy metal contamination from quarrying activities pose serious environmental and public health risks in Nigeria. This systematic literature review assesses the levels of heavy metals – specifically arsenic (As), cadmium (Cd), lead (Pb), and mercury (Hg) – in soil and water near Nigerian quarrying sites. The concentrations are compared against the safety thresholds of the World Health Organization (WHO) and the National Environmental Standards and Regulations Enforcement Agency (NESREA).

Additionally, this review evaluates the effectiveness of remediation strategies, including chemical precipitation, constructed wetlands, and bioremediation. A systematic search was conducted across academic databases and institutional repositories for studies published between 2010 and 2025. Data were synthesised qualitatively through thematic analysis and quantitatively using descriptive statistics to evaluate metal concentrations and removal efficiencies.

The findings reveal significant soil and water contamination near quarrying sites in Abuja and Akamkpa, with lead and cadmium levels frequently exceeding WHO and NESREA limits. AMD lowers water pH and increases the mobility of toxic metals, threatening drinking water, agriculture, and human health. While chemical precipitation using lime demonstrated an 80–90% removal efficiency for lead and cadmium and successfully raised pH levels to WHO compliance, it faces challenges regarding high operational costs and toxic sludge disposal.

This study concludes that quarrying-related AMD and heavy metal pollution present major health risks, including neurological disorders and cancers. It recommends stricter NESREA enforcement, extensive field trials for eco-friendly remediation methods, and expanded data collection on arsenic and mercury levels in Abuja. Ultimately, this research contributes to the field of medical geology and supports the United Nations Sustainable Development Goals (SDGs).

The findings support sustainable remediation strategies for building resilient mining communities in the Federal Capital Territory (FCT).

Keywords

Medical geology; Acid mine drainage; Heavy metals; Public Health, Abuja

HYDROGEOCHEMICAL EVALUATION OF GROUNDWATER QUALITY FOR DRINKING AND IRRIGATION IN THREE PROMINENT TOWNS OF ONDO STATE

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Abstract

The sustainability of groundwater is vital for health and agriculture. This study assessed the hydrogeochemistry, drinking and irrigation quality of 50 shallow wells from Ododе-Idanre, Alade-Idanre, and Akure, Ondo State, Nigeria. Well water samples were analyzed for major ions, pH, and Total Dissolved Solids (TDS) following standard methods. Results showed near-neutral pH (7.14±0.08 - 7.15±0.10) and Total Dissolved Solids (87.40±50.80 - 332.10±71.79 mg/L) within the limits of the World Health Organization. The major ion dominance followed $Ca^{2+} > Mg^{2+} > Na^{+} > K^{+}$ for cations and $HCO_3^{-} > SO_4^{2-} > Cl^{-}$ for anions.

Magnesium levels (66.80±7.84 - 78.37±24.01 mg/L) exceeded the Nigerian standard for drinking water quality of 20 mg/L. Dietary intake analysis revealed groundwater contributed 28–29% of the recommended daily allowance for Ca, up to 72% for Mg, while Na, K, and Cl contributions were negligible. The Water Quality Index rated samples as 56% "good," 42% "poor" and 2% "very poor". Irrigation indices (SAR, KR, %Na, SSP, MAR, MH, CBR/RI, PI, PS, CR) indicated generally good irrigation quality with exception of magnesium hazard (100% of samples), and corrosivity (24% of samples). Geochemical diagrams and Principal Component Analysis (PC1: 88.55%, TDS = 0.99742; PC2: 5.44%, Na + = 0.75496) identified mineral dissolution, reverse ion exchange and mixed silicate-evaporite weathering as dominant hydrogeochemical processes. The study recommends appropriate water treatment, corrosion-resistant irrigation infrastructure, and continuous monitoring to safeguard groundwater quality in the region.

Keywords

Drinking water quality; Hydrogeochemistry; Irrigation suitability; Southwestern Nigeria; Water Quality Index

PROSPECT OF THERMAL AND MINERAL SPRINGS AS RESOURCES FOR BALNEOLOGICAL TOURISM IN NIGERIA

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Abstract

Thermal and mineral springs are increasingly recognized as valuable geo-resources for balneological tourism, combining geological heritage with health, wellness, and recreational services. In Nigeria, these natural systems remain underutilized despite their widespread occurrence across diverse geological terrains, including the Basement Complex, Benue Trough, and volcanic provinces. This study evaluates the prospects of thermal and mineral springs as strategic resources for the development of balneological tourism in Nigeria, focusing on their distribution, geochemical properties, and socio-economic potential.

Significant thermal spring systems include Ikogosi Warm Springs, Wikki Warm Springs, Akiri Hot Springs, and Ruwan Zafi thermal springs. These springs are structurally controlled by deep-seated fractures and fault systems that facilitate the circulation of groundwater to geothermal depths, resulting in mineral enrichment and elevated temperatures. Hydrogeochemical studies indicate variable concentrations of dissolved ions such as calcium, magnesium, sodium, potassium, bicarbonate, sulfate, chloride, and trace elements including silica and iron, which are associated with therapeutic properties in global balneotherapy practices.

The prospects for balneological tourism development in Nigeria are substantial. These include diversification of the national economy beyond oil dependency, generation of employment opportunities, stimulation of rural development, and enhancement of public health through wellness-oriented tourism. Thermal springs also provide opportunities for the establishment of spa resorts, rehabilitation centers, and eco-health tourism destinations, aligning with global trends in preventive healthcare and sustainable tourism.

However, several constraints limit full exploitation of these resources, including inadequate hydrogeological characterisation, poor infrastructure, limited investment, weak policy integration, and insufficient promotion of wellness tourism. Additionally, there is a lack of standardized scientific validation of the therapeutic properties of Nigerian thermal waters.

This study recommends systematic inventory, geospatial mapping, hydrochemical analysis, and environmental monitoring of thermal and mineral springs across Nigeria. Interdisciplinary collaboration among geoscientists, health professionals, and tourism stakeholders is essential for sustainable development.

In conclusion, Nigeria's thermal and mineral springs represent significant untapped assets with strong potential to support balneological tourism, promote rural development, and contribute to economic diversification if properly harnessed through science-based and policy-driven frameworks.

Keywords

Thermal springs; Balneotherapy; Inventorisation; Health benefits; Nigeria

THE SILENT BURDEN OF FLUOROSIS IN LANGTANG NORTH, PLATEAU STATE, NIGERIA

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Abstract

Fluorosis is a significant public health concern in many parts of the world where naturally occurring fluoride concentrations in drinking water exceed recommended levels. This study investigates the prevalence, risk factors, and public health implications of dental and skeletal fluorosis in Langtang North Local Government Area of Plateau State, Nigeria. The research aims to assess the extent of fluoride-related health conditions among residents, identify major sources and determinants of fluoride exposure, and evaluate the impact of fluorosis on affected populations.

A cross-sectional study design will be employed, involving the collection of demographics, clinical, and environmental data from selected communities within Langtang North. Data will be gathered through structured questionnaires, clinical examinations, and laboratory analysis of drinking watersamples. The prevalence of dental fluorosis will be assessed using standard diagnostic indices, while skeletal fluorosis will be evaluated through clinical signs, symptoms, and relevant medical assessments. Statistical analyses will be conducted to determine associations between fluorosis prevalence and factors such as age, duration of exposure, water source, dietary habits, and socioeconomic status.

The study is expected to reveal the burden of dental and skeletal fluorosis in the area and highlight key risk factors contributing to fluoride exposure. Findings will provide valuable evidence for public health authorities, policymakers, and healthcare professionals in developing preventive strategies, promoting safe water interventions, and increasing community awareness regarding fluoride-related health risks. Ultimately, the study seeks to contribute to efforts aimed at reducing the incidence of fluorosis and improving the overall health and well-being of residents in Langtang North, Plateau State, Nigeria.

Keywords

Fluoride exposure; drinking water, water quality, associated public health challenges and the prevalence and risk factors of fluorosis among resident of Langtang north, plateau state Nigeria

GEOLOGY AND BRINE OCCURRENCES IN PARTS OF EBONYI STATE, SOUTH-EASTERN NIGERIA: A REVIEW OF RECENT ISSUES

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Abstract

Ebonyi State, located within the southeastern segment of Nigeria, hosts some of the most important natural brine deposits in the country. The major saline occurrences are concentrated around Uburu and Okposi in Ohaozara Local Government Area, where natural salt lakes, springs, and brine-bearing groundwater systems have supported indigenous salt production for centuries. The occurrence of these brines has attracted considerable scientific interest because of their economic significance, hydrogeological peculiarities, and relationship with the tectonic evolution of the Lower Benue Trough. Geologically, the area is underlain predominantly by sedimentary formations of the Albian Asu River Group and the Turonian Eze-Aku Formation. These lithological units consist mainly of shale, mudstone, siltstone, and sandstone deposited during the Early Cretaceous marine transgression. Regional tectonic deformation associated with the evolution of the Benue Trough produced extensive fractures, faults, folds, and joints that serve as conduits for deep-seated saline fluids. Previous hydrogeological studies suggest that the brines may originate from fossil seawater trapped within marine sediments and subsequently modified through water-rock interaction, evaporative concentration, and tectonic remobilisation.

Recent investigations have revealed significant spatial variations in groundwater chemistry within the saline lake areas. Sodium (Na^+) and chloride (Cl^-) dominate the brine composition, while elevated concentrations of sulphate, bicarbonate, magnesium, calcium, iron, and trace elements have also been reported. Hydrochemical facies analyses indicate the presence of sodium-chloride and sodium-potassium-bicarbonate water types within the southern portions of the basin. Current issues associated with the brine occurrences include groundwater contamination, environmental degradation from artisanal salt extraction, decline in productivity of traditional salt-making systems, inadequate resource characterization, and limited industrial utilisation. The growing demand for industrial salt, coupled with increasing pressure on groundwater resources, highlights the need for integrated geological, hydrochemical, isotopic, and geophysical investigations to improve understanding of the resource base and promote sustainable exploitation. This review synthesizes available geological, hydrogeological, hydrochemical, and socio-economic information on the brine occurrences of Ebonyi State and discusses recent developments, challenges, and opportunities for future research and resource development.

