# بيان بالأبحاث المنشورة الخاصة بقسم الجيولوجيا ٢٠٢٥م

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**البحث (١)**

# Green building development utilising modified fired clay bricks and eggshell waste

**Wafaa Soliman, Yasser M. Z. Ahmed, Ahmed Ghitas, Abdel-Hamid El-Shater & M. Abdelhamid Shahat**

***Scientific Reports* volume 15, Article number: 3367 (2025)**

**Abstract:**

The inadequate thermal insulation of the building envelope contributes significantly to the high power consumption of air conditioners in houses. A crucial factor in raising a building's energy efficiency involves utilizing bricks with high thermal resistance. This issue is accompanied by another critical challenge: recycling and disposing of waste in a way that is both economically and environmentally beneficial, including using it to fuel industrial growth, in order to reduce the harmful effects of waste on the environment as waste generation in our societies grows. To this end, the current study sought to assess whether integrating a specific amount of eggshell waste as $CaCO_3$ filler within bricks consistently produces fired clay bricks with desirable thermal insulation capabilities. By systematically investigating the physicochemical and thermal characteristics of bricks doped with varying eggshell content, this work demonstrates how waste materials can be repurposed to produce sustainable construction materials with superior performance. The results highlight significant improvements in thermal conductivity, diffusivity, and effusivity, alongside favorable changes in porosity, bulk density, and mechanical strength. The XRD analysis revealed that once the firing temperature rises, a high insulation feature arises due to siliceous melt formation. EDX analysis gave important insights into the impact of eggshell dopants on the physicochemical parameters of burnt clay bricks. Compared to pristine brick, CEs7% brick constructed with clay and 7 wt% eggshell exhibited a 38.7% loss on dry shrinkage, an enhancement on average pore size of 78.8%, an apparent porosity of 52.7%, a bulk density of 8.3%, and a compressive strength of 57.5%. The reduced shrinkage enhances stability, while increased pore size and porosity improve thermal insulation, making the bricks more durable and energy-efficient. In this regard, the brick containing 10% eggshell that was fired at 1100°C possessed the greatest drop in heat conductivity (i.e., 50%), thermal diffusivity (30%), and thermal effusivity (30%) as compared to the pure one. Given the aforementioned findings, these additions hold the potential to reduce the energy required for both heating and cooling buildings. This brings us to the conclusion that combining eggshell waste to create calcium silicate makes it feasible to be utilized as a thermal insulation material, paving the way for improved construction materials' performance and sustainability.

**البحث (٢)**

# Histological and digenetic study of juvenile crocodyliform vertebrae from the Campanian deposits, the Western Desert, Egypt

**Gebely A. Abu El-Kheir, Sara Saber, Abdelhameeed El Shater & Khaled Ouda**

***Historical Biology*, *37*(12), 2743–2750. https://doi.org/10.1080/08912963.2025.2462947**

**Abstract**

The Western Desert of Egypt exhibits well exposures of Late Cretaceous deposits, containing varieties of marine and terrestrial vertebrate fossils. The Quseir Formation (Campanian age) contains vertebrate fossils such as dinosaurs, turtles and crocodyliforms remains. This formation is formed of variegated shale and siltstone intercalations, indicating supratidal marsh environment. The present work concerns with the histology and the diagenetic process of the Late Cretaceous juvenile crocodyliform vertebrae from the Campanian deposits of the Quseir Formation of the south of Baris Oasis, Western Desert of Egypt. It provides the first discovery of the Late Cretaceous juvenile neosuchian crocodyliform postcranial remains in Egypt, in addition to the study of the early and the late diagenesis phases exhibited by the microbial activities and the minerals precipitations of the bone cavities.

**البحث (٣)**

# Lower Eocene mixed carbonate siliciclastic ramp facies, Sohag Governorate, Upper Egypt

**Abu Seif, ES.S., El-Shater, A.A., Soliman, W.A. *et al.***

***Arab J Geosci* 18, 146 (2025). https://doi.org/10.1007/s12517-025-12262-w**

Abstract

The study area (Egyptian Nile Valley, Upper Egypt, east Sohag Governorate) represents a minor slice of the El-Maaza Plateau, mainly composed of Lower Eocene carbonate succession. Three well-selected Lower Eocene sections were investigated (Wadi Bir Al-Ain, Awlaad El-Sheekh Village, and Hashem Al-Eseri Village). The studied Lower Eocene succession distinguished into distinct two formations: Thebes Formation (yellowish white laminated and bedded limestone with bands of chert and fine-sliciclastic beds) and conformably followed upward by Drunka Formation (snow white color, more or less horizontality and chert concretions). Field observations revealed numerous structural elements (faults, joints, folds, and shear zones associated with the Pan-African Orogeny) that greatly influenced the lithology and areal distribution of the Lower Eocene sequence. These structural elements were followed by a series of tectonic reactivations, especially during the Cretaceous and Oligocene periods. Particularly in the Wadi Bir Al-Ain, the carbonates of the Drunka Formation are often characterized by a distinct depositional cyclicity feature and more landward facies covering more basinward facies throughout each cycle. These cyclic carbonate deposits show shallowing upward, reflecting shallow epi-continental environmental conditions. The thickness of these cycles and lack of truncated cycles indicate that the amplitude of sea-level fluctuation and periodicity were generally consistent, pointing to a eustatic process for relative sea-level change rather than a tectonic one. Rockfalls, joints, tilting, and faulting are examples of deformation features seen within the Drunka Formation that could be post-depositional. Additionally, there is no argillaceous lithic succession within the Drunka Formation in the studied area. Consideration of the studied Lower Eocene rock units as carbonate ramp deposits was concluded based on thorough field investigations, sedimentological, and lithofacies of the studied Eocene succession, and careful reading of published works of Eocene rock units in Egypt and other international localities (Thebes Formation in inner-middle ramp environmental conditions and Drunka Formation in an outer-ramp environment). Based on standard classification schemes, five microfacies of the studied carbonate rock units (lime mudstone, lime wackestone, lime packstone, lime grainstone, and lime dolostones) were identified from the petrographic microfacies analysis conducted on 85 representative samples of the studied Lower Eocene succession. These microfacies were considered a main tool for better understanding the depositional environments of the studied Lower Eocene rock units.

البحث (٤)

# Stable mesoporous nanocomposites of iminocyclohexanones coordinated with Ca montmorillonite

**Omyma A ABD ALLAH, Abdelhamid ELSHATER**

**Turk J Chem. 2025 May 17;49(5):632–646. doi: 10.55730/1300-0527.3759**

Organomontmorillonite (organo-MMT) nanocomposites are widely used in environmental, food, and pharmaceutical applications. However, their weak adsorption and ionic exchange forces during synthesis can make them unstable and unreliable. In this study, we present a novel synthesis of stable mesoporous iminocyclohexanone-Ca-MMT nanocomposites through a green, rapid, one-pot reaction. The synthesis reaction between Ca-MMT clay suspended in water and a dioxane solution of 1,3-cyclohexanedione and 4-aminophenol at 2 temperatures (60 °C and 110 °C) completed in a short reaction time. The resulting nanocomposites were characterized using X-ray diffraction, Fourier transform infrared spectroscopy, nuclear magnetic resonance UV–visible spectroscopy, and advanced software tools. Surface area measurements were performed via multipoint Brunauer–Emmett–Teller analysis. The stability of these nanocomposites come from the formation of coordination bonds between the iminocyclohexanone moiety and Al, Mg, and Si minerals in the octahedral and tetrahedral layers of Ca-MMT. This innovative approach addresses the temporal instability issues of conventional organoclay nanocomposites, offering promising potential for broader industrial and environmental applications.

