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The Anelastic Attenuation of Surface Waves Beneath Southwestern Arabia and the Southern Red Sea

By
T.A. Mokhtar

Abstract

The seismic attenuation coefficients of surface waves in southwestern Arabian Peninsula and the southern Red Sea were investigated using the station radio method. Love and Rayleigh waves data recorded by two GSN stations RAYN and ATD are used to compute Love and Rayleigh waves attenuation coefficients ($\gamma_L$ and $\gamma_R$), and Love and Rayleigh waves internal friction (Quality factors, $Q_L$ and $Q_R$) in the region between the two GSN seismic stations RAYN and ATD. RAYN lies at the centre of Arabia, while ATD is located on the western coast of the southern Red Sea on the Afar depression. $\gamma_R$ is found to vary from a low of $4.03 \times 10^{-4}$ km$^{-1}$ at 27 s and a high of $22.9 \times 10^{-4}$ km$^{-1}$ at 44 s. $\gamma_L$, on the other hand, varies between a minimum of $-2.28 \times 10^{-4}$ km$^{-1}$ at 6 s and a maximum of $10.81 \times 10^{-4}$ km$^{-1}$ at 23 s. The average quality factors $Q_R$ and $Q_L$ for the upper crust are estimated to be 100 and 160, respectively. Surface wave attenuation below the upper crust is extremely high. The high attenuation of the crust and upper mantle may be explained in the frame work of the ongoing tectonic process of the Red Sea and the Afar depression. High temperature associated with partial melting beneath the crust can result in increasing the attenuation which is observed at long periods, while at short periods (less than 27 s), the level of attenuation is less. However, the attenuation is remarkably high. The results of this confirm previous indications that the Arabian plate, unlike other stable regions, has unusually higher attenuation characteristics for seismic waves in the crust and upper mantle comparable to many tectonically active regions of the world.
Investigating the Groundwater Occurrence in Wadi Rahjan and its Potential Contribution to Ain Zubaida Using Magnetic and Electric Methods, Makkah Al-Mukarramah, KSA

By
Mansour Abdullah Al-Garni

Abstract

Ground magnetic and DC resistivity surveys are implemented to explore groundwater in the northern part of Wadi Rahjan, Makkah Al-Mukarramah, Saudi Arabia. This part includes the downstream area of Wadi Rahjan which flows into Wadi Nu’man where Ain Zubida is located. A system of E-W dikes is shown on available geologic map, which is cutting across the surrounding metavolcanic rocks and Wadi Rahjan stream. This study aims to locating the extension of these dikes/discontinuities that may control the groundwater flow and distribution along this important part of Wadi Rahjan.

Ground magnetic survey is utilized along wadi Rahjan and the magnetic data is presented as contour map. Selected nine profiles are quantitatively analyzed using analytic signal analysis and horizontal gradient techniques. The present study reveals four discontinuities representing most probably dikes crossing the wadi. These dikes have great impact on the groundwater flow from upstream side to downstream side reaching wadi Nu’man where these dikes act as barriers for groundwater flow.

Electrical resistivity sounding using Schlumberger array is used along the wadi to delineate the extent of saturation zones, depth to basement, and to clarify the possible occurrence of the groundwater accumulations. It can be used also to show the effect of dikes occurrence on the groundwater flow and its distribution along this part of the Wadi. The study was successful in locating the water saturated zone and in determination its extension along the downstream part at the south of a major dike that partially prevents the groundwater flow to wadi Nu’man.
Petroleum Reserves and the Credibility Gap

By
Hassan S. Naji

Abstract

The paper focuses on studying the available definitions of petroleum reserves and the resulting credibility gap. The credibility gap refers to the apparent disparity amongst the reported petroleum reserves values. There are two main reasons for this gap; the first reason is that there is no consistent definition of petroleum reserves. In fact there are many definitions available today in the oil industry. In addition, the wording of each definition is sufficiently vague allow evaluators a great deal of latitude when classifying reserves. Furthermore, oil companies tend to use definitions that fulfill their specific goals. This misuse, along with the companies’ pressure to look good in the financial market, has led to a bending of the rules. Consequently, it is necessary to adopt a consistent definition with clear wording in order to enhance communication and to avoid a situation where the definition of petroleum reserves loses all meanings.

