

**High-Level Radioactive Waste Storage Feasibility for the Kingdom of Saudi Arabia**

- Dheya Shujaa Al-Othmany, Ahmad Hussain , Essam Banoqitah

**Abstract:**

With the inception of King Abdullah City of Atomic and Renewable Energy in the Kingdom, the future of nuclear power looks promising in near future. Although nuclear power will help solve the energy-related issues of the country, however, the high-level radioactive waste has to be stored securely. In this regard, an evaluation of the available geological data has been conducted to determine where the most suitable sites could serve as permanent disposal of radioactive wastes from future nuclear power activities in the Kingdom of Saudi Arabia. Also, the volume of high-level wastes expected to be generated have been estimated, so as to access the cost (and size) of such a disposal site. Conclusions are presented, indicating that by the year 2060, the construction of such a disposal site would be economically feasible, based upon a surcharge of 1 mill/kWh for the disposal activities. The site selection is tentative and very preliminary, since actual core drillings and other geologic assessments will be required before a site can be seriously proposed.

**Potential of  $k$ -Means Clustering-Based Fuzzy Logic for Prediction of Temperature in Ambient Atmosphere**

- Robin A. Christian, Dipi A. Patel

**Abstract:**

Accurate prediction of meteorological parameters is a challenging task due to dynamic nature of atmosphere. It has drawn a lot of research potential. Among this, temperature prediction has prominent applications in many important sectors like agriculture, vegetation, water resources, tourism, energy, aviation, etc. Temperature prediction is quite complex in ambient atmosphere, and stochastic models have the limitations of not able to learn the nonlinear relationships between the considered variables. The fuzzy logic can express uncertain and inaccurate information without involvement of physical processes. An attempt is made in this paper to present a  $k$ -means clustering approach for future temperature prediction using fuzzy logic. The database of maximum temperature, corresponding M.S.L. pressure, relative humidity, wind speed and historical temperature are utilized to develop a prediction methodology in fuzzy rule base domain to estimate next day maximum temperature for Mumbai, India, in the study. Clusters of input and output parameters are made using  $k$ -means clustering, and based on this, fuzzy knowledge base is prepared for prediction of temperature. The model is able to predict the temperature with lower prediction errors.

**Investigation on Different Scanning Resolutions for Slope Mapping Studies in Cameron Highlands, Malaysia**

- Khairul Nizam Tahar

**Abstract:**

The development of laser scanning is one of the surveying methods, which able to produce a digital surface in a short period. The good results of digital surface must be followed by specific procedures, for example, interpolation algorithm and filtering methods. The improvement in information technology has influenced the growing development and application of laser scanning technique in order to fulfill the user needs. Laser scanning resolution might have an effect on the results of slope mapping studies. The objective of this paper is to evaluate the results of different laser scanner resolutions in producing a slope map. This study was conducted at Cameron Highlands, Pahang, Malaysia. Two site locations were identified for this study due to the condition of the slope characteristics that provides a more accurate assessment. Topcon GLS1500 is being used for data collection at both sites, and several control points were established using real-time kinematic global positioning system. The storage of point clouds was increased when the resolution value is decreased. The results of laser scanner were analyzed based on different laser scanner resolutions. It can be concluded that laser scanner resolutions do have an effect on slope mapping accuracies. Determination of the appropriate resolution for specific applications can be identified in this study.

**An Integrated Analysis of Petrophysics, Cross-Plots and Gassmann Fluid Substitution for Characterization of Fimkassar Area, Pakistan: A Case Study**

- Aamir Ali, Muhammad Kashif , Matloob Hussain , Jamil Siddique , Irfan Aslam , Zulfiqar Ahmed

**Abstract:**

Reservoir characterization is a process of describing various reservoir properties using all the available data to provide reliable reservoir models for accurate reservoir performance prediction. This process requires the use of proper methods for characterization to avoid many prominent errors in the prediction of reservoir performance. Fluid substitution is an important process which provides a tool for fluid identification and quantification in a reservoir. In the present study, petrophysical, cross-plot and Gassmann fluid substitution analysis is applied for the characterization of reservoir of Fimkassar area, Pakistan. The data used for this purpose consist of suite of wireline logs from two wells and laboratory data showing typical rock properties for water-saturated limestone. Our results show that cross-plot analysis performed in this study can provide a qualitative method for the identification of type (water or hydrocarbons) of fluid present within the reservoir. The results of Gassmann fluid substitution at Sakesar limestone level indicate variation in acoustic properties (velocity and density) at different water saturation levels which can be modeled in terms of synthetic seismograms and may help in determining future optimum well locations.