**البحث (٥)**

# Mineralogy of the Upper Cretaceous–Lower Paleogene Successions at Esh El-Mellaha area, Gulf of Suez, Egypt

Shimaa k. M. Azoz; AbdelHamid El-Shater; Nageh A. Obaidalla; Ibrahim Y. El-Mohandes; Mahmoud H. Darwish

New Valley University Journal of Basic and Applied Sciences, Volume 3, Issue 2, December 2025, Pages 1-16, DOI: 10.21608/nujbas.2025.378257.1042

## Abstract

This study presents a comprehensive mineralogical analysis of the Upper Cretaceous–Lower Paleogene sedimentary successions in the Esh El-Mellaha area, Gulf of Suez, Egypt. Utilizing X-ray diffraction (XRD), infrared spectroscopy (IR), and scanning electron microscopy with energy-dispersive spectroscopy (SEM-EDS), forty-two samples from the Sudr, Dib, Esna, and Thebes formations were examined to resolve previous inconsistencies in mineralogical interpretations. The results reveal that the Sudr and Dib formations are predominantly composed of calcite, suggesting deposition under stable, shallow marine conditions, with the upper Sudr showing greater mineral variability, indicative of fluctuating environmental conditions. The Esna Formation displays significant mineralogical heterogeneity, particularly in the El-Dabbabyia Member near the Paleocene–Eocene boundary, reflecting complex depositional settings influenced by global climate shifts. The Thebes Formation is marked by high calcite content with minor contributions from quartz, dolomite, gypsum, and phyllosilicates, pointing to a warm, carbonate-rich marine environment with limited terrigenous input. Infrared spectroscopy confirmed the presence of clay minerals such as smectite, kaolinite, and illite, supporting the XRD results and indicating varied sources and diagenetic alterations. These findings provide new insights into the mineralogical evolution, depositional environments, and diagenetic history of the region, contributing to a more refined stratigraphic and paleoenvironmental framework for northeastern Egypt.

**البحث (٦)**

# Diagenetic Evolutions of the Lower Eocene Carbonate Ramp Facies, NE-Sohag Governorate, Upper Egypt

**El-Sayed Sedek Abu Seif, El-Shater AA, Wafaa A. Soliman and Esraa H. Attia**

**Sohag J. Sci., 10(2), 243-251, (2025): DOI: 10.21608/sjsci.2025.354711.1249**

Abstract:
The study area (NE-Sohag Governorate, Upper Egypt,) represents an ideal succession of Lower Eocene (Thebes Formation and Drunka Formation) where the Nile Valley Valley is nearly surrounded by Lower Eocene succession which is considered as the oldest outcropped carbonate succession. Lower Eocene in NE-Sohag Governorate is subdivided into two distinct formations; Thebes and Drunka formations. The vertical and lateral litho-facies variation had occurred within both Thebes Formation and Drunka Formation. Thebes Formation is a basal part of the Lower Eocene sequence that is mainly consisting of bedded whitish yellow laminated limestone intercalated with bands of chert and fine-siliciclastic beds. Drunka Formation conformably lie directly on Thebes Formation and is characterized by creamy-white color and more or less horizontality, chert concretions and depositional cyclicity. This variation owes mainly to marine transgression and regression as a result of sea-level variations during Lower Eocene. The most common microfacies within the studied Lower Eocene are lime wackestone, lime packstone, lime grainstone, lime mudstone and lime dolostones. Petrographically, micritization, neomorphism, cementation, dissolution, dolomitization, fracturing and internal filling and silicification were the most observed diagenetic features within the studied Lower Eocene carbonate successions

**البحث (٧)**

# Sustainable fired clay bricks with variable $TiO_2$–PET plastic waste content for thermal insulation applications

**M. Abdelhamid Shahat, Yasser M.Z. Ahmed, Ahmed Ghitas, Wafaa Soliman**

**Electrochimica Acta; Volume 541, 20 November 2025, 147314,**
**https://doi.org/10.1016/j.electacta.2025.147314Get rights and content**

## Abstract

The accumulation of non-biodegradable plastic waste, particularly polyethylene terephthalate (PET), poses serious environmental challenges due to its persistence in landfills and the release of harmful toxins. Recycling PET waste into functional construction materials presents a sustainable solution. This study investigates the incorporation of PET waste and titanium dioxide nanoparticles ($TiO_2$–PET) into fired clay-based composite bricks to assess their effects on thermophysical properties, including thermal conductivity and thermal effusivity. Five formulations were developed with varying $TiO_2$–PET concentrations: pristine clay (CTP0 %), clay–$TiO_2$–Plastic5 % (CTP5 %), clay–$TiO_2$–Plastic10 % (CTP10 %), clay–$TiO_2$–Plastic15 % (CTP15 %), and clay–$TiO_2$–Plastic20 % (CTP20 %). FTIR spectroscopy revealed structural modifications, including the partial inclusion of carbonyl functional groups, which influenced the material's thermal properties. SEM micrographs confirmed significant variations in microstructural porosity, with apparent porosity ranging from 38.13 % to 48.19 %, directly impacting bulk density and thermal performance. The experimental results demonstrated a clear trend of increasing porosity with higher PET content, which effectively reduced thermal conductivity and thermal effusivity. Notably, CTP20 % exhibited the lowest thermal conductivity (0.17 W/mK), highlighting its superior insulating properties and potential application in energy-efficient construction. This study underscores the feasibility of repurposing PET waste into sustainable building materials, offering an environmentally friendly approach to improving thermal insulation in construction.

**البحث (٨)**

# Lightweight thermally insulating fired clay bricks enhanced with chitosan-based clay nanocomposites for sustainable construction

**M. Abdelhamid Shahat & Wafaa Soliman**

*Scientific Reports* **volume 15, Article number: 26528 (2025)**


## Abstract

This study explores the enhancement of thermal insulation in fired clay bricks through the incorporation of chitosan (CS) as a biopolymeric dopant. A series of composite samples were prepared with CS concentrations of 0%, 2%, 4%, 6%, and 8%, and their structural, mechanical, and thermophysical qualities were comprehensively investigated. Analytical techniques including X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), field emission scanning electron microscopy (FESEM), and thermogravimetric analysis (TGA) were employed to assess compositional and morphological changes. The introduction of CS led to increased XRD peak intensity, indicating improved crystalline organization, while FTIR spectra revealed the presence of CS-associated functional groups. SEM micrographs confirmed the development of a more porous microstructure, and TGA data demonstrated enhanced thermal stability. The CS-modified bricks exhibited an increase in porous topography (33.2–47.9%), a reduction in bulk density (i.e., 1.84–1.29 g/cm$^3$), and improved compressive strength (from 0.768 to 1.232 MPa). It is noteworthy that the clay@CS (6%) mix encountered a low thermal diffusivity in addition to the lowest thermal conductivity value (i.e., 0.3418–0.2334 W/mk). The findings show that adding more CS to composite bricks significantly improves their thermal insulation qualities (i.e., 0.314–0.213 mm$^2$/S). These outcomes underscore the potential of CS as a sustainable additive for improving the performance of clay-based construction materials, offering promising implications for energy-efficient and environmentally conscious building applications.