The second reason for the gap is that petroleum reserves are not measurable quantities; they are only estimates. As a matter of fact there is no single estimation method and there is always uncertainty in each method. This reason coupled with the countries’ underlying politics and prevailing economics govern the credibility of the reported reserves values. Therefore, it is necessary to provide a methodology for estimating reserves on a common basis in order to improve the support for financial reporting and to attract the public financing.

Key words: Petroleum Reserves; Reserves Definitions; Reserves Values.
Examination of the Potential for Time Domain Electromagnetic Method for Monitoring Infiltration and Recharge in Arid Areas

By
Hesham H. Kaliouby, Ty Ferre and Ken Zonge

Abstract
Recharge flux is one of the most difficult components of the water balance to measure. However, quantitative estimates of this flux are critical for water resources planning in semi-arid and arid areas. Geophysical methods that can be operated from the ground surface offer significant advantages for recharge monitoring. Specifically, because they do not require boreholes, they are typically inexpensive and can be used to monitor over large areas. Electrical and electromagnetic geophysical methods may be useful for monitoring recharge because of the dependence of both the electrical conductivity and the dielectric permittivity on the volumetric water content of a porous medium. However, it is unclear whether the pattern of water content change that occurs during recharge can be inferred, uniquely, from all geophysical responses. In this study, we examine the suitability of time domain electromagnetic (TEM) methods for monitoring infiltration into an initially dry soil. This preliminary examination is conducted as a sensitivity analysis in which we vary the porosity (P), initial water content (Wci) and the hydraulic conductivity (K) of the medium and calculate the TEM response with time during an infiltration event. Infiltration into a dry medium causes a large, localized change in the water content, making these conditions most conducive to recharge monitoring with geophysical methods. We consider this study to be a first level examination of the potential for recharge monitoring with TEM.
Radioelements and Uranium Migration in Granites, El-Missikat Tunnels, Central Eastern Desert, Egypt

By
Ali Abu-Deif, Helmy S.O. Abouelnaga and Hamdy I.E. Hassanein

Abstract
Fracture–filling uranium mineralization, connected mainly to black and jasperoid silica veins, occupying shear and fracture zones, was detected in 1968-1969 at the northern margin of El-Missikat post-tectonic granite, Central Eastern Desert, Egypt. Tunnels and excavations were executed, nearly at Wadi level, following these shear zones, in order to determine extensions of parts of the tunnels and evaluate their potentiality. Excavation works revealed the existence of disseminated pitchblende, as well as its secondary association, in some drifts of the explored shear zones. The granite along the shear zone is intensely altered. The main alteration features are silicification, sericitization and kaolinization. An extensive gamma-ray spectrometric survey was carried out on some of the mineralized parts. The obtained data were statistically treated in order to outline the radiolithological features of the different rock units in the prospect area. The original uranium content and uranium migration rate were calculated in order to identify the migration trends in the granite and its alteration products.

The study shows that there is a close relationship between the distribution of radioelements and lithology, in which the silica veins and silicified granites possess the highest radioelement contents. The migration of uranium took place inward in the brecciated jasperoid silica, massive silica, and silicified granite. Meanwhile, the migration is outward in the case of pink (unaltered), kaolinized, and sericitized granites. The results show that, the pink granite has the highest outward uranium migration rate (-148), followed by the sericitized granite (up to -123). The kaolinized granite has the lowest outward uranium migration (up to -67). Meanwhile, both silica types the silicified granite and jasperoid silica show inward uranium migration rate reach up to 56 and 77, respectively. These results reflect the similarity between uranium migration in the granitic rocks of El-Missikat prospect and the nearby El-Erediya prospect, located about 30 km to the south.
The Use of DC-Resistivity to Outline the Sub-surface Hydrogeological and Structural Setting Beneath a Proposed Site for Subsurface Dam Building, Makkah Al-Mukarramah, Saudi Arabia

By
H. Hassanein, H. El-Kaliouby and M.A. Al-Garni

Abstract

The present study is conducted in the down stream area of Wadi No’man, Makkah Al-Mukarramah, Saudi Arabia. Wadi No’man is bounded by Gabal Kabkab from the north and Gabal No’man from the south; it discharges its water to the Red Sea. The area under investigation forms a part of the Arabian shield of the western Saudi Arabia. Accordingly, igneous and metamorphic rocks cover the study area. In the upstream of Wadi No’man, the escarpment is a conspicuous structural feature, besides; major and minor faults are dominant in Wadi No’man and adjacent areas.