Keywords

Brine; Salt Lakes; Uburu; Okposi; Lower Benue Trough; Hydrogeology

IDENTIFYING ENVIRONMENTAL TRIGGERS FOR CHRONIC KIDNEY DISEASE (CKD) IN BADE LGA AND ENVIRONS, NORTH-EASTERN NIGERIA

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Abstract

Chronic Kidney Disease (CKD) has emerged as a significant public health challenge globally, with increasing prevalence in low- and middle-income countries. While traditional risk factors such as hypertension, diabetes mellitus, and genetic predisposition have been widely documented, growing evidence suggests that environmental factors may play a critical role in the onset and progression of CKD, particularly in rural and resource-constrained settings. In Northeastern Nigeria, including the Bade Local Government Area (LGA) of Yobe State, there is limited evidence regarding the environmental determinants contributing to the burden of kidney disease despite widespread exposure to potential environmental hazards such as poor water quality and food items, agrochemicals, heavy metals, climatic extremes, and inadequate sanitation conditions.

This study aims to identify and assess environmental triggers associated with Chronic Kidney Disease among residents of Bade LGA, Yobe State. Specifically, the study will investigate the relationship between environmental exposures and the occurrence of CKD, evaluate the quality of drinking water sources, assess community exposure to agricultural and industrial contaminants, and examine the influence of climatic and socio-economic factors on kidney health outcomes.

An environmental sampling, laboratory analysis, and geospatial assessment. Water, Soil samples (from the earth's surface and underground (borehole) will be analysed, and other environmental samples will be analyzed for potential nephrotoxic contaminants. The species of the heavy metals shall be determined to understand how they exist in their ionic forms in all environmental substances. Statistical analyses, including multivariate regression models, will be used to identify significant environmental predictors of CKD. Qualitative interviews with healthcare providers and community members will provide additional insights into local perceptions and patterns of environmental exposure.

The expected outcome of the study is the identification of key environmental risk factors contributing to CKD in Bade LGA. Findings will provide evidence for targeted public health interventions, environmental management strategies, and policy development aimed at reducing CKD burden in Yobe State and similar settings. The study will contribute to the growing body of knowledge on environmentally associated kidney disease and support efforts to strengthen disease prevention and environmental health surveillance in Nigeria.

Keywords

Chronic kidney disease (CKD); environmental triggers; heavy metals; water quality; agrochemicals

GENDER BASED RISK IN ARTISANAL MINING IN AFRICA: THE MEDICAL GEOLOGY PERSPECTIVE

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Abstract

Artisanal and small-scale mining (ASM) sustains over 10 million Africans, with women constituting 30- 50% of the workforce. Medical geology provides a critical lens to understand how exposure to geogenic contaminants such as mercury (Hg), lead(Pb), arsenic(As), cadmium(Cd), and repairable silica translates into gendered health outcomes. Despite this, risk assessments in ASM remain largely gender-blind.

This review examines gender-based risk factors in African ASM through a medical geology framework, using case evidence from Nigeria, Ghana, Tanzania, and the Democratic Republic of Congo (DRC) to identify exposure pathways, health impacts, and intervention gaps specific to women miners.

A synthesis of peer-reviewed literature, environmental data, and field biomonitoring studies from 2015-2025 was conducted. Focus was placed on (1) Geological sources of contaminants, (2) Occupational roles and hygiene practices of women, (3) Biomonitoring data for Hg, Pb, As, Cd, and (4) Reported reproductive and chronic health outcomes. Across African sites, women are disproportionately engaged in ore processing, amalgam burning, and tailings reworking, resulting in elevated exposure to Hg vapor and Pb dust. In Nigeria's Zamfara gold belt and Ghana's Tarkwa region, 55-68% of women processors exceeded WHO blood lead thresholds correlating with poor hand hygiene and absence of workplace sanitation. Reproductive health impacts including menstrual disorders, spontaneous abortion, and low birth weight were 2-3x higher in high-exposure communities. Comparative analysis shows that hygiene infrastructure and gender-responsive PPE use are stronger predictors of metal uptake than geology alone.

The African ASM experience demonstrates that geological hazard is mediated by gendered labor and hygiene deficits. Reducing medical geology-related disease burden requires integrating gender-responsive risk assessment, women-fit PPE, and sanitation infrastructure into ASM governance and public health policy across the continent.

Keywords

Medical geology; gender; artisanal mining; Africa; mercury; lead, occupational hygiene; women's health.

BALNEO-ECONOMICS: A PROPOSED SCIENTIFIC THEME FOR BALNEOLOGICAL RESEARCH

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Abstract

This paper explores the economics of an important aspect of medical geology known as balneotherapy. Balneotherapy is an aspect of medical geology that is concerned with therapeutic use of bathing agents such as mineral and thermal waters, muds and gases. Through balneotherapy, several health tourism and hospitality industries have been created which has resulted in income generation to many countries. In addition, balneotherapy has also served as an aspect of alternative medicine that has replaced the orthodox medicine in the cure of many chronic ailments and rehabilitation of patients. This aspect of balneotherapy necessitates economic analysis using health economic tools to estimate its value addition to the society.

Health economic tools adopted in this paper include the cost-benefit and cost-effectiveness analysis, market analysis of balneo-industries, application of macroeconomics in balneology, mineral/mining economics of medical resources and analysis of burden of diseases and health impact of balneology using Disability Adjusted Life Years (DALYs) and Quality Adjusted Life Years (QALYs) to measure quality of life gain in treatment using balneological procedure.

Keywords

Balneotherapy; Balneo-economics; Balneo-industries; Health economic tool

OPTIMISATION OF HYDROCARBON BIODEGRADATION BY PROVIDENCIA SPECIES USING RESPONSE SURFACE METHODOLOGY

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Abstract

Petroleum hydrocarbon pollution poses a significant threat to the ecosystems due to its persistence and toxicity in contaminated environments. In this study, soil sample collected from auto mechanic workshop was characterised for physicochemical properties and microbial diversity. Response Surface Methodology (RSM) was employed to optimise three key parameters: pH, microbial concentration, and substrate concentration and their effect of diesel removal. A total of 20 experimental runs were conducted, and residual oil content was quantified gravimetrically. Physicochemical analysis of the soil revealed pH of 7.57, total carbon (4.00%), organic matter (6.88%), total nitrogen content (0.07%), phosphorus levels (454.5 5mg/kg) and moisture content (0.23%). Heavy metal analysis detected elevated level of Cu (58.50mg/kg), Zn (158.50mg/kg), Pb (146.25mg/kg), and Cr (332.75mg/kg). From the experimental results obtained, a maximum oil removal efficiency of 91.42 % was achieved at a pH of 6.5, inoculum concentration of 2% and substrate concentration of 2.75%. The results demonstrated that removal efficiency increased with rising pH showed the percentage of diesel removal increased with an increase in pH but declined at higher substrate concentration. These findings revealed that Providencia sp. is an effective hydrocarbon degrader with strong potential for application in the bioremediation of petroleum-contaminated environments.

Keywords

Biodegradation; Diesel; RSM; Providencia sp.

ARSENIC ABOVE WHO GUIDELINES, HEALTH RISK NEAR THRESHOLDS: GEOGENIC MOBILISATION AND RISK DISSOCIATION IN SHALLOW URBAN AQUIFERS OF SOUTH-WESTERN NIGERIA

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Abstract

Shallow urban aquifers in Ibadan Southwestern Nigeria are an important drinking water source for a fast growing urban population, however, using guideline-derived arsenic levels to assess the geogenic source of arsenic in water may not capture the true exposure risk to human health. In this study, the dissociation between the exceedance of the WHO guideline on arsenic and the calculated health risk was analysed in 72 groundwater samples, where hydrochemical facies classification, profiling of redox parameters, arsenic species ratio (As (III) *vs* As(V)), and multi--pathway exposure health risk assessment (using the exposure parameters for ingestion-based exposure: ingestion--rate = 2 L/day; body weight = 65 kg; exposure duration = 30 years) were performed. The concentration of arsenic was in the range of 2.4 - 38.6 µg/L (mean of 14.8 µg/L), whereas 18% of water samples had arsenic concentration above the guideline set by WHO (10 µg/L), indicating that the samples contained active reducing conditions, with As (III) being dominant from 68 - 74% of the total dissolved arsenic. The reductive dissolution of Fe-oxyhydroxides is supported by significant positive correlations with Fe ($r = 0.63$, $p < 0.01$) and HCO_3^- ($r = 0.58$, $p < 0.01$) and is a mechanism expected to be influenced by water table fluctuations associated with extreme rainfalls and flooding events being more common in the region as a major control on mobilization. All non-carcinogenic hazard quotients (0.08 to 0.74) were < 1 and cumulative hazard indices were ≥ 1 at 7% of sites, suggesting non-negligible multi- pathway risk. Lifetime carcinogenic risk ranged from 1.2×10^{-5} - 3.8×10^{-4}, 82% of which were within the acceptable range (10^{-6} - 10^{-4}); 18% of the values were above the upper limit of the carcinogenic risk range and are priority targets for intervention, with the majority at sites with high arsenic concentrations. The results, based upon cross section sampling and thus not representing the entire seasonal variations, provide evidence of the measurable discordance between the hydrogeochemical guideline signals and risk-based measures of health and the need for a water quality governance framework that integrates rather than binary compliance with water quality guidelines in cities in Sub Saharan Africa.

Keywords

Arsenic; Shallow aquifers; Hydrogeochemistry; Water quality; Health risk; Southwestern Nigeria

ESTABLISHING MEDICAL GEOLOGY FOUNDATIONS: A MULTI-DISCIPLINARY FRAMEWORK FOR BRIDGING ENVIRONMENTAL GEOCHEMICAL ASSESSMENT AND PUBLIC HEALTH RISK COMMUNICATION IN NIGERIA

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Abstract

The integration of medical geology into environmental health research and policy frameworks remains nascent in many developing nations, particularly in Nigeria, where environmental geochemical risks pose significant public health challenges. Despite established links between environmental trace elements, radionuclides, and human health, critical gaps persist in the systematic assessment and communication of these risks across disciplinary boundaries. This paper presents a novel multidisciplinary framework that bridges environmental geochemical assessment and public health risk communication in Nigeria. The framework addresses fundamental questions: How can geochemical mapping data be effectively translated into public health interventions? What mechanisms best facilitate knowledge transfer among geoscientists, environmental scientists, medical professionals, and public health practitioners? Through a systematic review and stakeholder engagement, this study examines the current state of medical geology adoption in Nigeria and identifies barriers and opportunities for integration across disciplines. The methodology encompasses environmental trace element analysis, geochemical mapping, epidemiological pathway assessment, and evaluation of risk communication strategies. The resulting framework provides a structured approach to understanding toxicological and epidemiological pathways and establishes effective channels for communicating environmental hazards and health risks to key stakeholders. This work contributes to the emerging field of medical geology by demonstrating how cross-disciplinary collaboration can enhance understanding of environment-health relationships and improve public health outcomes in developing nations. The framework's adaptability makes it relevant to other regions facing similar challenges in establishing medical geology foundations. The study is expected to yield comprehensive guidelines necessary for implementing medical geology practices and protocols to support sustained interdisciplinary collaboration in environmental health assessment. Furthermore, this study would catalyse dialogue among geoscientists, environmental researchers, medical professionals, and public health practitioners, ultimately fostering the collaborative approaches necessary to address complex environmental health challenges in the twenty-first century.