البحث (٩)

# Post-Collisional Mantle Processes and Magma Evolution of the El Bola Mafic–Ultramafic Intrusion, Arabian-Nubian Shield, Egypt

**Khaled M. Abdelfadil, Hatem E. Semary, Asran M. Asran, Hafiz U. Rehman, Mabrouk Sami, A. Aldukeel, Moustafa M. Mogahed**

***Minerals*** **2025, *15*(7), 705; https://doi.org/10.3390/min15070705**

**Abstract**

The El Bola mafic–ultramafic intrusion (EBMU) in Egypt's Northern Eastern Desert represents an example of Neoproterozoic post-collisional layered mafic–ultramafic magmatism in the Arabian–Nubian Shield (ANS). The intrusion is composed of pyroxenite, olivine gabbro, pyroxene gabbro, pyroxene–hornblende gabbro, and hornblende-gabbro, exhibiting adcumulate to heter-adcumulate textures. Mineralogical and geochemical analyses reveal a coherent trend of fractional crystallization. Compositions of whole rock and minerals indicate a parental magma of ferropicritic affinity, derived from partial melting of a hydrous, metasomatized spinel-bearing mantle source, likely modified by subduction-related fluids. Geothermobarometric calculations yield crystallization temperatures from ~1120 °C to ~800 °C and pressures from ~5.2 to ~3.1 kbar, while oxygen fugacity estimates suggest progressive oxidation (log $fO_2$ from −17.3 to −15.7) during differentiation. The EBMU displays Light Rare Earth element (LREE) enrichment, trace element patterns marked by Large Ion Lithophile Element (LILE) enrichment, Nb-Ta depletion and high LILE/HFSE (High Field Strength Elements) ratios, suggesting a mantle-derived source that remained largely unaffected by crustal contribution and was metasomatized by slab-derived fluids. Tectonic discrimination modeling suggests that EBMU magmatism was triggered by asthenospheric upwelling and slab break-off. Considering these findings alongside regional geologic features, we propose that the mafic–ultramafic intrusion from the ANS originated in a tectonic transition between subduction and collision (slab break-off) following the assembly of Gondwana.

البحث (١٠)

# Petrochemistry and Tectonic Evolutions of the Tertiary basalt along Red Sea Coast, Central Eastern Desert, Egypt

**Yasmin M. Taher, Asran M. Asran, A. El-Shater and Shaymaa Rizk**

*Sohag J. Sci. 2025, 10(2), 218-228*

**Abstract:**

To investigate the petrochemistry and genesis of Tertiary basalts in Egypt, which are among the most extensively distributed Tertiary basaltic flows in the region, nineteen basaltic samples were collected from basaltic rocks situated south of Qusier city, specifically in Wadi Sharm El Bahari, Wadi Sharm El Qiblli and Wadi Wizr along the Red Sea Coast. The samples were analyzed mineralogically and geochemically. The field investigation indicates that the basaltic rocks are oriented in a NWSW direction, parallel to the Red Sea Rift. Petrographic analyses elucidate the existence of olivine basalts, porphyritic basalts, amygdaloidal olivine basalts and porphyritic olivine basalts. Some basalt flows exhibit slight alteration, showing the development of chlorite, serpentine, clay minerals and actinolite, along with the release of iron oxide. Geochemical data, encompassing major and trace elements, were evaluated. Variation diagrams validated that the basalts originated from partial melting and fractional crystallization. The significance of fractional crystallization processes, as opposed to crustal contamination processes, is accentuated by plotting Nb/Y versus Rb/Y. The Rb/Nb ratios (>2) signify the crustal compositions and melts, with the magma source originating from the OIB-source mantle. As indicated by discrimination diagrams, the basalts exhibit an alkaline to tholeiitic magma type and an orogenic, within-plate tectonic context. Their estimated crystallization temperatures range between 1180- 1200°C. The oceanic characteristics of some basalt samples on the TiO2-K2O-P2O5 diagram indicate their association with the earliest rifting phase of the Red Sea.

البحث (١١)

# Integrated Application of Artificial Intelligence and Remote Sensing Techniques for Improved Subsurface Resource Exploration

**Marat Nurtas, Elmira Orynbassarova, Mohammed Atef Mohammed, Sydyk Nurmakhambet, Aizhan Altaibek, Elmira Serikbayeva and Berik Iskakov**

**Engineered Science. Volume 39, 2026; https://dx.doi.org/10.30919/es1948**

## Abstract

Mineral exploration is undergoing a significant transformation driven by the integration of remote sensing technologies and artificial intelligence (AI). While conventional methods remain foundational, they are often constrained by high costs, limited spatial coverage, and subjective data interpretation. This review critically examines the emerging synergy between multisensory remote sensing platforms and AI-based analytical frameworks, highlighting their potential to enhance the accuracy, efficiency, and scalability of subsurface mineral prospecting. This study reviews traditional geophysical methods alongside the evolving roles of satellite and airborne platforms in mineral exploration. Particular attention is given to recent advancements in data-driven analytics, encompassing machine learning, deep learning, and hybrid physics-informed models. Emphasis is placed on sensor fusion, real-time geospatial mapping, and the integration of explainable AI to improve model interpretability and transparency. The study also addresses key challenges, including the limited availability of labelled ground-truth data, the difficulty of achieving model generalization across diverse geological settings, and the ethical implications associated with the application of AI in geosciences. By synthesizing insights from recent case studies and state-of-the-art methodologies, this paper outlines future research directions aimed at fostering more accurate, efficient, and sustainable approaches to mineral exploration.

البحث (١٢)

# Non-Invasive geophysical imaging reveals Ptolemaic tombs at Al-Dyabat for global archaeological applications

**Abdelbaset M. Abudeif, Mohammed A. Mohammed & Hossameldeen A. Gaber**

***Scientific Reports*** **volume 15, Article number: 38488 (2025)**

**Abstract**

This study presents a geophysical investigation aimed at identifying Ptolemaic Period tombs and associated archaeological structures at Al-Dyabat archaeological hill, near Akhmim City, Egypt. The site gained international attention following the 2018 discovery of the tomb of the Priest Tutu. Combined ground magnetic surveying and ground-penetrating radar (GPR) were used at the promising selected site. Integrated analysis revealed subsurface anomalies interpreted as tomb chambers, mudbrick walls, and possible limestone coffins, located at depths between 0.2 and 3 m. The combination of magnetic and GPR data significantly enhanced the detection capabilities and structural resolution, demonstrating the effectiveness of multimodal geophysics in archaeological contexts. Beyond its regional relevance, this work offers a transferable model for non-invasive archaeological prospection in sensitive heritage zones worldwide. It underscores the value of geophysical integration in cultural heritage preservation, offering insights into best practices for sustainable and non-destructive archaeological exploration.

البحث (١٣)

# Global perspectives on evaluating effective porosity and permeability: Insights from hydrocarbon reservoirs in the Lower Rutba Formation, Sijan Field, Syria

**Abdelbaset M. Abudeif, Marwa M. Masoud, Mohammed A. Mohammed, Ayoub Y. Alhussain, Mahmoud A. Abbas**

**Min. miner. depos. 2025, 19(3):51-65, https://doi.org/10.33271/mining19.03.051**

**Abstract**

Purpose. This paper aims to evaluate the petrophysical characteristics of the Lower Rutba Formation in the Sijan Field, Syria, focusing on effective porosity and permeability, and their influence on hydrocarbon productivity. The study intends to develop a practical and cost-effective model for optimizing hydrocarbon recovery, contributing to energy resource sustainabi-lity and global energy security.

Methods. The research utilizes log data from 10 wells in the Sijan Field. Sonic, density, and neutron logs were employed to calculate porosity and permeability, while water saturation was estimated using the Archie equation. A comparative analysis across wells was conducted to determine reservoir quality variations and identify high-potential production zones.