Historically, Ain Zubida used to be the main groundwater source in the area. Intensive and uncontrolled discharge led to lowering the groundwater level. The aim of this study is to determine the main hydrological and structural setting beneath a proposed site of subsurface dam. The purpose of building the subsurface dam is to control the groundwater flow in the area to rise the water table in the area surrounding Ain Zubida galleries.

DC resistivity using profiling and vertical electrical sounding surveys was conducted for horizontal and vertical investigation of the hydrological and structural parameters beneath the study area. This method lead to the classification of alluvium, which covers the basement rocks but, according to the DC resistivity values, it is divided into two distinctive alluvium layers. The upper layer has relatively high resistivity values (dry alluvium) and the lower alluvial layer has relatively low values since it consists of moist alluvium. The middle layer corresponds to the expected water saturated layer with the lowest resistivity values. Finally, at the bottom of the Wadi, the resistivity values increase due to the occurrence of the basement rocks which forms the Wadi basin.
Application of Walsh Transform to Interpret Residual Magnetic Anomalies due to Simple Geometrically Shaped Causative Targets

By
Talal Ali Mokhtar

Abstract

A set of complete and orthogonal functions of noninusoidal waveform, known as Walsh functions which assume only discrete amplitude values of +1 and -1, are utilized for the analysis of magnetic data. Procedures are formulated using the Walsh transform for interpreting vertical magnetic anomalies of (1) the sphere (finite depth extent) (2) the horizontal circular cylinder, and (3) the vertical sheet of infinite depth extent. The applicability of the method has been tested on theoretical models. The method is also applied on the famous Kursk anomaly of a sheet of infinite depth extent, and the result is in good agreement with other published techniques. Keywords: Walsh transforms; Wash spectra; Sequence octave number; Sphere; Horizontal cylinder; Vertical thin sheet; and Magnetic anomaly.
Construction and Interpretation of Two Regional Seismic Sections for Jurassic Sediments in Southern Iraq (Arabic paper)

By
Ahmad S. Al-Banna, H.N. Al-Sadi and S.A. Mohammad

Abstract

This study include the construction of two regional seismic sections in southern Iraq; the first is 196 km in length and started from SA-1 well in southern west of Iraq, and ended at SA-3 well, passing through SA-2 well at Basrah region. The second regional seismic section, about 167 km in length, started at SA-3 well near the southern boundaries of Iraq, south of Basrah city, and passed by SA-3, SA-4 and SA-5 wells, then ended at SA-6 well at the Amara region.

Twelve seismic reflections lines were used, in addition to some minor seismic lines to link the major lines. Many conventional processing tools were applied to construct the two regional sections.

One of the results of the present study is the explanation of the general structural features along the regional sections. The results also show the detail structural changes on the Jurassic sediments considered in the present study, which included Gotnia, Najmah, Sargelu, and Alan formations.

Gotnia Formation showed a decrease in thickness between 2390-2470 CDP, which is thought to have resulted from salt and anhydrite beds motion. Generally, it is believed that the thickness of Jurassic sediments for the studied formations is reduced in southern Rumaila and Halfaya due to vertical tectonic movements which affected the structures of the southern southeastern region of Iraq.

The boundary between the main tectonic units of Iraq (the stable and unstable shelf) has been defined on the first regional seismic section at 1500-2000 CDP.


R.J. Taj, N.A. Saad, M.A.El-Askary and M.H. Basyoni. Geochemistry and Depositional Environments of the Tertiary Clays in Makkah and Rabigh Quadrangles, West Central Arabian Shield, Saudi Arabia.


Variations of the Crustal Structure of Arabia

By
T.A. Mokhtar

Abstract

Data from the broadband seismic stations deployed in Saudi Arabia during 1996 made it possible to study the variation of surface wave dispersion of the Arabian plate as a function of azimuth. Careful selection of the paths from earthquakes associated with the boundaries of the Arabian plate was made, and the group velocities of the fundamental mode of both Love and Rayleigh waves along these paths were studied. Results show that the Arabian plate is characterized mainly by two different sets of similar group velocities curves that are related to the two major geological units, the Arabian shield and the Arabian platform. The group velocities along paths that traverse the eastern, northeastern, and northwestern regions of Arabia are found to be representative of the Arabian platform geologic province, and are slower than those the Gulf of Aqaba, the southeastern and the southwestern paths, which in turn represent the Arabian shield geologic province.