Keywords

Cross-sectoral collaboration; Toxicological pathways; Trace elements; Community/stakeholder engagement; Knowledge transfer; Epidemiological assessment

BRIDGING SCIENCE AND TRADITION: HOW CLIMATE CHANGE AND GEOMEDICAL DISEASES REDUCE NUTRIENT ABSORPTION FROM GEOPHAGY, CENTRED ON URBAN WOMEN IN SOUTH-EASTERN NIGERIA

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Abstract

Background

In Southeastern Nigeria, geophagy – the intentional consumption of soil and edible clay – is common among women of childbearing age during pregnancy and lactation to manage nausea and uphold traditions. In cities such as Awka and Onitsha, women buy processed kaolin rather than harvesting traditional soil. Climate change, with flooding and rising temperatures, affects Nigeria's health by altering soil chemistry and increasing exposure to toxins. When women eat climate-affected Nzu, it interacts in the gut, forming complexes with iron and zinc rather than facilitating mineral absorption, leading to malnutrition and anaemia. This reveals a health paradox at the intersection of urban environmental health, climate change, and traditional maternal care.

Objectives

We aim to assess how climate change and altered geomedical profiles threaten the safety of traditional geophagia by quantifying reduced nutrient absorption among urban women and by developing a culturally sensitive, data-driven public health framework. This framework would address maternal malnutrition and heavy metal toxicity while respecting local traditions in South-eastern Nigeria.

Proposed Methodology

Our work links scientific data with sociocultural aspects of interdisciplinary research in two phases. Phase I: Environmental Geology and Marketplace Sampling of Clay Sourcing and Formulations were conducted in heavily populated markets in Anambra, with parasitological assays using zinc sulphate flotation to identify soil-transmitted helminths. Phase II involved clinical assessment and patient tracking of pregnant women in urban clinics across Southeastern Nigeria. This multi-centre observational study used biomedical screening and questionnaires to track Nzu intake, with blood tests measuring haemoglobin, ferritin, and lead levels. A GIS map integrated mine sources, flooding, surface temperature, and toxicity data from marketplace samples.

Proposed Impact

Redefining antenatal care in Nigeria involves providing clear, evidence-based guidelines for obstetricians and midwives to screen for geophagy, shifting from shaming to biochemical education on iron chelation, and regulating markets through bodies such as NAFDAC, with chemical baselines for the safer processing of consumer-grade clays. It aims to reduce maternal and neonatal mortality by addressing severe iron deficiency, low birth weight, and lead exposure, while promoting Medical Geology research into the impact of climate change on traditional practices and creating a model for environmental health in the Global South.

Keywords

Geophagy (Pica); Geomedicine; Kaolin Clay (Nzu/Ulo); Maternal Malnutrition; Metal Toxicity; Iron-Deficiency Anaemia; Climate Change Adaptation; Southeastern Nigeria; Urban Health; Quantitative; Geographic Information Systems; Antenatal Care

THE ROLE OF MEDICAL GEOLOGY IN NIGERIA'S ECONOMIC DEVELOPMENT AND PUBLIC HEALTH: HARNESSING GEOSCIENCES FOR A HEALTHIER AND PROSPEROUS NATION

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Abstract

Nigeria's economic development is closely linked to its abundant geological resources, particularly within the mining, agricultural, and water sectors. However, the interaction between geological materials and human health presents complex challenges and opportunities with direct implications for national productivity and economic sustainability. This paper examines the role of medical geology in Nigeria, focusing on how geo-environmental factors influence public health outcomes and, consequently, economic performance. The study synthesizes existing literature and case evidence from key mining regions, including Plateau and Zamfara States, where exposure to geogenic contaminants such as lead, arsenic, and mercury has resulted in severe public health crises. These health impacts have led to increased healthcare expenditures, reduced workforce productivity, and broader socio- economic disruptions. In contrast, the paper also highlights the beneficial aspects of geomaterials, including their contributions to soil fertility, agricultural productivity, and nutritional quality, which are essential for food security and rural livelihoods. Emphasis is placed on the application of geospatial technologies, particularly Geographic Information Systems (GIS), and emerging analytical tools for environmental monitoring, disease mapping, and risk assessment. The integration of these approaches within medical geology enhances early warning systems and supports evidence-based decision-making. Furthermore, the study underscores the importance of strengthening regulatory frameworks, environmental policies, and community engagement strategies to mitigate geogenic health risks and promote sustainable resource utilization. The paper concludes that medical geology represents a critical interdisciplinary framework for addressing the nexus between environmental health and economic development in Nigeria. Its effective integration into national planning and public health systems can reduce economic losses, enhance human capital, and support sustainable development goals.

Keywords

Medical geology; Public health; Economic Development; Geogenic contamination; GIS; Environmental monitoring.

GEOENVIRONMENTAL AND HEALTH DYNAMICS OF POTENTIALLY TOXIC ELEMENTS (PTES) IN HYDROCARBON-CONTAMINATED SOIL AND WATER IN BAYELSA STATE, NIGERIA: A REVIEW

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Abstract

Hydrocarbon contamination resulting from petroleum exploration, production, transportation, and refining activities remains a major environmental challenge in oil-producing regions worldwide. In the Niger Delta of Nigeria, particularly Bayelsa State, decades of oil spills, gas flaring, pipeline leakages, produced water discharge, and artisanal refining have led to the accumulation of potentially toxic elements (PTEs) in soil and water systems. This review examines the geoenvironmental behavior, distribution, ecological implications, and human health risks associated with PTEs in hydrocarbon-contaminated environments. The review synthesises existing literature on the occurrence of key PTEs, including lead, cadmium, chromium, nickel, arsenic, mercury, copper, zinc, cobalt, manganese, and vanadium, and evaluates their sources, fate, transport mechanisms, and bioavailability in terrestrial and aquatic ecosystems. Particular attention is given to the influence of soil physicochemical properties, hydrogeological conditions, redox reactions, adsorption–desorption processes, and seasonal flooding on contaminant mobility. The review further discusses contamination assessment approaches, including pollution indices, ecological risk models, human health risk assessment frameworks, and geospatial techniques for environmental monitoring and hotspot identification. Evidence from the Niger Delta indicates that elevated concentrations of PTEs in hydrocarbon-impacted environments pose significant threats to ecosystem integrity, agricultural productivity, water quality, and public health through ingestion, inhalation, dermal contact, and food-chain transfer pathways. The study identifies critical knowledge gaps regarding integrated geoenvironmental-health assessments and highlights the need for sustainable remediation, effective environmental governance, and continuous monitoring. The review provides valuable insights for researchers, environmental managers, policymakers, and public health professionals working toward environmental sustainability and pollution risk reduction in petroleum-producing regions.

Keywords

Potentially toxic elements; Hydrocarbon contamination; Bayelsa State; Human health risk; Geoenvironmental dynamics

BASELINE ASSESSMENT OF NANOPARTICLES AND GASEOUS AIR POLLUTION IN KARU, NASARAWA STATE, NIGERIA

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Abstract

A baseline assessment of nanoparticles and gaseous air pollutants will be conducted in Karu, Nasarawa State, Nigeria, to evaluate localized air quality and potential public health risks. The study will systematically measure particulate matter (PM_{10}, $PM_{2.5}$), ultrafine nanoparticle size distribution and concentration, alongside criteria gaseous pollutants (NO_2, SO_2, CO, O_3). Comprehensive laboratory analyses will be carried out to evaluate and compare empirical outcomes against World Health Organization (WHO) air quality guidelines. Additionally, the resulting spatial-temporal data will be correlated with regional vehicular emissions and biomass burning patterns to deduce evidence-based recommendations for policy frameworks, regular environmental monitoring, emission mitigation controls, and community public health awareness campaigns. While macro-level air quality indexes broadly categorise atmospheric conditions in Karu as „moderate," ground-level fine particulate matter ($PM_{2.5}$) levels frequently threaten to exceed healthy thresholds due to rapid urbanisation, congestion, and commercial activities. Crucially, empirical baseline data regarding ultrafine particles (nanoparticles < 100 nm) and specific ambient gaseous concentrations remain virtually nonexistent for this fast-developing zone. Because nanoparticles possess the distinct physiological capability to penetrate deep into pulmonary alveoli, enter systemic blood circulation, and accumulate within vital metabolic organs, their co-presence with secondary gaseous pollutants introduces severe toxicological health risks. Consequently, this proposed research aims to bridge critical data gaps by establishing a definitive baseline dataset essential for informed public health policy planning and long-term environmental management decisions within the region.

Keywords

Nanoparticles; Air Quality Baseline; PM2.5; Volatile Organic Compounds (VOCs); Public Health; Karu

HEALTH, SOCIAL SECURITY AND ENVIRONMENTAL IMPLICATION OF RARE EARTH ELEMENT EXPLORATION IN THE NORTHERN STATES OF NIGERIA; CAUSE FOR CONCERN

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Abstract

Rare Earth Elements (REEs) exploration offers a real shot at economic diversification, job creation and tech--industry positioning of the country to the world. However, the health risk in addition to social security and environmental implication of REEs exploration is of great concern. Rare Earth Elements (REEs) are group of metals that found applications in high technology devices such as smart phones, digital cameras, computer hard disc, computer monitors, electronic display, fluorescent, light-emitting diode (LED), electric motor including flat screen television. Assessment of Rare Earth Element (REEs) in the Lagos coastal waters and sediment was carried out to evaluate the geochemical distributions in the coastal environments, since the sediment serves as a sink for most contaminants from land based anthropogenic activities. Water samples and core sediments were collected at 20 stations, and analyzed using ICP-MS. Statistical analysis of the water sample result showed La(2.83± 2.37), Ce(3.22±2.87), Pr(0.74±0.64), Nd(2.98±2.57), Sm(0.55±0.47), Eu(0.12±0.11) and Gd(0.45±0.31)for dry season while the wet season showed La(4.32±4.38), Ce(10.56±10.54), Pr(1.15±1.21), Nd(4.58±4.70), Sm(0.83±0.85), Eu(0.19±0.19) and Gd(0.67±0.66).The core sediment sample ranged La(2.09-91.70), Ce(2.65-24), Nd(1.18-83.10), Pr(0.30-21.20), Sm(0.10-13.10),Dy(<0.005-8.50), Eu(<0.11-2.31) and Gd (0.10-1.60) with mean value 41.97, 20.54, 17.71, 4.59, 3.01, 1.910.82 and 2.57respectively. Mean concentration of the elements as detected is in the order Ce < La < Nd < Pr < Sm < Gd < Dy < Eu < Ho < Tb. The result of the dry season when compared with wet season showed an elevation in value. This could be attributed to runoff from land based anthropogenic activities. REEs are associated with some serious health challenges, environmental degradation, social security challenge and of course economic benefits. REE exploration can power Nigeria's industrial growth, tech future and job creation, but with very strong legislation, regulation and monitoring.