Findings. Results revealed significant heterogeneity in petrophysical properties across the field. Wells such as SIJ.110 showed high effective porosity and good permeability, indicating enhanced hydrocarbon storage and flow capacity. In contrast, wells with elevated clay content, such as SIJ.115, displayed low permeability and diminished reservoir quality. Saturation maps effectively highlighted zones with promising production potential.

Originality. The paper introduces a novel integration of log interpretation and mathematical modeling, enabling permeability estimation without core samples. This approach enhances reservoir evaluation, particularly in sandy clay formations, and is adaptable to similar geological settings worldwide.

Practical implications. The study provides a robust and economical framework for assessing reservoir quality. It reduces dependency on core data, supports targeted field development, and promotes sustainable hydrocarbon extraction through improved decision-making in reservoir management.

# Petrophysical assessment of reservoir quality and recoverable reserves in fluviodeltaic Nubian sandstone Saqqara field Gulf of Suez Egypt

Abdelbaset M. Abudeif, Ahmed E. Radwan, Mohammed A. Mohammed & Faten A. Tawfik

*Scientific Reports* volume 15, Article number: 32469 (2025)

## Abstract

Heterogeneous reservoirs require integrated petrophysical rigor to improve the accuracy of hydrocarbon reserve calculation, minimize uncertainty in reservoir characterization, and optimize development options. Using the Fluvio-Deltaic Nubian Sandstone in the Saqqara Field, Gulf of Suez, as an example, this study uses multi-petrophysical workflows, such as well-log correlation, core-log calibration, petrophysical evaluation, petrophysical distribution maps, and multi-petrophysical cross-plot for lithology, fluid saturation, and reservoir parameters, across four important wells (GS323-1, GS323-2 A, GS323-3, and GS323-4 A). Original hydrocarbons in place (OHIP) and recoverable reserves were calculated using volumetric methods, and thermal maturity was evaluated using geothermal gradient estimations. Lithological interpretation, based on neutron-density cross-plots, confirms the dominance of clean sandstone with minimal clay and anhydrite cementation. Thermal analysis indicates a moderate geothermal gradient (~ 2.75 °C/100 m) and formation temperature (~ 147 °C), supporting hydrocarbon maturation. The reservoir exhibits excellent quality, with low shale volume (~ 0.6%), total porosity averaging 13.5%, and high hydrocarbon saturation (~ 78.5%). Despite variations in permeability, significant net pay zones (ranging from 108.5 to 481.5 ft) offer robust development potential. Using volumetric methods, the estimated hydrocarbons in place reach ~ 106 billion barrels, with ~ $31 \times 10^9$ barrels considered recoverable. These findings highlight the strategic value of the Nubian Formation in hydrocarbon planning and underline the critical role of integrated petrophysical analysis in maximizing production efficiency in mature basins. Moreover, the insights derived from this study can be effectively applied to similar sandstone reservoirs worldwide, contributing to improved resource management and energy security.

# Magnetic Imaging of Subsurface Lineaments for Geotechnical Applications: A Case Study from the Sohag University Campus, Egypt

**Abdelbaset Mohamed Abudeif, Mohammed Atef Mohammed, Mohsen Mohamed Attia, Mohamed M Khalifa, Hossameldeen Adel Gaber, Marwa Ibrahim Elsharkawy**

**Sohag Journal of Sciences, 10(3), 359-370. https://doi.org/10.21608/sjsci.2025.405370.1294**

**Abstract**

This study applies the ground magnetic surveying method to investigate shallow subsurface structural lineaments within the Sohag University campus at El-Kawamel for potential engineering purposes. A detailed magnetic survey was conducted over an area of approximately 0.2 square kilometers using a high-sensitivity GEM GSM-19 Overhauser magnetometer. The survey involved six systematically spaced profiles oriented in an east-west direction with 50-meter spacing, employing a zigzag acquisition pattern to ensure full coverage of the site. A total of 1,487 magnetic readings were collected under carefully controlled conditions to minimize noise. Advanced data processing techniques, including regional–residual separation, tilt derivative (TDR), first vertical derivative (FVD), total horizontal derivative of tilt derivative (THDR_TDR), horizontal gradient (HG), and source edge detection (SED), applied to identify structural features and lineaments. Depth estimation methods such as analytic signal, source parameter imaging (SPI), and 3D Euler deconvolution revealed magnetic sources at depths ranging from about 6 to 75 meters with occasional deeper sources reaching ~113 meters in localized zones. The analysis highlighted dominant N-S, E-W and NW-SE structural trends, which are consistent with regional tectonic settings. The results demonstrate the effectiveness of ground magnetic surveying as a valuable tool for preliminary geotechnical investigations prior to construction.

البحث (١٦)

# Geomagnetic prospection of the Ptolemaic tombs in Al Dyabat archaeological hill, Akhmim city, Sohag, Egypt.

**Abdelbaset Mohamed Abudeif, Mohammed Atef Mohammed, Hossameldeen Adel Gaber**

**Sohag Journal of Sciences, 10(3), pp. 412-422. https://doi.org/10.21608/sjsci.2025.396659.1283**

**Abstract**

This study employs high-resolution magnetic surveying to prospect buried archaeological features, primarily Ptolemaic tombs, within the archaeological hill at Al Dyabat, near Akhmim City, Sohag, Egypt. Despite its historical importance, the site remains largely uninvestigated, presenting a valuable opportunity for new archaeological discoveries. A dual-sensor Overhauser magnetometer was used to conduct a magnetic survey over an area of approximately 2500 m², aiming to detect subsurface anomalies indicative of tomb structures. Advanced data processing techniques, including high-pass filtering, vertical derivatives, analytic signal transformation, Source Parameter Imaging (SPI), and Euler Deconvolution, were applied. The results revealed several shallow magnetic anomalies, ranging in shape from circular to elongated which were interpreted as ninteen potential tombs and associated mudbrick enclosures. These features were identified at depths between 0.5 and 1.5 meters, as outcomed by both SPI and Euler depth solutions. The study demonstrates the effectiveness of jointing magnetic methods in non-invasive archaeological prospection and provides essential guidance for future targeted excavations.

البحث (١٧)

# APPLICATION OF SPECTRAL GAMMA-RAY LOGS TO DETERMINE THE LITHOFACIES AND DEPOSITIONAL ENVIRONMENT OF THE LAM MEMBER, HABBAN OILFIELD, SAB'ATAYN BASIN (*Yemen*)

**N.A.S. Al-Azazi; A.M. Abudeif; M.A. Mohammed; M.A. Albaroot; N. Alarifi; S. Bellucci; F.M.Q. Basrada; M.M. Masoud**

**Russ. Geol. Geophys. (2025) 66 (7): 858–868. https://doi.org/10.2113/RGG20254854**

**Abstract**

The study of spectral gamma-ray logs plays a critical role in understanding the lithofacies and depositional environments of subsurface geologic formations. This research focuses on the Lam Member within the Habban oilfield, located in the Sab'atayn Basin, Yemen. By integrating spectral gamma-ray data with core analysis and other geological datasets, this study aims to provide insights into the stratigraphic distribution, mineral composition, and depositional processes of the Lam Member. Key parameters, such as thorium, uranium, and potassium concentrations, recorded from two wells were analyzed to infer sedimentary characteristics and environmental conditions. The results reveal significant lithologic heterogeneity and suggest a complex interplay of fluvial and marine depositional systems, enhancing the understanding of the basin petroleum potential. The Lam Member comprises interbedded carbonate (dolomite) and claystone with intercalated sandstone. Spectral gamma-ray results indicate that clay minerals primarily consist of mixed-layer clays, chlorite, kaolinite, and minor illite. Based on the Th/U ratio (less than 2), the depositional environment is identified as marine.