**The Concept of Operational Near Real-Time GNSS Meteorology System for Atmospheric Water Vapour Monitoring over Peninsular Malaysia**

- Muhammad Faiz Bin Norazmi , Yusuf D. Opaluwa , Tajul Ariffin Musa , Rusli Othman

**Abstract:**

The operational system from near real-time global navigation satellite system (NRT GNSS) meteorology is crucial for supplying information about climate and meteorological activities over Malaysia. As demonstrated by many researchers all over the world, the applicability of NRT GNSS meteorology has proved as a valuable tool for capturing high spatio-temporal resolution of atmospheric water vapour. This study discusses a design of NRT GNSS meteorology system for future development in Malaysia. There are three major components of this system which cover the architecture of GNSS meteorological station, the engine processor and data flow management. This paper provides the functional illustration for each component and discusses several challenges in the development of NRT GNSS meteorology system.

**Evaluation of Dual Tipping-Bucket Rain Gauges Measurement in Arid Region Western Saudi Arabia**

- A. S. Al-Wagdany

**Abstract:**

In this study, a dual tipping-bucket (TB) rain gauge station is installed in an arid region in western Saudi Arabia. The size of the gauge collector was the only difference between the two installed rain gauges. Records of both gauges for the period 2006–2013 are collected, analyzed and compared, focusing on characteristics of rainfall events as well as rainfall temporal variability. The two gages recorded almost the same total rainfall depth but significantly different mean storm depth values. For the large storms, both gauges recorded the same mean storm depth. However, significantly variable values throughout the storm duration are observed. The TB gauge with the larger funnel size (TEMM) has the advantage of recoding more storms with depth less than 1 mm though it underestimates the depth for storms of high intensities. This study also shows the importance of using dual rain gauges in arid regions where large storms are rare and hence can be missed if only one gauge is used due to gauge failure, which is not a surprise in such harsh environment.

**Deciphering Groundwater Potential Zones Using Geospatial Technology: A Study in Bankura Block I and Block II, Bankura District, West Bengal**

- S. K. Nag, S. Ray

**Abstract:**

Integration of remote sensing data and geographical information system (GIS) for exploration of groundwater resources has become a breakthrough in the field of groundwater research, which assists in assessing, monitoring and conserving groundwater resources. In the present paper, groundwater potential zones for the assessment of groundwater availability in Bankura Block I and Block II, Bankura District, West Bengal, has been delineated using remote sensing and GIS techniques. Survey of India toposheets and IRS-1C—LISS III satellite imagery are used to prepare various thematic layers, e.g., hydrogeomorphology, lithology, slope and lineament density were transformed to raster data using feature to raster converter tool of software like MicroImages TNT mips 2012. The raster maps of these factors are allocated to a fixed score and weight computed from multi-influencing factor technique. Each weighted layer is statistically computed to get the groundwater potential zones. Weighted overlay modelling technique was used to develop a groundwater potential model with three weighted and scored parameters. Although the area is characterized by hard rock, it has groundwater prospective zones due to fracturing, weathering and the presence of valley fills overlying a planation surface. The area has been categorized into four distinct zones—very good, good, fair and poor. Very good groundwater potential zones constitute 19.81% of the total block area, good groundwater potential zones occupy majority of the block, covering approximately 30.83%, and the fair potential zones occupy about 33.08% of the total block, poor potential zones occupy very small portion 16.28%.

**Predicting Potential Mineralization Using Surface Geochemical Data and Multiple Linear Regression Model in the Kuh Panj Porphyry Cu Mineralization (Iran)**

- Seyed Hasan Tabatabaei, Parisa Roshani Rodsari , Ahmad Reza Mokhtari

**Abstract:**

Geochemical exploration is mainly utilized for prospecting of economically viable mineralization. Several methods have been introduced for identifying the potential mineralization based on surface geochemical data; however, based on these methods, the definite presence of mineralization in the region cannot be ascertained. Therefore, in this study, a combination of the core drilling analysis with the surface geochemical data was used in order to determine the actual position of the porphyry Cu mineralization. To achieve this objective, multivariate statistical method of multiple linear regression was applied. So, the regression equation is calculated based on the mean of Cu in sample of core drillings and elemental concentrations at surface geochemical rock samples. Predicting regression model has shown coefficient of determination ( $R^2 = 83\%$ ). The model validity has also been checked through bootstrapping technique, which has demonstrated that the model is valid, with a 95 % confidence level as well. The result of multiple stepwise linear regression model showed that this method could draw the line of the best fit on the rock sample data in order to obtain the positions of mineralization underneath. The result obtained by this method was used to compare the distribution of Cu and Mo at surface samples with the boundary of economic zone in the core drillings, and the results are consistent and elongated northwest-southeast in diorite and quartz-diorite rock units.