Keywords

Anthropogenic; contaminant; diversification; geochemical

RADIOLOGICAL ASSESSMENT OF GEOGENIC PRIMORDIAL RADIONUCLIDES IN AQUIFER MATERIALS UNDERLYING REDEEMER'S UNIVERSITY, SOUTH-WESTERN NIGERIA

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Abstract

Gamma-ray spectrometry employing a NaI (TI) detector was engaged to assess the radioactivity level of geogenic primordial radioactive elements (232 Th, 238 U, and 40 K) in rock-cuttings out of 14 water boreholes exploited within the Redeemer's University Campus underlain by the Southwest Basement Complex of Nigeria. The radioactivity levels of 40 K, 232 Th and 238 U within the analyzed spanned between 444.05 ± 11.77 Bq/kg to 583.86 ± 8.60 Bq/kg, 7.05 ± 0.95 Bq/kg and 16.73 ± 1.12 Bq/kg, 19.22 ± 1.97 Bq/kg and 32.84 ± 1.61 Bq/kg respectively, with mean values of 492.57± 42.58, 24.72 ± 4.13 and 13.29 ± 2.27 respectively. The activity concentrations were quantify to establish the radiological potential harm from the aquifer materials (rock-cuttings) using variant indices including radium equivalent activity (Ra eq) with an arithmetic mean of 81.69 Bq/kg, absorbed dose rate (D) with an average concentration within 39.98 nGy/h, annual effective dose (AED) with average value of 0.0495 mSv/year, internal hazard (H in) and external hazard (H ex) indices with an arithmetic mean of 0.2222 as well as 0.2878 correspondingly and excess lifetime cancer risk with an arithmetic mean of 0.1727. These measured primordial radiological indices were within the regulatory dose limits established by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR). This implies that the basement rocks hosting groundwater in the study area do not constitute an immediate substantial health challenge to the drillers, groundwater end users, and the environment. However, long-term exposure to aerosol and dust from drilling may cause health risks.

Keywords

Basement Complex, Radiological indices, Activity Concentration

ASSESSMENT OF POTENTIALLY HARMFUL ELEMENTS (PHES) IN FARM SOILS NEAR ABANDONED TIN-COLUMBITE MINE SITES, JOS, BARKIN LADI, NORTH-CENTRAL NIGERIA

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Abstract

Assessment of potentially harmful elements (PHEs) in farm soils around abandoned tin–columbite mine sites in Jos and Barkin Ladi, north-central Nigeria, was carried out to evaluate contamination levels and possible environmental risks. Thirty-three composite soil samples and four control samples were collected from cultivated farmlands and analyzed using Inductively Coupled Plasma–Mass Spectrometry (ICP–MS). Pollution assessment was conducted using the Index of Geo-accumulation (Igeo) and Contamination Factor (CF). The results indicate elevated concentrations of several trace elements, particularly Pb, Ba, Ce, Zn, and Mn, reflecting both lithological influence and anthropogenic contamination associated with historical mining activities. Lead concentrations exceeded background levels in all sampled soils, while silver showed localised anomalous enrichment. Geo-accumulation and contamination factor analyses revealed that most elements ranged from unpolluted to moderately contaminated conditions, whereas Ag and Ba exhibited very high contamination levels. Chromium and nickel largely reflected geogenic contributions from the parent rocks. The study demonstrates that abandoned mining activities continue to influence the geo-chemical quality of agricultural soils within the study area. The enrichment of toxic elements such as Pb, Ba, As, and Ag raises concerns regarding long-term soil quality, crop contamination, and human exposure through the food chain. Continuous environmental monitoring, improved irrigation management, and remediation of contaminated mine environments are therefore recommended to support sustainable agriculture and public health protection.

Keywords

Geo-accumulation; Contamination Factor; Environmental; Pollution

LEVELS AND FORMS OF POTENTIALLY HARMFUL ELEMENTS IN MINE POND WATERS OF THE JOS, BUKURU AND BARKIN LADI AREA, NORTH-CENTRAL NIGERIA

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Abstract

Mining activities across the Jos Plateau have generated numerous abandoned mine ponds that serve domestic and agricultural purposes, raising concerns about contamination by potentially harmful elements (PHEs). This study assessed the concentrations, distribution patterns, and aqueous speciation of selected trace metals in 37 mine pond waters from Jos North, Jos South, and Barkin Ladi areas of north-central Nigeria. Field physicochemical parameters indicate generally fresh and weakly mineralized waters, with pH ranging from 6.51 to 8.27 (mean = 7.49), total dissolved solids (TDS) between 4.00 and 100.00 mg/L (mean = 32.76 mg/L), electrical conductivity (EC) from 11 to 253 µS/cm (mean = 67.46 µS/cm), and dissolved oxygen (DO) between 3.99 and 8.36 mg/L (mean = 5.99 mg/L). Trace element analysis reveals marked spatial variability. Zinc (Zn) shows extreme enrichment, reaching 10,000.7 ppb (WRID7), while other elevated values include 3,836.8 ppb (WRID10) and 3,009.7 ppb (WRID34). Manganese (Mn) ranges up to 681.95 ppb (WRID28) and 517.38 ppb (WRID36). Barium (Ba) reaches 180.77 ppb (WRID31), and strontium (Sr) peaks at 152.82 ppb (WRID6). Lead (Pb) attains 11.2 ppb (WRID1) and 10.5 ppb (WRID31), whereas cadmium (Cd) is mostly below detection limits, with isolated values up to 0.06 ppb. Hierarchical Cluster Analysis identifies Zn as the dominant contaminant signature, forming a distinct cluster at high Euclidean distance, while Ba and Sr cluster together, reflecting lithogenic control from Younger Granite host rocks. Principal Component Analysis shows that PC1 represents the main pollution gradient, separating contaminated ponds (e.g., WRID1, WRID28, WRID32, WRID34) from background sites. Speciation modeling using WateQ4F indicates predominance of free ionic forms: Zn^{2+} (100%), Mn^{2+} (100%), Ba^{2+} (100%), Cd^{2+} (100%), Pb^{2+} (91.71–100%), and Cu^{2+} (99.43%), implying high mobility and bioavailability. Chromium occurs mainly as Cr^{3+} (99.38%), indicating lower immediate toxicity. The dominance of bioavailable divalent species suggests significant ecological and human health risks where pond water is used for irrigation and domestic purposes. The findings demonstrate that mine-related metal enrichment on the Jos Plateau is spatially structured, redox-influenced, and of growing environmental concern.

Keywords

Contamination; Bio-available; Ecological; Environmental; Concentration

SOURCE(S) OF FLUORIDE IN GROUNDWATER OF KALTUNGO AND ENVIRONS, NORTH-EASTERN NIGERIA

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Abstract

Consumption of fluoride in drinking water of less than 0.5 mg/l may result in the development of dental mcaries and in excess greater than 1.5 may result in dental fluorosis. Dental fluorosis is a common manifestation in school children in Kaltungo area, Northeast Nigeria. The aim of the study was to determine the mineral source(s) and spatial distribution of fluoride and other ions in different water sources (borehole, hand dug well and springs) that are used for drinking purposes in the area. A total of 40 water samples, 6 rocks and 4 soil samples were collected for this study. Fluorine in rocks and soils were analyzed using the fusion method and microprobe analysis of minerals was carried out using JEOL JXA-8200 Super Electron Probe Micro-Analyzer (FPMA).

Four out of the six rock samples were selected for microprobe analysis after determining fluorine content in them. Cation analyses in water were carried out using Inductively Coupled Plasma Optical Emission Spectrophotometer. The anions (Cl^-, SO_4^{2-}, NO_3^-) were determined using UV Multi-Ion Parameter and bicarbonate was by titration method. Fluoride was determined by Ion Selective Electrode. Results indicate concentration of fluorine ranged from 62–1100 ppm in rocks and 164–560 ppm in soils. Average concentration of fluorine in biotite across the lines are porphyritic hornblende biotite granite - 0.805 and 0.963, porphyritic biotite granite – 1.128 and 0.745, coarse porphyritic hornblende biotite granite – 0.111 and 0.346 and coarse-grained hornblende biotite granite – 0.522 and 0.487 wt%. Average concentration of fluorine in hornblende are 0.443 and 0.474, 0.255 and 0.318, 0.179 and 0.209 wt% respectively.

The biotite in coarse porphyritic biotite granite has the highest content of fluorine of 1.13wt % and has chemical formula $(K_{0.85})^A(Ti_{1.17}\ Fe_{1.55}\ Mg_{0.93}\ Mn_{0.02})\ ^M(SiO_{2.83}\ Al_{1.37})^T\ O_{10}(F_{1.13}\ Cl_{0.10}\ OH_{1.73})$. Since biotite is likely to release fluorine on the onset of weathering, it is the major contributor of fluoride in the groundwater of Kaltungo area with minor contribution from hornblende. Sixty-five percent of water sources have concentration of fluoride above the WHO recommended upper limit of 1.5mg/l for what should be in drinking water and this manifest in form of dental fluorosis in mostly children.

Keywords

Fluoride; Fluorine; Hornblende; Dental fluorosis; Groundwater

AN INTEGRATED SOURCE-TO-RECEPTOR HEALTH RISK MODEL FOR ARTISANAL QUARRYING IN NORTH-CENTRAL NIGERIA

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Abstract

Artisanal quarrying exposes workers to multiple hazards – radiological, toxicological, and respiratory – yet current risk assessments typically examine these pathways in isolation. This study develops an integrated source--to-receptor health risk model for manually quarried rocks in North-Central Nigeria by combining geochemical characterization of 95 rock samples, air quality monitoring, and biological surveillance of 120 workers. Activity concentrations of ^{238}U (72.07 Bq/kg), ^{232}Th (79.23 Bq/kg), and ^{40}K (616.14 Bq/kg) in quarry rocks exceeded UNSCEAR world averages by factors of 2.1, 2.6, and 1.5 respectively. Crushing operations posed the greatest exposure risk, with $PM_{2.5}$ concentrations exceeding WHO standards by 76.7% and inhalation contributing 94% of the total daily dose. Hazard quotient methodology revealed that all exposure categories exceeded $HQ > 1.0$, indicating significant non-carcinogenic risk. Cancer risk ($CR = 1.50 \times 10^{-5}$) exceeded the acceptable limit (10^{-6}) by a factor of 15. Biological monitoring confirmed bioaccumulation of uranium, lead, and arsenic, with elevated BUN and creatinine levels indicating early renal impairment. The integrated model successfully predicted health outcomes based on source characteristics ($R^2 = 0.87$, $p < 0.001$), demonstrating the value of a unified framework for assessing occupational health risks in artisanal quarrying. These findings underscore the urgent need for occupational safety measures and regulatory interventions.