البحث (١٨)

# Influence of Shale on Petrophysical Properties and Reservoir Quality: Insights from the Matulla Formation, Saqqara Field, Gulf of Suez, Egypt

Abdelbaset M. Abudeif, Mohammed A. Mohammed, Marwa M. Masoud, Ahmed E. Radwan, Nasir Alarifi, Stefano Bellucci & Faten A. Tawfik

Pure and Applied Geophysics, Volume 182, pages 2799–2820, (2025)

## Abstract

This study examines the impact of shale volume (Vsh) and clay mineral distribution on the petrophysical properties and reservoir quality of the Matulla Formation in the Gulf of Suez, a critical factor in global hydrocarbon exploration and production. Understanding how shale affects porosity, permeability, and fluid saturation enhances reservoir characterization, optimizing recovery techniques such as hydraulic fracturing and sustainable resource management. The evaluation process involved calculating shale volume using the neutron-density method, with values ranging from 1.9% to 11% across four wells (GS323-1, GS323-2A, GS323-3, GS323-4A). Clay minerals have been identified through Potassium-Thorium (K-Th) cross-plot include chlorite, illite, kaolinite, montmorillonite, and mixed-layer clays. Montmorillonite and chlorite negatively impact porosity and permeability, while kaolinite and illite improve hydrocarbon retention. Shale distribution analysis using the Thomas and Stieber model showed both laminated and dispersed forms, where laminated shales had minimal blockage, and dispersed clays significantly reduced the reservoir quality. Results reveal that wells with low Vsh (GS323-1 and GS323-4A) which ranges from 1.5 to 2% exhibit excellent reservoir quality, with high porosity (14%), high permeability (317–320.7 mD), and low water saturation (32–44%). Moderate Vsh wells (GS323-2A) show reduced porosity (13%), permeability (220 mD), and increased water saturation (46%), reflecting good but diminished quality. High Vsh well (GS323-3) display lower porosity (12%), permeability (140 mD), and moderate water saturation (37%), indicating challenges in fluid flow. This study highlights the need for tailored strategies to mitigate high shale content and swelling clays, offering valuable insights into optimizing hydrocarbon exploration and production in shale-influenced reservoirs worldwide.

# Environmental hazards of wastewater disposal on groundwater at the West Sohag site, Egypt

**Shaymaa Rizk, Mariam Anis, Merna Nazer, Ahmed M. Youssef, Mostafa Redwan & Bosy A. El-Haddad**

*Scientific Reports* **volume 15, Article number: 36303 (2025)**

**Abstract**

Effluent infiltration from wastewater treatment plants into groundwater systems can be a source of contaminants of emerging concern that are not fully removed during the treatment processes. In the lowland desert area in Upper Egypt between the Eocene Limestone plateau and the new floodplain, wastewater disposal plants have been set up. Woody farmland will be irrigated with the treated wastewater. Some wastewater disposal sites, including the west Sohag site, have been operating since 1990. This site is considered a very hazardous source of soil and groundwater pollution. The current work aims to assess the environmental impact of the sewage water treatment plants (west Sohag site) in the Sohag Governorate, Egypt, using remote sensing and geochemical techniques. Monitoring the continuous extent of sewage water leakage and heavy metal mobility in the groundwater. The detailed visual interpretation of the different remote sensing data showed that the contaminated areas increased substantially. The area was classified into four classes, namely Urban centers, agricultural areas, water courses, and barren lands. The study showed that insufficient land is available to accommodate the projected quantities of wastewater. The hydraulic conductivity varies between 0.29 and 3.72 m/day with an average porosity of 38.9%. Excess raw wastewater accumulates on the ground surface at current operating sites, forming large, uncontrolled ponds. When soil, crops, and water supplies are contaminated chemically and bacteriologically, such ponds pose a risk to the ecosystem and could have catastrophic health consequences. Average heavy metal concentrations in the analyzed groundwater decreased from Zn > Cu > Pb > Cd, with mean values of 8.55 > 0.421 > 0.282 > 0.207 ppm, respectively. The correlations between heavy elements in the water are very high, with correlation coefficients greater than 0.8 between Pb & Cd, Pb & Cu, Pb & Zn, Cd & Cu, Cd & Zn, and Cu & Zn. According to speciation analysis, Zn, Cu, Pb, and Cd are highly mobile metals in the study area. Our findings confirmed the occurrence of sewage water leaking into the groundwater aquifer in the study area. These results offer useful data for examining the transport properties of heavy metal contaminants and developing practical remediation strategies.

البحث (٢٠)

# Flood Inundation Mapping Using HEC-RAS 2D Modeling and Examining the Impact of Changes in the Model-Meshing Pixel Scale on the Final Output

**Bosy A. El-Haddad, Ahmed M. Youssef, Zeinab Karimi & Hamid Reza Pourghasemi**

**Water Resources Management, Volume 39, pages 5807–5826, (2025)**

## Abstract

Floods as a Natural disaster are incredibly destructive and have detrimental effects on people lives and properties. Engineering and no engineering techniques have been developed for flood mitigation. This work aims to evaluate the impact of floods in the Wadi Al-Arj area, northeast of Taif City, Saudi Arabia. An integrated approach utilizing GIS, remote sensing, HEC-HMS, and HEC-RAS was used for the hydraulic modeling. This technique involved the construction of several maps and subsequent assessments. Within the Wadi Al-Arj basin, satellite images from the Landsat-8 "OLI" 2023, DEM-30 m, geology map, and meteorological data were collected and utilized in the GIS environment to extract various thematic layers, including land use, soil, and rainfall distribution, for hydrologic modeling by HEC-HMS. The flood hydrograph curve for the Wadi Al-Arj Basin was calculated after applying the Muskingum routing method, and floodwater quantities of 18.2 million $m^3$ and a discharge rate of 1,144 $m^3/s$ were estimated for a 100-years return period. The flood severity matrix approach was applied to simulate and map flood inundation over the 10-kilometer Wadi Al-Arj stretch using the HEC-RAS-2D model with high-resolution DEM-4 m. Based on the severity index matrix, the flood water depth (m), velocity (m/s), and severity rate ($m^2/s$) were classified into five zones: low (0-0.2), medium (0.2–0.5), high (0.5–1.5), very high (1.5–2.5), and severe (above 2.5). This study also examines the impact of changes in the model-meshing pixel scale on the final result of the simulation. According to previous reports, the 10 m × 10 m pixel simulation results that matched the validation data matched the flooded areas. This study illustrates the two-dimensional capabilities of HEC-RAS and assists specialists in enhancing the management processes.