The group velocity data were inverted to obtain shear wave velocity structure model of both the shield and the platform regions. Damped least-squares inversions method that utilizes a differential rather than stochastic damping was used to obtain smooth shear wave velocity models. The resulting models are in good agreement with previous results obtained from tomographic inversion.
Intensive site location operation was conducted in the western region, to locate a site suitable for the disposal of solid wastes to serve an urban district of about 800,000 inhabitants. This study investigates the engineering geological properties of the proposed landfill site, Malkan-1. The site is formed of Precambrian basement rocks, covered by alluvial deposits and sand dunes, surrounded by a low to medium relief topography. The site is of about 1.2 km long and 800 m wide includes single outlet to the main wadi. Geological, structural features and engineering geological parameters were studied, in addition to intensive investigation of the prevailing joints system. These collected data were implemented to the rock mass classification systems, and conclude the suitability of the site to be used as a solid waste landfill.
Volcaniclastic in El Tarr Area, Southeastern Sinai, Egypt: Petrological and Geochemical Evidence

By
Ezz El Din Abdel Hakim Khalaf

Abstract
The Tarr complex forms the southernmost portion of the Kid Group in the Southeast Sinai Peninsula. This complex consists of diverse interstratified volcanic and volcaniclastic sedimentary strata and cogenetic hypabyssal intrusive rocks of Late proterozoic age. The occurrence of slightly preserved glass shards and volcanic clasts within volcaniclastic sediments indicate a narrow time span between eruption and final deposition by reseisdimentation. The volcano-sedimentary sequence of El Tarr area displays a low metamorphic grade and is nearly underformed. These volcanoclastic rocks are characterized by rapid lateral and vertical facies and petrofacies variation. Modal analysis of these rocks defines a source area comprising mainly volcanic and intrusive rocks, with no indication of continental detritus or detritus from exotic sources.

The studied sequence is divided into three stratigraphic intervals on the basis of the predominant lithosomes in each of the intervals. The lowermost stratigraphic interval contains metamorphosed felsic pyroclastic rocks with marble intercalations, continues vertically to mafic and intermediate volcanic fows, pyroclastic fall and flow deposits and local interbeds of clast-supported conglomerates, associated with cross-laminated sandstones with lensoidal layers of tuffaceous mudstones. These rocks were deposited in a low relief, proximal alluvial fan volcanic apron environment. The middle stratigraphic interval consists of thick massive to bedded coarse to medium-grained sandstones and interbeds of tuffaceous mud/siltstones, with lensoidal beds of metamorphosed mafic volcanics. Rocks in the middle interval were deposited in distal alluvial fan volcanic apron environment. The upper stratigraphic stratigraphic interval contains matrix/clast-supported conglomerates of mixed sources that were deposited in poorly confirmed, shallow proximal braided river channels on a fluvial plain.

Tectonics are perceived to be a major control on the positioning and long-term evolution of alluvial systems. By increasing slope gradients through uplift and tilting, or by chaning local base-level, incision can be stimulated leading to a switch in the active area of sedimentation. The switch from alluvial fan to braided river sedimentation and the spatially variable patterns of incision into the alluvial fan bodies can be accounted for by a phase of deformation which affected the El Tarr volcaniclastic rocks during Late proterozoic time. A lack of pedogenic modification throughout most of the channelized sediments suggests high rates of sedimentation which inhibited soil development. The whole studied sequence is similar to rock units in arc-flank volcanic complexes which are interpreted to have accumulated principally on river flood plain and alluvial fan and local Aeolian environment.
Geochemistry and Depositional Environments of the Tertiary Clays in Makkah and Rabigh Quadrangles, West Central Arabian Shield, Saudi Arabia

By
R.J. Taj, N.A. Saad, M.A. El-Askary and M.H. Basyoni

Abstract

The present work deals with a detailed chemical study on the clay mineral assemblages characterizing some clay deposits, shales and mudstones, which differ in their texture, colour lithology, and depositional environments. Samples selected from seven Tertiary formations located in Makkah and Rabigh quadrangles are chemically analyzed; some are used as environmental discriminators.