Keywords

Source-to-receptor model; artisanal quarrying; health risk assessment; NORMs; occupational exposure; North-Central Nigeria

FROM ROCK TO RESPIRATORY SYSTEM: A PATHWAY ANALYSIS OF RADIOLOGICAL AND TOXICOLOGICAL RISKS IN MANUAL STONE QUARRYING, NORTH-CENTRAL NIGERIA

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Abstract

Manual stone quarrying liberates naturally occurring radioactive materials (NORMs) and toxic heavy metals from their geological matrix into environmental media through which they reach human receptors. This study traces the complete pathway from rock to respiratory system using a multi-media approach combining geochemical analysis of 95 rock samples, air quality monitoring ($PM_{2.5}$, PM_{10}), GIS-based spatial analysis, and biological monitoring of 120 quarry workers. Results demonstrate that uranium and thorium show the highest enrichment from rock to dust (Enrichment Factor > 3), with crushing operations concentrating these radionuclides in respirable particles. $PM_{2.5}$ concentrations during operations (142.7 μg/m^3) exceeded WHO standards by a factor of 9.5, with the high $PM_{2.5}/PM_{10}$ ratio (0.95) confirming that the majority of airborne particles are fine and capable of reaching the deep lung. GIS-based kriging analysis identified three pollution „hotspots" within the quarry, with 40% of sampling points exceeding annual effective dose limits of 2.5 mSv/year. A clear dose-response relationship was observed: workers with >10 years exposure had blood uranium levels 4.6 times higher than those with <1 year exposure. The pathway model demonstrated strong predictive performance ($R^2 = 0.84$, $p < 0.001$), establishing a traceable chain of evidence linking quarry operations to adverse health outcomes. This „rock-to-respiratory" narrative provides compelling evidence for regulatory intervention and highlights the urgent need for occupational safety measures in artisanal quarrying.

Keywords

Pathway analysis; rock-to-respiratory; NORMs; air quality; bioaccumulation; occupational health; Nigeria

APPLICATION AND HEALTH IMPLICATION OF AGROCHEMICALS ON SOIL AND WATER BY FCT FADAMA PROJECT CROP FARMERS

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Abstract

The Fadama Project in the Federal Capital Territory (FCT), Nigeria, has significantly improved crop production through the increased use of agro –chemicals (NPK Fertilizer, Urea Fertilizer, Herbicides (Glyphosate) & Pesticides). While these Input enhance agricultural productivity and reduce crop losses, their excessive or improper application poses serious environmental and public health concerns for the resident of the FCT. Agro -chemicals applied on farmlands can accumulate in soils, alter soil pH, reduce beneficial microbial populations, impair nutrient cycling, and decrease long-term soil fertility. Persistent Agro Chemicals residues may also remain in the soil, affecting biodiversity and ecosystem stability.The impact identification matrix from Environmental & Social Audit conducted for 6 sampling in each Area Council shows that Fadama activities are highly significant with positive impact. The negative impacts however showed significant (<20) and as a result they can be easily be mitigated. Laboratory analysis indicates that the indictors investigated were within acceptable limits of WHO and FMEnv. But in Fugbe Community in Kwali Area Council, there are concentration of toxic heavy metals

Lead (Pb) in water (0.33g/kg) above limit of 0.01 and Cadmium (Cd) in soil0.003mg/L at exact limit of WHO and FMEnv due to runoff and leaching from treated farmlands and transportation of agrochemical residues into rivers, streams, ponds, and groundwater sources commonly used by rural communities. Such Pb & Cd contamination degrades soil & water quality, promotes eutrophication, and exposes humans and aquatic organisms to toxic substances. Pesticides enter water bodies mainly through surface runoff and infiltration, especially during rainfall events. The implications of Phosphorus include nutrient loading of water bodies, The health implication of Glyphossate inhalation and dermal contact may include eye irritation, skin irritation, nausea, vomiting , respiratory sysmptoms and acute poisoning from direct exposure during mixing and spraying. Long-term exposure can lead to substantial increases in bioaccumulation (biomagnification) well beyond threshold limit in the human body. This study highlights the need for sustainable agrochemical management among FCT Fadama farmers through proper training on the use of Agro- Chemicals, adherence to recommended application rates, use of personal protective equipment (PPE), integrated pestmanagement (IPM), and regular monitoring of soil and water quality. Adoption and mitigation measures will help minimise environmental pollution, protect public health, and ensure sustainable agricultural production.

Keywords

Agrochemicals; Fadama Project; Soil Contamination; Water Pollution; Pesticides; Fertilizers; Bioaccumulation; Biomagnification Crop Farmers; Public Health; Environmental Impact; FCT, Nigeria

GEOGENIC ARSENIC MOBILISATION AND RISK DISSOCIATION IN SHALLOW URBAN AQUIFERS OF SOUTH-WESTERN NIGERIA: BEYOND WHO GUIDELINE COMPLIANCE

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Abstract

Shallow urban aquifers in Ibadan, Southwestern Nigeria, provide critical drinking water for a rapidly growing population, yet reliance on guideline-derived arsenic thresholds may fail to adequately capture human health risks from chronic low-to-moderate exposure. This study investigated the dissociation between WHO guideline exceedance and calculated health risk across 72 groundwater samples collected during the dry season. Hydrochemical facies classification, redox profiling, arsenic speciation (As(III) vs As(V)), and multi-pathway health risk assessment were conducted. Arsenic concentrations ranged from 2.4 to 38.6 µg/L (mean = 14.8 µg/L), with 18% (n = 13) exceeding the WHO 10 µg/L guideline. Reducing conditions prevailed (mean ORP = -45 mV, DO = 0.8 mg/L), with As(III) constituting 68–74% of total arsenic – an As(III)/As(V) ratio of 2.1–2.8 indicating strongly reduced conditions and enhanced arsenic mobility and toxicity. Significant As-Fe correlations ($r = 0.711$ $p < 0.01$) and HCO_3^- associations ($r = 0.451$, $p < 0.01$) supported reductive dissolution of Fe-oxyhydroxides as the dominant mobilisation mechanism. Individual non-carcinogenic hazard quotients ranged from 0.28 to 2.58; cumulative hazard indices from 0.31 to 2.84, with 12.5% (n = 9) exceeding unity. Lifetime carcinogenic risk (CR) ranged from 1.2×10^{-5} to 7.6×10^{-4}; 55% (n = 40) fell within the acceptable range (10^{-6}–10^{-4}), while 45% (n = 32) exceeded the upper threshold. Monte Carlo simulation confirmed qualitative robustness, with 21–31% of samples (95% CI) exceeding $CR > 10^{-4}$ under plausible parameter variation. Notably, 21% (n = 15) of samples meeting the guideline exhibited unacceptable CR, suggesting measurable dissociation between guideline compliance and health risk, though this finding is based on a limited number of discordant cases and requires further validation (Fisher's exact test, $p < 0.001$; odds ratio = 9.27, 95% CI: 2.83 – 30.4). These findings evidence discordance between hydrogeochemical guidelines and risk-based health measures – a „risk dissociation" phenomenon with implications for water quality governance in Sub-Saharan African urban contexts. The results advocate for integrative risk-based approaches accounting for arsenic speciation, cumulative exposure, and differential species toxicity, while acknowledging the preliminary nature of these observations pending broader validation.

Keywords

Arsenic mobilisation; Reductive dissolution; Health risk assessment; Risk dissociation; Groundwater quality

ECOLOGICAL RISK ASSESSMENT OF POTENTIALLY TOXIC ELEMENTS IN SURFACE SEDIMENT CORES FROM LAGOS COASTAL WATERS, SOUTHWESTERN NIGERIA

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Abstract

Sediment pollution often accumulates in the uppermost layer of the seabed or riverbed. Spatial distributions and risk assessment of potentially toxic elements (PTEs, Hg, Pb, Cd, As, Sb, and Se) from the top layer of sediment core (0-5 cm) from Lagos coastal waters, SW Nigeria, were investigated using inductively coupled plasma mass spectrometer (ICPMS) Agilent 7700 series at Activation Laboratories, Canada. Sampling stations were grouped into three environmental categories based on predominant land use and anticipated anthropogenic pressures. Group A: industrial/port-dominated stations; group B: residential–urban/utility-influenced stations. Group C, domestic waste/mixed anthropogenic influence. Mid Lagoon, a relatively low-impact station, was used as a control station.

The mean PTEs show descending order of Pb (15.75 ppm) > As (2.09 ppm) > Se (0.84 ppm) > Cd (0.174) > Sb (0.39), and > Hg (0.11 ppm). Sampling stations were assessed using the Mean ERM quotient (MERMQ), contamination severity index (CSI), and Nemerov pollution index (PN). The mean concentrations of the metals were lower than the Effects Range Median (ERM), suggesting non-adverse biological effects from the PTEs. MERMQ values are > 0.1 at 60%, 0%, and 20% at group A, to group C, respectively, indicating > 21 % toxicity probability at the stations. The CSI values range from 0.50-2.52, 0.33-1.54, and 0.12-1.16 at group A, to group C, respectively. The PN values range from 0.11 to 15.17, 0.006 to 1.55, and 0.005 to 7.41 from group A, to group C, respectively, indicating low to ultra-high pollution severity.

The study revealed higher pollution pressure at group A compared to group B, and group C. Although current PTE concentrations indicate generally low ecological risk, localized enrichment may pose potential long-term human health concerns through bioaccumulation and exposure along the coastal food chain. This study calls for more investigations on the estimated severe contamination from enriched PN > 3 values for Hg and Sb, respectively, at Iddo station (Group A). Generally, Lagos coastal sediments showed low to moderate contamination, with industrial and port-dominated shipping and dredging areas requiring targeted monitoring and management interventions.