البحث (٢١)

# Seismic-induced landslides susceptibility mapping of the NEOM area, northwestern Saudi Arabia using machine learning modelsEarth

**Bosy A. El-Haddad, Ahmed M. Youssef, Ali M. Mahdi, Zeinab Karimi & Hamid Reza Pourghasemi**

**Science Informatics, Volume 18, article number 443, (2025)**

## Abstract

Saudi Arabia is vulnerable to various natural disasters, each of which can affect life and property significantly. As steep regions frequently experience seismic activity and significant precipitation, landslides have become widespread. Consequently, creating susceptibility maps by simulating these threats is of paramount importance. The potential landslide susceptibility in the NEOM area of northwestern Saudi Arabia was identified by incorporating topographic, geological, meteorological, and earthquake data from various sources. Landslide inventory data were evaluated to determine the probability of landslides in the NEOM area. Eighteen thematic layers were produced, each representing one of the key landslide factors. The relative importance of key landslide factors for landslide susceptibility mapping was determined using a random forest (RF) model, enabling us to evaluate the effectiveness and significance of each parameter in the mapping process. Three machine algorithms were utilized—"Logistic Regression (LR)", "Random Forest (RF)", and "eXtreme Gradient Boosting (XGB)" to integrate inventory data from field studies, historical documents, and high-resolution remote sensing images with key landslide factors. This approach allowed us to create landslide susceptibility maps that could effectively identify areas at risk for landslides. The landslide susceptibility indices (LSI) for the LR, RF, and XGB models were divided into five landslide susceptibility zones. Numerous statistical indices, including the kappa index (K), "mean absolute error (MAE)", "root mean square error (RMSE)", overall accuracy (OAc), hazard accuracy (HAc), non-hazard accuracy (NHAc), and "area under the curve (AUC), were used to evaluate the predictability of the landslide susceptibility models. Analysis of these indices indicated that the XGB model performed remarkably well in landslide prediction, with a high area under the curve (AUC) of 95.5% and a superior kappa score of 0.930. However, it provided the lowest MAE (0.064) and RMSE (0.213). The c map shows that high and very high landslide susceptibility covers 29.4%, moderate zone covers 16.9%, and low and very low susceptibility zones cover 53.7%. When implementing development projects in the NEOM region, the ultimate landslide susceptibility map can potentially increase decision-making effectiveness. Avoiding critical infrastructure and implementing geotechnical measures to prevent the negative consequences of landslides are possible with the assistance of this map.

البحث (٢٢)

# Exploring potential mineral deposits: Integrating airborne magnetic and remote sensing data in North-eastern Desert, Egypt

Ali M. Mahdi, Ahmed M. Youssef, Safwat S. Gabr, Hassan I. Diab, Saad S. Alarifi, Peter András, Ahmed M. Eldosouky

Advances in Space Research, Volume 75, Issue 6, 15 March 2025, Pages 4472-4489.
https://doi.org/10.1016/j.asr.2024.12.043

**Abstract**

This study demonstrates the effectiveness of integrating Magnetic and Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) remote sensing data to identify hydrothermal alteration zones and structural features associated with gold mineralization in Egypt's Fatira region. We employed the Center for Exploration-Targeting (CET) porphyry and grid enhancement methodologies on Magnetic data. Band ratios with constrained energy-minimization (CEM) techniques were applied to ASTER data. Newly identified altered zones are detected. Shuttle Radar Topography Mission-Digital Elevation Model (SRTM-DEM) data aids in locating regions conducive to mineralized hydrothermal fluid migration. Statistical analyses reveal predominant directional trends in the study area. Gold mineralization is linked to NE-trending severely fractured felsite dikes and contacts between granitic intrusions and highly sheared metavolcanic rocks. These findings resemble documented mineralized deposits, providing valuable insights for future mineral prospecting in the region and globally in areas with similar geological characteristics. Integrating aeromagnetic with ASTER remote sensing data in our study offers an approach to link surface potential zones of mineralogy with subsurface structures. This integration provides a detailed understanding of geology and enhances exploration in underexplored provinces.

**البحث (٢٣)**

# National flood susceptibility mapping in Saudi Arabia

**Bosy A. El-Haddad, Ahmed M. Youssef, Ali M. Mahdi, Zeinab Karimi & Hamid Reza Pourghasemi**

**Earth Science Informatics, Volume 18, article number 118, (2025)**

## Abstract

Flood hazards play a vital role in land use planning and have profound implications if they are not considered in the early development phases. Detecting the likelihood of flood hazards and estimating their probability and magnitude are complex tasks that require integration of multidisciplinary approaches. In this study, a national flood susceptibility map (NFSM) and a national "flood vulnerability map" (NFVM) were developed for Saudi Arabia. Various data types were used in this study, including geological, topographical, geomorphological, meteorological, and anthropogenic. The "Analytical Hierarchy Process (AHP)" approach was used to calculate the weight coefficient for the factors and their classes, and the GIS environment was used to produce the final product. The accuracy of the flood susceptibility map was measured based on actual flood data from 70 locations" using the area under the curve method "(AUC)". The accuracy of the model was 0.933 (93.3%), indicating that it is an excellent model for the national flood susceptibility scale. Finally, flood susceptibility management was discussed, enabling actions in complex and confusing disaster scenarios. Furthermore, this work demonstrates the applicability of these national-scale maps as guidelines and recommends considerations to achieve beneficial outcomes at economic, sociocultural, and environmental multidisciplinary levels.

البحث (٢٤)

# The geomorphology of monoclinal scarps associated with interstratal-dissolution fronts in evaporite formations, illustrated with the Upper Jurassic Arab and Hith formations in Ar Riyadh and Central Saudi Arabia

**Francisco Gutiérrez, Yasser Zabramawi, Abdullah Memesh, Ahmed M. Youssef, Alaa Bahamil, Luis Auqué**

**Earth-Science Reviews, Volume 261, February 2025, 105032,**
**https://doi.org/10.1016/j.earscirev.2024.105032**

## Abstract

The downdip migration of dissolution fronts in gently tilted evaporite formations produces updip-facing monoclinal folds and adjacent synformal troughs (depositional basins) in the supra-evaporite strata. These gravitational deformation structures, up to 1000 km long, can be expressed in the landscape as laterally migrating fold escarpments and linear depressions, forming the largest karst features on Earth. Despite their large dimensions and numerous associated practical implications (hydrocarbon, salt, geostorage, water quality, sinkhole hazards), the scientific publications dealing with these interstratal evaporite karst features are rather scarce. This work reviews the available literature on dissolutional edges and associated features developed on dipping salt and gypsum/anhydrite formations. It also analyses the >800 km long dissolution and subsidence belt associated with the updip edge of the Upper Jurassic Arab and Hith anhydrites in the Interior Homocline of central Saudi Arabia, with special focus on its striking geomorphic features. This is the largest Ca-sulphate karst feature in the world, despite the aridity of the region, and is also the example in which the associated landforms and deformation structures are best displayed. It displays striking monoclinal scarps with an aggregate length of 420 km, affected by crestal extensional structures and punctured by numerous giant caprock collapse sinkholes. The increased sinkhole hazard and risk documented in the Ar Riyadh area in recent times can be attributed to adverse human activities (localized artificial water input) and the expansion of the urban area across the dissolution front and monoclinal scarp.