The distribution of major and some trace elements in 77 samples has been investigated and the results obtained were tabulated and graphically illustrated. A wide range of variation is shown in the results of both major and trace constituents. This is due to their variable content of clay mineral constituents and the abundance or paucity of other admixtures, e.g. quartz, feldspar and minor heavy mineral grains. The local occurrence of minor gypsum and carbonate veinlets in some formations and ferrugination in others are also effective.

A positive correlation exists in some formations between Fe₂O₃ and each of MnO, Cr, Ni, Cu & Zn; between each of Sr & Cu versus CaO; and in most cases between Ga and Al₂O₃. Whereas, SiO₂ shows a negative correlation with each of Al₂O₃ and L.O.I.

Most of trace elements entered the depositional basin in close association with clay minerals and Ca-Fe-bearing detritus.

The examined clay minerals and their trace elements are mainly source controlled (e.g. granitic and some pelitic rocks) and, an environmental illustration using Ga, B & Rb in a ternary diagram would indicate transitional to marine depositional environments for the studied clay deposits.

Key words: Tertiary clays, Makkah and Rabigh, Saudi Arabia, Geochemistry, and depositional environments.
An Application of the GIS in the Engineering Classification of Rock Masses

By
Abdullah A. Sabtan

Abstract

A comparison is made of the application of two major systems or rock mass characterization, namely Rock Mass Rating (RMR) and Rock Mass Quality (Q system). The two systems used to classify the rock masses of Jabal Setarah, a mountain in the Al-Baha area within the Arabian Shield. Geographic Information System (GIS) technique was used utilizing the RMR and Q systems to produce rock mass zoning maps. The studied mountain is composed of coarse grained quartz syenite. The RMR and Q systems were calculated and compared using field measurements. A logical agreement was found between the obtained GIS maps of the two rock mass rating systems. Some discrepancy was observed which might be related to the application of the rating systems in an arid region although these systems are designed for humid regions. The rock quality, engineering properties and the mountain size suggest that suitability of the mountain to be quarried for dimension stone. In addition, the Slope Mass Rating (SMR) system was used to calculate the slope stability of the quarry. The SMR system results were compared with the conventional method of slope stability analysis and two maps were produced using GIS. The two GIS maps SMR system and the conventional method were found to have good agreement.
Geotechnical Aspects of Loess in Kingdom of Saudi Arabia.

By
Ammar Amin and Khalid Bankher

Abstract
Loess is geologically recent deposit, which consists of unconsolidated silt of eolian origin; it is buff in colour and characterized by lack of stratification, porous and has low bulk density. This paper aimed to review the distribution and geotechnical properties of loess in Saudi Arabia as the publications about loess in Saudi Arabia are very limited. The available literature reported that the loess soils are observed in many parts of the Kingdom where various construction projects were planned. Loess materials are generally uniform in texture, consisting of 50% to 90% silt-size particles exhibiting plasticity. Porosity is relatively high; ranging from 50 to 60%. These loess deposits subside and form earth fissures by the process of hydrocompaction upon wetting in some remote areas. The process of wetting can be either natural through storms or man-made through agricultural or civil activities.

Key words: Loess soil, Kingdom of Saudi Arabia, Al-Ghatt, Mubaraz, Al-Yutamah, Hutat Bani Tamim, Geotechnical Problems, Hydrocompaction, Earth fissures, and Collapse.
An Iterative Approach to Depth Determination from Second Moving Average Residual Magnetic Anomalies.

By
E.M. Abdelrahman, T.M. El-Araby and K.S. Essa

Abstract

We have developed a numerical method to estimate the depth of a buried structure form second moving average residual anomalies obtained from magnetic data using filters of successive graticule spacings. The problem of depth determination has been transformed into the problem of finding a solution to a nonlinear equation of the form $z = f(z)$. Formulas have been derived for a dyke, horizontal cylinder, geologic contact, and a sphere. The method involves using simple models convolved with the same second moving average filters as applied to the observed magnetic data. As a result, our method can be applied not only to residuals but also to observed magnetic data. The method is applied to synthetic data with and without random errors. The validity of the method is tested in detail on a field example from Canada. In all cases examined, the depth obtained gives satisfied results with actual depth.