Keywords

Potentially Toxic Elements (PTEs); Inductively Coupled Plasma Mass Spectrometer (ICPMS); ecological risk assessment; human health; Lagos coastal sediments; SW Nigeria

MINING-DRIVEN WATER CONTAMINATION AND WASH COLLAPSE IN A CONFLICT-AFFECTED ARTISANAL GOLD RUSH: MEDICAL GEOLOGY EVIDENCE FROM THE LOMERA/LUHIHI SITE, LAKE KIVU BASIN, DR CONGO

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Abstract

The Lomera/Luhihi artisanal gold mining site, located on the shores of Lake Kivu in Kabare territory (South Kivu, DR Congo), emerged in late 2024, attracting more than 30,000 people within weeks. Since April 2025, the site has operated under the military control of the AFC/M23 armed group, with no water infrastructure, no sanitation system, and no public health authority; making it a critical case study at the intersection of medical geology, WASH, and community resilience science. This study presents the first systematic medical geology assessment of the site, combining field observation, 35 semi-structured interviews, and physicochemical water analysis at three georeferenced sampling points (March–July 2025). Results reveal severe Lake Kivu contamination: mercury at 0.012 mg/L; twelve times the WHO limit; lead at 0.021 mg/L, arsenic at 0.014 mg/L, turbidity exceeding 100 NTU, and fecal coliforms in all samples. Sluice operations discharge mercury-laden effluents directly into the lake, while the same water serves simultaneously for ore washing, cooking, bathing, and consumption. Women and children bear the highest burden: gastrointestinal illness, mercury-linked neurological symptoms, skin infections, and reproductive risks in pregnant women are documented on site. From a medical geology perspective, this compound exposure heavy metal toxicity amplified by biological contamination; dismantles the foundations of community health resilience. The armed governance vacuum institutionalises environmental impunity: no monitoring, no WASH intervention, no regulatory framework exists. Comparison with Kamituga and Shabunda confirms that even minimal state or NGO presence measurably reduces contamination levels and health outcomes. This paper argues that geology-informed WASH interventions; protected boreholes, biosand filters, mercury-free concentration techniques, and community water monitoring; can build resilience even under institutional collapse, provided geochemical evidence drives the response.

Keywords

Medical Geology; WASH, Artisanal Gold Mining; Mercury; Contamination; Lake Kivu; Conflict-Affected Mining; Community; Resilience; Heavy Metal; Toxicity; South Kivu; DR Congo

GEOENVIRONMENTAL AND HEALTH DYNAMICS OF POTENTIALLY TOXIC ELEMENTS IN HYDROCARBON-CONTAMINATED SOIL AND WATER IN BAYELSA STATE, NIGERIA: A COMPREHENSIVE REVIEW

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Abstract

Hydrocarbon exploration and production have contributed substantially to environmental degradation in petroleum-producing regions worldwide, particularly in the Niger Delta of Nigeria. Among the most persistent pollutants associated with petroleum activities are potentially toxic elements (PTEs), which accumulate in soils, sediments, surface water, and groundwater, posing long-term ecological and public health concerns. This review critically examines the geoenvironmental dynamics, sources, transport mechanisms, ecological impacts, and human health implications of PTEs in hydrocarbon-contaminated environments, with emphasis on Bayelsa State, Nigeria. Existing literature indicates that oil spills, gas flaring, produced water discharge, pipeline leakages, drilling wastes, and artisanal refining constitute the principal anthropogenic sources of PTE contamination. Environmental processes such as adsorption, desorption, redox reactions, leaching, precipitation, dissolution, and complexation govern the mobility and bioavailability of these contaminants within terrestrial and aquatic ecosystems.

Human exposure occurs predominantly through contaminated water, food crops, aquatic organisms, inhalation of polluted dust, and dermal contact, resulting in increased risks of neurological disorders, kidney dysfunction, cardiovascular diseases, developmental abnormalities, and cancer. The review further discusses contamination assessment using pollution indices, ecological risk evaluation, human health risk assessment models, and geospatial technologies for identifying contamination hotspots and supporting environmental management. Although considerable progress has been made in understanding hydrocarbon pollution in the Niger Delta, integrated assessments linking contaminant distribution, environmental processes, ecological consequences, and human health risks remain limited. This review highlights current knowledge gaps and proposes sustainable remediation strategies, strengthened environmental governance, and continuous monitoring to enhance ecosystem restoration and public health protection. The findings provide a scientific basis for environmental management, policy formulation, and future research in hydrocarbon-impacted regions.

Keywords

Potentially toxic elements; Hydrocarbon contamination; Geoenvironmental dynamics; Human health risk; Bayelsa State

MERCURY TAILINGS MANAGEMENT: A PANACEA FOR RISK EXPOSURE AT UKE GOLD PROCESSING SITE, NASARAWA STATE, NIGERIA

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Abstract

Mercury contamination from artisanal gold mining in Uke, Nasarawa State, Nigeria is largely driven by improper handling and disposal of mine tailings generated during gold extraction and amalgamation processes. This study examines mercury tailings management as a critical strategy for reducing environmental contamination and minimizing human and ecological risk exposure in mining-impacted communities.

The research evaluates tailings generation, disposal practices, and associated mercury dispersion pathways in soil, water, and vegetation systems. Findings indicate that unmanaged tailings serve as a major reservoir for mercury release into the environment, particularly through leaching, runoff, and atmospheric volatilization during dry conditions. These processes contribute significantly to contamination of agricultural land, surface water bodies, and fish habitats.

Proper tailings management practices, including containment, controlled storage, stabilization, and safe disposal, are identified as effective mitigation strategies. The study highlights that integrating tailings management with environmental monitoring systems can significantly reduce mercury mobility and exposure risks.

The findings demonstrate that mercury tailings management is a practical and effective "panacea" for reducing risk exposure in artisanal mining environments. It provides a sustainable pathway for environmental protection, public health safety, and ecosystem restoration in Uke and similar mining communities.

Keywords

Mercury Contamination; Mercury Tailings; Human Health Risk Assessment; Artisanal Gold Mining; Environmental Geochemistry; Nigeria

ASSESSMENT OF MERCURY EXPOSURE AND HUMAN HEALTH RISKS IN ARTISANAL GOLD MINING COMMUNITIES OF UKE, NASARAWA STATE, NIGERIA

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Abstract

Mercury contamination resulting from artisanal and small-scale gold mining (ASGM) has become a significant Medical Geology concern due to its impacts on environmental quality and human health. This study assessed mercury concentrations in environmental media and evaluated associated health risks in Uke and surrounding communities of Nasarawa State, Nigeria. A multidisciplinary approach integrating geochemical analysis, health risk assessment, Geographic Information Systems (GIS), and remote sensing techniques was employed. Samples analyzed included fish, water, agricultural soils, mine tailings, sediments, and edible plants collected during both wet and dry seasons. Mercury concentrations were determined using a Direct Mercury Analyzer (DMA-80) following USEPA Method 7473. Vegetation health and land-use impacts were evaluated using Normalized Difference Vegetation Index (NDVI) derived from satellite imagery.

Results revealed mercury contamination across multiple environmental compartments. Soil mercury concentrations ranged from 0.0162–0.387 mg/kg during the wet season and 0.025–4.125 mg/kg during the dry season, exceeding average crustal background levels. Mercury concentrations in mine tailings and river water also exceeded recommended environmental thresholds. Elevated mercury levels were detected in edible crops including rice, pepper, and sweet potato, indicating potential dietary exposure pathways. Fish samples exhibited mercury bioaccumulation patterns in the order of gills > liver > intestine > muscle > bone, although concentrations remained within the WHO permissible consumption limit of 0.5 mg/kg. Geoaccumulation Index (Igeo) and Contamination Factor (CF) analyses indicated localized contamination linked to mining tailings.

Medical geology implications include chronic community exposure through contaminated water, food crops, and aquatic resources, with potential risks to neurological, renal, and developmental health. Spatial analysis demonstrated a relationship between mercury occurrence and vegetation stress, while a GIS-based weighted overlay model successfully identified areas vulnerable to mercury migration and exposure.

The study highlights the need for continuous biomonitoring, public health surveillance, environmental remediation, and sustainable mining practices to reduce mercury-related health risks in artisanal mining communities across Nigeria.

Keywords

Medical Geology; Mercury Contamination; Human Health Risk Assessment; Artisanal Gold Mining; GIS, Environmental Geochemistry; Nigeria.

GEOLOGICAL INVESTIGATION AND MEDICAL SUITABILITY ASSESSMENT OF NATURAL ZEOLITES IN THE MADA YOUNGER GRANITE COMPLEX, NORTH-CENTRAL NIGERIA

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Abstract

Natural zeolites are crystalline hydrated aluminosilicate minerals renowned for their high cation exchange capacity, adsorption properties, molecular sieving ability, and bio-compatibility, making them valuable in environmental, industrial, agricultural, and medical applications. Despite their economic and scientific importance, information on the occurrence and medical suitability of natural zeolites within the Mada Younger Granite Complex of North-Central Nigeria remains limited. This study investigates the geological occurrence, mineralogical characteristics, and medical suitability of natural zeolite deposits in the study area. Field investigations will involve detailed geological mapping, structural analysis, and systematic sample collection from identified zeolite bearing outcrops. Laboratory analyses will include petrographic examination, X-ray Diffraction (XRD) for mineral identification, X-ray Fluorescence (XRF) for chemical composition, and Scanning Electron Microscopy coupled with Energy Dispersive Spectroscopy (SEM-EDS) to determine morphology and elemental composition. Additional physicochemical tests, including cation exchange capacity (CEC), surface area, porosity, and the determination of potentially toxic trace elements, will be conducted to evaluate their suitability for medical applications. The study is expected to identify the dominant zeolite species, establish their mode of occurrence and genesis, and assess whether their mineralogical and chemical properties meet internationally recognised standards for potential medical applications. The findings will contribute to the understanding of Nigeria's natural zeolite resources and provide baseline data for their possible utilisation in pharmaceutical formulations, wound care, detoxification products, drug delivery systems, and other biomedical applications. Furthermore, the research will enhance the economic value of the Mada Younger Granite Complex by promoting the sustainable development and value addition of indigenous industrial minerals.

Keywords

Natural zeolites; Mada Younger Granite Complex; Geology; Mineralogical characterisation; Medical suitability; XRD; XRF; North-Central Nigeria

COMBATTING POTENTIAL HEALTH IMPACTS OF RARE EARTH ELEMENTS PRODUCTION AND DISPOSAL IN NASARAWA STATE, NIGERIA

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Abstract

It is now well established that rare earth elements (REEs) production in Africa could yield substantial economic gains. These elements are used widely to sustain our modern lifestyle and industries and are indispensable in some critical advanced technologies such as their use in permanent magnets. Increasing demand and the current uneasy trade relationship between the United States and China provide an economic development opportunity for Africa which has rich resources of REE [cf, huge reserves in Nigeria (re.: Nasarawa State), South Africa and Tanzania] to develop its own sector.