البحث (٢٥)

# Assessing flood hazard mapping using AHP and GIS in a tectonically active region

Skilodimou, Hariklia D.; Bathrellos, George D.; Pappa, Maria-Ioanna; Youssef, Ahmed M.; Kontakiotis, George; Karymbalis, Efthimios

Zeitschrift für Geomorphologie Volume 64 Issue 3-4 (2025), p. 275 – 288,
DOI: 10.1127/zfg/2024/0804

**Abstract**

This study focuses on the development of a flood hazard model for the Phoenix River drainage basin, located in the northern Peloponnese region of southern Greece. In situations where runoff exceeds the drainage system's capacity, five key factors have been identified as the most significant in influencing it. These factors include slope, elevation, hydro-lithology, distance to streams, and land cover. The Analytical Hierarchy Process (AHP) was integrated with Geographic Information System (GIS) to facilitate the assessment of the chosen factors employed in the production of the flood hazard assessment map. The hazard zones depicted on the generated flood hazard map underwent an evaluation process involving uncertainty analysis. Additionally, the verification of the map was carried out through the utilization of frequency ratio analysis and examining previous flood events. The research findings indicate that the areas with the most pronounced risk of flooding are predominantly situated in the northern and central regions of the drainage basin. This heightened hazard is attributed to a combination of factors, including flat morphology, proximity to the hydrographic network, the presence of semi-permeable formations on very gentle slopes, urban land use, and the presence of previously burnt areas. The uncertainty analysis indicates the reliable predictions produced by the applied method. The verification analysis confirms a satisfactory correspondence between the flood hazard zones on the map and the actual spatial occurrence of flood events. The methodology employed in this study was applied effectively in various projects, including flood hazard assessment mapping, flood hazard mitigation, and land use planning.

البحث (٢٦)

# Release of potentially toxic elements from an operational phosphate mine (Sebaiya east, Egypt): geochemical characterizations, environmental risks and mining sustainability

**Mouataz T. Mostafa, Hassan I. Farhat, Sahar M. Abd El-Bakey, Mariam Y. Zakaria, Hala A. Zekry, Reham Y. Abu Elwafa, Shaimaa S. Wazery & Ahmed Abdelaal**

**Environmental Earth Sciences Volume 84, article number 445, (2025)**

## Abstract

The extraction and processing of naturally occurring phosphate deposits have significantly intensified the mobilization of potentially toxic elements (PTEs), resulting in their pervasive release into the environment. Accordingly, this study investigated the environmental impact of phosphate mining at Sebaiya East area (Egypt), analyzing 24 surface sediment samples for PTEs via ICP-OES, supported by statistical analysis (descriptive and multivariate), pollution indices (individual, composite, and ecological), and health risk assessments (carcinogenic and non-carcinogenic) to understand the release, distribution, accumulation, and geochemical behavior of contaminants. The median values of PTEs were lower than their maximum concentrations, highlighting localized hotspots. Cd's average level consistently exceeded all geochemical reference values. The individual contamination grades, based on average $I_{geo}$ and CF values, ranked as Cd > As > Cr > Ni > Zn > Cu > Pb. Samples showed overall contamination (mean PLI: 1.79, mean $C_{deg}$: 20.45, mean $PI_{Nemerow}$: 4.29), with 29.2% severely polluted (PLI > 2) and 37.5% highly contaminated ($C_{deg} \geq 24$), localized near mining activities. The mean RI value of 383.9 indicated a considerable ecological risk ($300 < RI < 600$) throughout the study area. Weak Pearson correlations observed for As and Cd with other PTEs indicated distinct geochemical behavior and anthropogenic origins. PCA revealed the mixed origin of Pb, Cu, Zn, As, and Ni in PC1 (weathering of local bedrock and diffuse deposition from mining activities) and the anthropogenic origin of Cd in PC2. Cr and As posed the highest carcinogenic (CR: 3.64E + 02) and non-carcinogenic risks (HQ: 3.04E + 05), respectively, exceeding safety thresholds.

البحث (٢٧)

# Dolomitization and Silicification in Syn-Rift Lacustrine Carbonates: Evidence from the Late Oligocene–Early Miocene Duwi Basin, Red Sea, Egypt

**Tawfiq Mahran, Reham Y. Abu Elwafa, Alaa Ahmed, Osman Abdelghany, Khaled M. Abdelfadil**

***Geosciences*** **2025, *15*(9), 356; https://doi.org/10.3390/geosciences15090356**

**Abstract**

Studies of early syn-rift successions in the Duwi Basin have revealed repetitive lacustrine carbonate deposits exhibiting regressive sequences and early diagenetic processes. Two main informal stratigraphic units (Units 1 and 2), spanning the Late Oligocene to Early Miocene, have been identified in the area. Unit 1 primarily consists of lacustrine limestone and calcrete deposits that formed in a palustrine environment, whereas Unit 2 is composed of dolomites and cherts, which developed during times of lake evaporation and desiccation under arid climatic conditions. A wide variety of pedogenic features, including brecciation, nodulization, rhizocretions, fissuring, microkarsts, and circumgranular cracks, dominate the carbonate sequence, indicating deposition in a marginal lacustrine setting. Integrated petrographic, mineralogical, geochemical, and isotopic studies of carbonate facies reveal two distinct evolutionary stages in the Duwi Basin, with dolomitization and silicification characterizing the late stage. Their isotopic compositions show a wide range of $\delta^{13}C$ and $\delta^{18}O$ values, ranging from −9.00‰ to −7.98‰ and from −10.03‰ to −0.68‰, respectively. Dolomite beds exhibit more negative $\delta^{13}C$ and $\delta^{18}O$ values, whereas palustrine limestones display higher (less negative) values. The upward trend of $\delta^{18}O$ enrichment in carbonates suggests that the lake became hydrologically closed. Trace element concentrations serve as potential markers for distinguishing carbonate facies, aiding with paleoenvironmental and diagenetic interpretations. Our findings indicate that the studied dolomites and cherts formed under both biogenic and abiogenic conditions in an evaporative, alkaline-saline lake system. Biogenic dolomite and silica likely resulted from microbial activity, whereas abiogenic formation was driven by physicochemical conditions, including decreasing pH values and the presence of smectite clays. Tectonics, local climate, and provenance played crucial roles in controlling the overall diagenetic patterns and evolutionary history of the lake basin system during the Late Oligocene to Early Miocene.

البحث (٢٨)

# Machine learning-driven geochemical fingerprinting and risk characterization of mineral dust across different operational settings in El-Gedida Iron Mine, Egypt

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**Environmental Geochemistry and Health, Volume 47, article number 575, (2025)**

## Abstract

Investigating mineral dust emitted from mining activities enables the assessment of environmental risks posed by potentially toxic elements (PTEs) and the discrimination of geochemical fingerprints characteristic of distinct operational settings. Accordingly, this study employed site-specific dust sampling, geochemical analysis of PTEs using ICP-AES, supervised machine learning (e.g., Support Vector Machine and Multinomial Logistic Regression), multivariate statistics (e.g., Principal Component Analysis), pollution and ecological indices (e.g., Pollution Load Index), and health risk modeling to delineate PTE contamination patterns, determine high-risk microenvironments, and identify geochemical fingerprints (e.g., ore-handling zones vs. confined cabins) within El-Gedida Iron Mine (Western Desert, Egypt), thereby establishing dust-borne elemental profiles as tracers for evidence-based environmental intervention. Mean PTE concentrations decreased in the order of Fe > Mn > Zn > Cr > Pb > Cu > Ni, with Cu showing extreme variability (CV = 142.6%) and a 40-fold range, linked to a localized enrichment. Composite indices exhibited substantial contamination across all samples, with a mean PLI of 2.21. Cr and Ni posed unacceptable lifetime cancer risks in children (TCR = 6.87E−04 and 2.28E−04, respectively), while Cr exhibited the highest non-carcinogenic risk (HI = 0.522), though below the critical threshold (HI < 1). Supervised machine learning models demonstrated reliable group separability and probabilistic discrimination driven by key elemental predictors (e.g., Cu), effectively extracting latent geochemical signatures, with prominent examples including the Cu–Pb-enriched fingerprint indicative of confined drilling cabins, reflecting localized accumulation from internal vehicular emissions, and the Fe–Mn lithogenic-derived signature characteristic of ore-handling zones. The Multinomial Logistic Regression (MLR) model achieved a predictive accuracy of 95.8%, highlighting the framework’s strong practical applicability.