However, health issues caused by REE production across Africa are known to abound, including respiratory illnesses, metal toxicity and radioactive exposure. Significant gaps in our knowledge exist on the toxicity dynamics of long-term REE community exposure such as their mechanism of action and the metabolic pathways that they activate, bio-fluid tracking, and context-specific African dietary pathways. Nor have the novel techniques in use elsewhere for impact mitigation seen widespread application in many African REE mining projects.

At a time when the Nasarawa State government has just inaugurated a $400 million rare earth and critical minerals processing plant in the State, JACMEDGEO researchers consider it timely to unravel the major potential health impacts of REE production from a multidisciplinary perspective, focussing on the physiological effects following ingestion, inhalation, and dermal exposure for workers and surrounding residents. Tropical climatic conditions could increase the risks to human and ecological health in future, giving the growing trend of REE production development in Nigeria.

To address these issues, we first need to understand the mode of propagation of REE along the entire trail, starting from their exploitation to their high mobility of transfer from the environment to plants and then along the entire food chain where their perturbations engender several health consequences. JACMEDGEO researchers are doing just that!

Keywords

Nasarawa State; REE production; Emerging contaminants; Mitigative measures; New technologies; Future research directions

THE ROLE OF GEOENVIRONMENTAL VARIABLES IN UNDERSTANDING CAUSAL CO-FACTORS OF DISEASES OF UNKNOWN AETIOLOGY IN AFRICA

JACMEDGEO Research Working Group

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Abstract

Diseases of unknown aetiology (DUA) or idiopathic diseases are diseases whose origins or causes are uncertain or unknown. These diseases are widespread in Africa, as in other parts of the world. In Africa, Noma and Nodding disease are examples of diseases for which the aetiological agents to date, remain a mystery. Occasionally also, outbreaks occur in a population, or a cluster of disease appears for which the cause is unclear. All of these diseases, no doubt, have a multifactorial aetiology. Outbreaks may be due to a novel or modified pathogen, a naturally occurring toxic agent or an initially undetected release of a chemical. In investigating the causes of such enigmatic outbreaks, we need to deeply consider, in addition to other possible aetiological cofactors, geological/geochemical/biochemical phenomena in the localities concerned, such as sudden physical and/or chemical changes in soil, water or air composition, over-exposure to ionising radiation or organic compounds from mining or from other geogenic sources. Carefully recording the history of the episode and conducting a thorough epidemiological study, may point to one or more possible causes that could then provide a focus for further, more specialised investigation.

Our work focuses on the magnitude and modus operandi of involvement of geoenvironmental factors; in particular, the entry of trace elements/metals/metalloids into biological systems, and their participation in humoral and cellular immune responses, representing potentially toxic agents with possible implications as co-factors for certain DUA. It is important to note that some of these elements (the micronutrients) play vital roles as cofactors for essential enzymes and antioxidant molecules, thus conferring protection against disease. It is the amount of trace element, metal or metalloid that is taken up and its dynamics of entry and accumulation in human tissues that decisively determine whether the exerted effects are toxic or beneficial. Several described cases of common DUA in Africa will be investigated and an illustration made of how our knowledge of trace element/metal/metalloid interactions in the immune system may be implicated as causal co-factors in these diseases. This project emphasises the strength of the urgent call for more research on the sources and dynamics of entry of trace elements/metals/metalloids into the food chain and a demonstration of how the use of these results can aid precise aetiological characterisation of DUA; as well as serve as the basis for harmonising and updating current legislative regulations regarding the concentrations of trace elements/metals/metalloids in food and in drinking water in Africa.

Keywords

Unknown aetiology; determinants of risk; geoenvironmental variables; element deficiency/excess; disease clusters; environmental risk maps

COMBATTING NEONATAL, MATERNAL AND CHILD DEATHS FROM IONISING RADIATION EXPOSURE AROUND GOLD AND URANIUM MINES IN SUB-SAHARAN AFRICA: A MEDICAL GEOLOGY PERSPECTIVE

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Abstract

The exposure of pregnant women to ionising radiation in Sub-Saharan Africa has long been a source of concern, and many questions related to this problem still remain unanswered. Yet this source of radiation exposure has received much less research attention than those exposures arising from the industrial and medical uses of man-made sources of radiation.

We know that there is a high percentage of neonatal deaths due to foetal abnormalities or congenital malformations from ionizing radiation exposure in major uranium and gold mining countries where good morbidity estimates exist, e.g., South Africa. There is therefore an urgent need to study the incidence of neonatal, maternal and child deaths in areas of the Sub-Continent with high exposure to ionising radiation exposure due to mining.

There has been some progress recently on study of the effects of ionising radiation on the embryo. However, those often tasked with such studies are from a medical background, e.g., paediatric clinicians and radiologists. They go about their work with little cognisance taken of uranium's geogenic characteristics and other geodynamic intricacies that bear so heavily on the mode of radioactivity uptake, the doses received, the dose-rate and dose--distribution. These are physical exposure parameters that result in both qualitatively and quantitatively different cellular and molecular responses, thus demonstrating non-linear responses with respect to dose. We hope to demonstrate unequivocally that the inclusion of Medical Geologists in teams investigating the effects of ionising radiation exposure on pregnancy outcomes (neonatal and child radiation-related morbidity and mortality) in major uranium and gold mining countries in Sub-Saharan Africa can lead to much improved prognosis, diagnoses and therapy, as well as prevention and other forms of intervention for these conditions. The project would thus assume a leading role on the world stage in arguing for the critical need for greater communication and coordination between the fields of radiation biology and geomedical science.

Keywords

Research gaps; ionising radiation exposure; uranium (and gold) mining in Sub-Saharan Africa; environmental and health impacts (neo-natal, maternal and child deaths); radioprotection; legislative articles

GEOPHAGY (DELIBERATE GEOGENIC MATERIAL CONSUMPTION) IN THE GREATER KEFFI MUNICIPALITY (GKM): A SOCIO-ECONOMIC, GEOCHEMICAL AND MICROBIOLOGICAL STUDY

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Abstract

Geophagy (or geophagia), the habit of eating clay or earth is practiced widely in the Greater Keffi Municipality (GKM). To date, there is a great deal of misunderstanding of the phenomenon, but it is thought to have both beneficial and deleterious effects. JACMEDGEO researchers propose a 4-phase field study comprising (I) interviews with children and pregnant women to estimate the prevalence, causative reasons, and the amount/type of soils consumed; (II) mineralogical and geochemical analyses to determine the composition of the geophagic materials; (III) microbiological examination of stool and blood samples of geophagists to determine the presence of micro--toxins and other pathogens, and (IV) investigations on the marketing of geophagic soils, quantifying the volume of production and the economics and participants of the distribution channels.

It is expected that syntheses of our survey results as well as conclusions drawn from mineralogical and chemical analyses of geophagic materials will help erase some of the standing confusions regarding geophagy's aetiology. Thus, JACMEDGEO researchers would lay down the basis for prescribing for geophagists in the Municipality, practical behavioural adjustments that would obviate the undesirable consequences of the practice, while at the same time promoting optimum derivation of its benefits.

Keywords

Africa; aetiology; bioavailability; geophagy; microbiological infections.

EVALUATION OF SEDIMENT AND SURFACE WATER QUALITY WITHIN ONITSHA AND ENVIRONS, ANAMBRA BASIN, SOUTH-EASTERN NIGERIA: AN INDEX ANALYSIS APPROACH

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Abstract

Rapid urbanization and industrial expansion in Onitsha and environs (Anambra Basin, southeastern Nigeria) have raised concerns about trace metal contamination in surface water and sediments. This study integrates multiple contamination indices to assess pollution status and spatial distribution. Thirteen sediment and surface water samples each were collected along River Niger and the Nkisi–Idemili watershed. Concentrations of Al, Cd, Cr, Cu, Fe, Mn, Ni, Pb, and Zn were determined by ICP-MS and were evaluated for their Contamination Factor (CF), Enrichment Factor (EF), Geo-accumulation Index (Igeo), Pollution Load Index (PLI), and Water Quality Index (WQI). In sediments, mean Cr (88.2 mg/kg) and Zn (205 mg/kg) exceeded both ISQG and TEL; Cr exceeded PEL at several sites. Pb (56.6 mg/kg) exceeded TEL and ISQG, while Mn (960 mg/kg) exceeded TEL at all sites. CF indicated moderate contamination for Cd, Mn, Pb, and Zn. EF revealed significant enrichment for Pb (mean 5.05) and moderate enrichment for Cd, Mn, and Zn. Igeo classified Pb and Cd as unpolluted to moderately polluted. In surface water, Al (0.57 mg/L), and Fe (0.84 mg/L) exceeded WHO guidelines, while Pb (0.26 mg/L) exceeded the guideline at all sites. WQI classified all water sites as unsuitable for drinking (mean 552.6). Evaluation against irrigation water quality guidelines showed that Pb posed a moderate risk (CF = 1.295). The degree of contamination was very high for both drinking water (CD = 35.604) and aquatic life (CD = 53.47), with Fe exceeding drinking limits and Cr and Cu rendering the water unsuitable for aquatic organisms. The indices distinguished lithogenic from anthropogenic sources. Sediment and water quality are moderately to severely impacted by Pb, Zn, Cd, Cr, and Mn, with Pb being the most dominant contaminant. Urgent mitigation of Pb inputs, improved waste management, and continued monitoring are recommended to safeguard aquatic ecosystems and public health.

Keywords

Water quality; Pollution Indices; Addressing the issues; Anambra Basin

HYDROGEOLOGICAL FRAMEWORK AND INTEGRATED GROUNDWATER QUALITY ASSESSMENT IN OKERENKOKO, WESTERN NIGER DELTA: IMPLICATIONS FOR SUSTAINABLE GROUNDWATER MANAGEMENT AND PUBLIC HEALTH

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Abstract

This study evaluated the hydrogeological framework and groundwater quality of the Okerenkoko coastal aquifer in the Niger Delta, Nigeria, to determine its suitability for domestic use and assess potential public health risks. A cross-sectional field and laboratory research design was adopted, integrating hydrogeological, physicochemical, and microbiological assessments. Borehole lithological data were used to characterize the aquifer system, while groundwater samples collected from three representative boreholes were analyzed for physicochemical parameters (pH, temperature, electrical conductivity, total dissolved solids, dissolved oxygen, nitrate, and phosphate) and microbiological quality using standard laboratory procedures. The hydrogeological profile revealed predominantly unconsolidated fine- to medium-grained sandy formations interbedded with silty clay and sandy clay layers, indicating productive aquifer horizons but increased vulnerability to contaminant migration. Physicochemical results showed that most parameters complied with World Health Organization (WHO) and Nigerian Standard for Drinking Water Quality (NSDWQ) guidelines. However, groundwater from two boreholes was slightly acidic, and elevated phosphate concentrations were observed in some samples. Microbiological analysis revealed total coliform counts ranging from 1.0×10^3 to 6.8×10^3 CFU/100 mL, exceeding the permissible limit of zero coliforms in drinking water. Cultural, morphological, and biochemical characterization identified the presence of Escherichia coli, Salmonella spp., and Vibrio cholerae, indicating faecal contamination and potential health risks. The findings demonstrate that although the groundwater possesses acceptable chemical quality, its microbiological quality renders it unsuitable for direct human consumption without treatment. The study concludes that the permeable sandy aquifer, combined with inadequate sanitation and environmental contamination, increases groundwater vulnerability. Continuous groundwater monitoring, improved sanitation, effective borehole protection, and routine water treatment are recommended to safeguard public health and ensure the sustainable management of groundwater resources in Okerenkoko.

Keywords

Groundwater protection; Hydrogeological framework; Coastal aquifer; Microbiological contamination; Okerenkoko.

INTEGRATED INVESTIGATION OF LAGOS WASTE DUMPSITES TO ASSESS RISKS TO GROUNDWATER SUSTAINABILITY AND PUBLIC HEALTH

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Abstract

Rapid urban expansion in Lagos State has intensified municipal solid waste generation, strained existing disposal infrastructure, posed severe threats to groundwater security, public health, and long-term urban resilience. This study presents an integrated geological, geochemical, and geophysical framework evaluating three major dumpsites (Olusosun, Abule Egba, and Isolo) to establish a data-driven baseline for sustainable ecosystem management and community protection.

Twenty (20) Vertical Electrical Sounding (VES) stations were investigated across Olusosun (10), Abule Egba (5), and Isolo (5). Environmental media were comprehensively sampled to quantify pollution migration, comprised 61 soil, 6 leachates, and 32 groundwater samples. Trace metal concentrations were determined using Inductive Coupled Plasma Optical Emission Spectrometry (ICP-OES).

Geoelectric sections revealed extensive zones of low resistivity, mapping critical subsurface plumes where leachate exploits secondary permeability to migrate downwards into domestic aquifers. Notably, subsurface degradation remains severe at the active Olusosun and Abule Egba sites, whereas the Isolo site (abandoned for nearly 30 years) exhibits natural attenuation recovery, offering key insights for site rehabilitation. Water Quality Index (WQI) and Metal Index (MI) models reveal that a critical proportion of community water supplies are compromised. Groundwater samples categorized as „Unsuitable for Drinking" reached 37.50% at Olusosun, 11.11% at Abule Egba, and 42.86% at Isolo, which threatening local water security. Geochemical metrics confirmed severe localized heavy metal toxicity exceeding WHO standards, marked by high concentration of cadmium (Cd), lead (Pb), and zinc (Zn) at Olusosun, alongside copper (Cu), tin (Sn), and cobalt (Co) at Abule Egba and Isolo. Total Pollution Indices classified all three sites as severely polluted, with Isolo (16.41) and Abule Egba (20.78) exhibiting extreme values. Furthermore, the calculated Ecological Risk Index showed dangerous thresholds for regional biodiversity, escalating from considerable risk at Olusosun (370.20) to very high ecological risks at Isolo/Oke-Afa (1,401.67) and Abule Egba (1,334.09). While the calculated Hazard Index (HI) remains below the critical threshold baseline of 1 x 104, indicating minimal immediate systemic health risks.

In conclusion, this study demonstrates that unengineered waste disposal sites undermines the foundational pillars of urban sustainability. To protect public health and transition toward resilient community systems, these findings underscore an urgent imperative for policy shifts: transitioning from open dumpsites to engineered sanitary landfills, establishing continuous groundwater monitoring networks, and deploying advanced leachate management strategies capable of safeguarding vital sub-surface resources in rapidly urbanizing African megacities.

Keywords

Urban resilience, Public health sustainability, Groundwater protection, Waste management policy

STOVE RESOLVED HOUSEHOLD $PM_{2.5}$ RECONSTRUCTION REVEALS DIVERGENT EXPOSURE TRAJECTORIES ACROSS 54 AFRICAN COUNTRIES FROM 1990 TO 2023

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Abstract

Africa bears a severe burden of household fine particulate matter ($PM_{2.5}$) pollution. Despite gradual transition toward cleaner household energy and ongoing cook stove promotion efforts, inconsistent stove classifications and limited measurements impede robust exposure assessment and evidence-based intervention.

Methods: We expanded the WHO global household air pollution (HAP) database to 934 standardized measurements with harmonized stove classifications. Regression models linking specific fuel-stove combinations to indoor $PM_{2.5}$ quantified systematic model-based discrepancy in conventional fuel-only approaches used by the WHO and the Global Burden of Disease study. We applied these models to estimate indoor $PM_{2.5}$ concentrations across African countries (1990–2023) and reconstructed spatiotemporal exposure distributions byintegrating time activity patterns.

Findings: Indoor $PM_{2.5}$ concentrations varied markedly by stove type. Transitions from open fires or traditional stoves to improved designs reduced HAP concentrations by 433–873 $\mu g \cdot m^{-3}$ for biomass fuels. Fuel-only models systematically underestimated exposure in Africa by upto 50 μg·m-3 (2023) relative to fuel-stove models, owing to the widespread use of lower efficiency stoves. Continental mean integrated $PM_{2.5}$ exposure declined from 281 $\mu g \cdot m^{-3}$ (95%CI: 232–341) in 1990 to 196 $\mu g \cdot m^{-3}$ (95% CI: 164–233) in 2023, yet national trajectories diverged, from rapid declines to stagnation or increases, driven partly by heterogeneous stove transition progress and indoor $PM_{2.5}$ variations.

Interpretation: Fuel and stove transitions jointly drive spatiotemporal exposure variation in Africa, with substantial inter-country disparities. While some nations have achieved progress through clean fuel and stove adoption, most require urgent intervention. Effective strategies combine broader economic development with targeted fuel and stove policies.

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Keywords

Exposure assessment; household air pollution; $PM_{2.5}$; cookstove; Africa

POSTERS

1. SPATIAL DISTRIBUTION OF POLISH HEALTH RESORTS UTILISING NATURAL MEDICINAL WATERS AND THEIR IMPORTANCE FOR REHABILITATION

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2. EFFECTIVENESS OF SELENIUM SUPPLEMENTATION IN RHEUMATOID ARTHRITIS: A SYSTEMATIC REVIEW

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3. NATURAL MINERAL BRINES AND MUSCULOSKELETAL HEALTH: THE ROLE OF CIECHOCINEK SPA THERAPY IN KNEE OSTEOARTHRITIS MANAGEMENT

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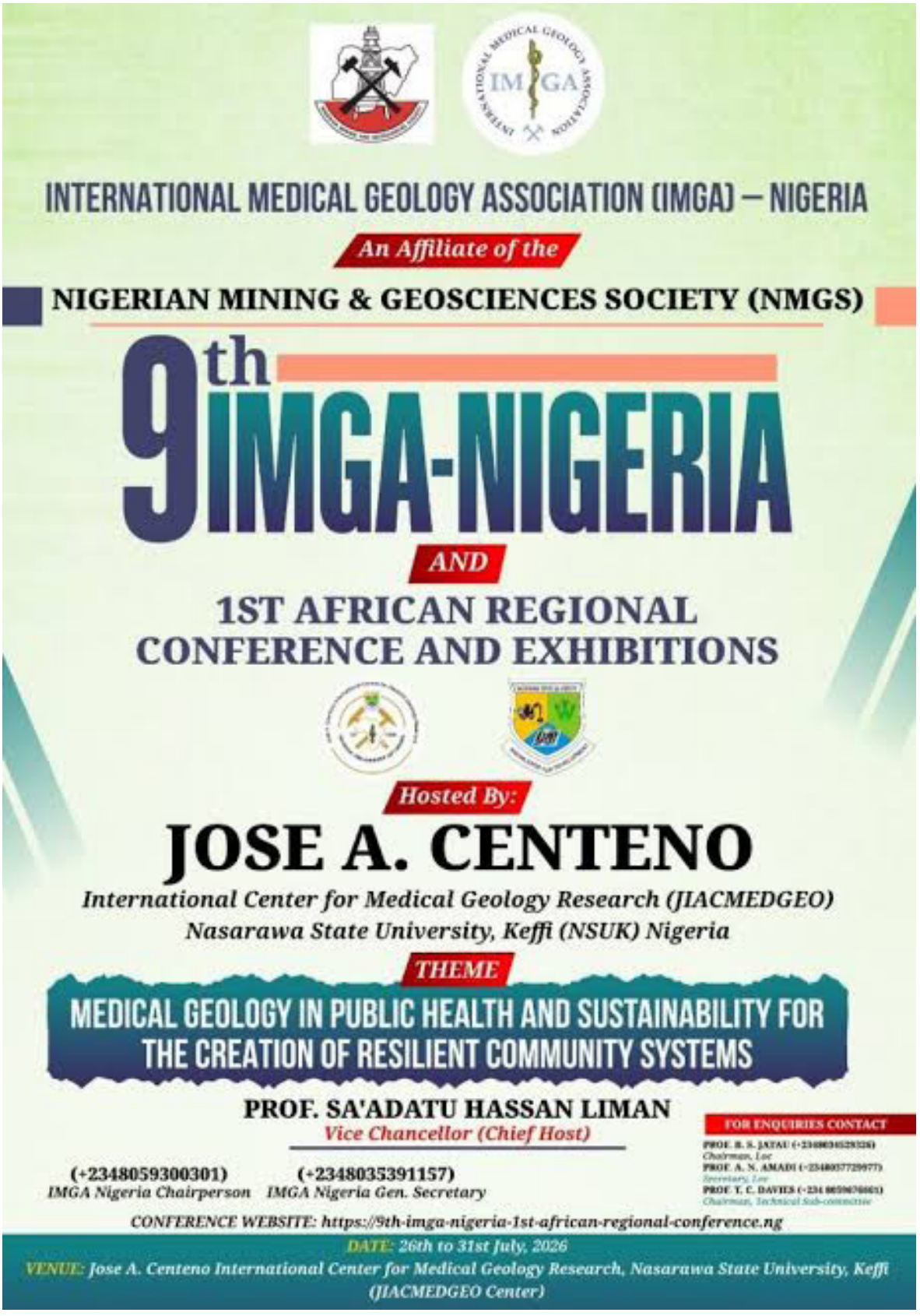
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