**Tectono-sedimentary evolution of early syn-rift deposits in a hangingwall dip-slope setting, northern Duwi half-graben, Red Sea, Egypt**

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**Abstract**

Studies comprehensively characterizing early syn-rift continental sedimentation in hangingwall settings are limited. To improve our understanding of how these deposits evolved, we must investigate the growth faults and related folds during rift-initiation. These structures significantly influenced the development of early syn-rift stratigraphic sequences along the strike and down the dip-slope. This study examines the stratal arrangement and sedimentology of the Late Oligocene-Early Miocene syn-rift lacustrine succession, which is consistently exposed along the hangingwall dip-slope strike in the northern Duwi half-graben sub-basin in the Red Sea Rift, Egypt. Detailed field-based description supported by petrographic investigations of the early syn-rift rocks enabled the discrimination of eight subassociations types that form three distinctive genetically-related facies associations deposited primarily in distal fluvial to lacustrine/palustrine carbonate-dominated environments. From a sequence stratigraphic perspective, three unconformity-bounded depositional sequences (*DSQ-1*, *DSQ-2*, and *DSQ-3*) have been identified, representing three successive phases of carbonate lake development. These sequences reflect transgressive-regressive cycles that record a major transition from open, shallow-lacustrine carbonate to fluvio-lacustrine carbonate, culminating in restricted lacustrine carbonate deposits. This study documents the interplay between hangingwall dip-slope tilting associated with growth segmented NW-SE-trending fault system, paleoclimate and provenance, proposing a new tectono-sedimentological model for rift initiation. The results of study have implications for other hangingwall dip-slopes in the Red Sea rift sub-basins.

**Assessment of Potentially Toxic Metals (PTMs) Pollution, Ecological Risks, and Source Apportionment in Urban Soils from University Campuses: Insights from Multivariate and Positive Matrix Factorisation Analyses**

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**Abstract**

Understanding pollution levels, ecological health risks, and sources of potentially toxic metals (PTMs) in the soil from university campuses is critical for assessing environmental safety. Soil samples were collected from 12 locations across urban parks and green areas at Sohag University in Egypt. The samples were processed and analysed for heavy metals, including iron (Fe), manganese (Mn), cobalt (Co), nickel (Ni), chromium (Cr), lead (Pb), zinc (Zn), copper (Cu), and cadmium (Cd). Pollution levels were evaluated using indices such as the pollution index (PI), pollution load index (PLI), geo-accumulation index ($I_{geo}$), and enrichment factors (EFs). Among the pollution indices, the EFs showed the highest sensitivity in detecting anthropogenic contributions, particularly for Cd, Pb, and Cr. Spatial distribution maps and multivariate statistical analyses, including correlation matrix (CM), principal component analysis (PCA), and cluster analysis (CA), were applied to identify the relationships between PTMs and soil properties, and source apportionment was performed using positive matrix factorisation (PMF). The results indicated that Mn, Ni, and Co were primarily geogenic, whereas Pb, Zn, Cr, and Cd showed higher concentrations, suggesting moderate-to-significant anthropogenic pollution. Pb and Cd pose considerable ecological risks, whereas other metals such as Cr and Cu exhibit moderate ecological threats. The non-carcinogenic and carcinogenic risks to the students were within safe limits, as defined by United States Environmental Protection Agency (USEPA) threshold values. Source apportionment using PMF identified five main sources of PTMs: industrial and anthropogenic activities (30.0%), traffic emissions (25.0%), natural soil processes (20.0%), agricultural practices (15.0%), and mixed industrial traffic sources (10.0%). These findings emphasise the importance of controlling anthropogenic activities to ensure a safer campus environment.

**Extreme impact of the Late Cretaceous–Paleocene tectonic events on the evolution of the southern Tethyan margin: a case study from Eastern Desert, Egypt**

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## Abstract

The well-distributed Late Cretaceous–early Paleogene rocks in Egypt are one of the keys to understanding the geologic history of the southern Tethys. Four Late Cretaceous–early Paleogene successions exposed in the Esh- ElMellaha area were investigated. The integrated stratigraphic analyses, including; field, lithostratigraphy and biostratigraphy of these sections within the Esh-ElMellaha ridge showed interesting results. Intensive tectonic processes throughout Paleocene period substantially influenced all rock units, causing differences in their facies and thickness. In addition, these tectonic processes deformed the sedimentary basins. During the Paleocene, Esh-ElMellaha area experienced two significant syn-sedimentary tectonic events (I and II) related to the Syrian Arc Tectonic Event. The evolution of the Esh-ElMellaha basin has been documented for the first time throughout this period which is extremely dependent upon these tectonic events. Four paleo-relief profiles were created to illustrate how these events impacted the history of sedimentary basins, extending from the North Wadi Qena northward to the Gabal Hamadat southward. The strength of tectonic events caused the Esh-ElMellaha area to undergo substantially varied degrees of instability. These profiles demonstrate the stability of the deposition during the Maastrichtian period. However, during the Danian, the basin experienced the deposition of thin strata expanding from north to south. This uplifted the basin into submarine paleohigh and created an erosional surface. During the late Paleocene (Selandian-Thanetian), the basin was deeper in the south (Hamadat) than in the north (North Wadi Qena). In contrast, the basin in the Esh-ElMellaha area became an aerial paleohigh, an event that began at the end of the Danian and continued until the early Eocene (Ypresian). This uplift led to the formation of significant paleosol layers. Moreover, the depocenter's southern sections of Esh-ElMellaha had a less tectonic effect, while the northern regions of Esh-ElMellaha witnessed extreme tectonic activity.

# Towards advanced Geological Mapping of Precambrian Rocks in the El Ineigi Area, Central Eastern Desert, Egypt: Integrating Hyperspectral Satellite Data and Machine Learning algorithm

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***Journal of Mining and Environment*** **(2025).**

**Abstract**

Hyperspectral imaging (HSI), combined with advanced machine learning algorithms (MLAs), has unlocked novel research opportunities and revolutionized geological mapping by enabling precise lithological classification. Accurately detailed geological mapping is one of the most essential requirements for targeting mineralization. However, achieving comprehensive lithological mapping remains a challenge, hindering systematic mineral exploration. This work explores the use of PRISMA hyperspectral data and the Support Vector Machine (SVM) and Artificial Neural Network (ANN) algorithms to objectively map the Precambrian rock assemblages at the El Ineigi area in the Central Eastern Desert (CED) of Egypt. For this purpose, PRISMA data in HDF5 format were first pre-processed and subsequently transformed through principal component analysis (PCA). The processed spectral data were then combined with extensive fieldwork and previously existing geological maps and classified using SVM and ANN to achieve enhanced discrimination of the exposed rock units in the study area. Our results conclusively demonstrate the exceptional capability of PRISMA data for detailed lithological mapping. The SVM and ANN classification achieved remarkably high overall accuracy, successfully generating a robust geological map that clearly discriminates between various Neoproterozoic basement rock units in the El Ineigi area. Through the integration of diagnostic spectral signatures with field verification, we confidently identified all major mappable units, including metavolcanics, metagabbro-diorite complexes, younger granites, and Wadi deposits. The proposed integrated approach demonstrates superior performance compared to traditional mapping techniques, offering enhanced discrimination precision and operational efficiency. These findings strongly support the combined use of PRISMA hyperspectral data and MLAs for lithological mapping applications.