**A Study of the Time Lags of the Indian Ocean Dipole and Rainfall Over Thailand by Using the Cross Wavelet Analysis**

- Kosum Chansaengkrachang , Anirut Luadsong , Nitima Ascharyaphotha Thonburi

**Abstract:**

The aim of this research was to study the time lags of the Indian Ocean Dipole (IOD) and monthly mean rainfall over Thailand by using the Cross Wavelet Analysis. Historical data of monthly mean rainfall during the period 1979–2008 in a total of 80 locations spread throughout Thailand are used in this study. This data was obtained from the archives of the Meteorological Department. The regions of Thailand have been divided into five parts: the Northern, Northeastern, Central, Eastern, and Southern regions of Thailand. The seasons for monthly mean rainfall can be divided into two seasons, dry and wet. This study used the Dipole Mode Index (DMI) covering a 30-year period from January 1979 to December 2008. The DMI is an indicator of the east–west temperature gradient across the tropical Indian Ocean, linked to the IOD or Zonal Mode. The analysis of the cross wavelet transform of the DMI and monthly mean rainfall over Thailand represents significant peaks in the years of strong IOD at a scale around 11 months. This implies that the IOD leads rainfall around two months. Although there may be other factors that affect rainfall over Thailand, it can be concluded that rainfall over Thailand is influenced by the IOD.

**Use of Geographic Information System and Water Quality Index to Assess Groundwater Quality in Rawalpindi and Islamabad**

- Rabia Shabbir , Sheikh Saeed Ahmad

**Abstract:**

Water quality assessment has always been a dominant part of environmental quality management. The present study involved the suitability assessment and mapping of groundwater quality for agricultural activities and drinking purposes in Rawalpindi and Islamabad area. A total of 22 samples were collected from borewells and open wells, and these water samples were further analysed for physical and chemical characteristics on the basis of which different indices were developed. Water quality index was calculated for overall water quality quantification from the perspective of human consumption. The results showed that a greater proportion exhibited poor quality for drinking due to over-exploitation of groundwater resource, agricultural impact and direct release of contaminants. Further, evaluation of groundwater for its suitability for irrigation showed that majority of the groundwater was suitable for irrigation purposes.

**A GIS-Based Inventory of Ornamental Stone and Aggregate Operations in the Beni-Mellal Region (Morocco)**

- Ahmed Barakat , Mohamed El Baghdadi , Jamila Rais

**Abstract:**

Straddling between two contrasting structural features, the High-Atlas in east and the Tadla plain in west, the Beni-Mellal region has a diversified and enormous potential in terms of natural resources, especially building materials and ornamental rocks. The material quarries became widespread and represent one of the significant economic activities in the region. The aim of this study was to develop a GIS-database that includes several themes (layers) in order to properly locate all exploited quarries in the Beni-Mellal region and to analyze its relationship with geology, hydrographic and road networks, and market area. The material extraction takes place by the open-pits in rivers and by the quarries in the Atlas piedmont. The majority of aggregate such as sand and gravel is produced from alluvial deposits, flood plains, and stream terraces located along the Oum Er-Rbia and Oued Derna Rivers and its tributaries. The quarries located in the Atlas piedmont produce crushed rock aggregates from limestone and brecciated dolomite rocks of Lias age. More easily accessible, they could provide long-term quarry material production (in tonnage and quality), meeting the needs of the inhabitants of the region. Also, the Beni-Mellal Atlas region offers huge reserves ornamental rocks, namely travertine and limestone onyx deposited in the dolomite and coral-reef limestone of Lias.

**Accuracy Assessment Study for Kinematic GPS–PPP Using Single- and Dual-Frequency Observations with Various Software Packages**

- Ashraf Farah

**Abstract:**

Precise point positioning (PPP) has been used for the last decade as a cost-effective alternative for the ordinary differential GPS with an estimated precision sufficient for many applications. PPP requires collecting observations at the unknown station and correcting them for different types of errors using proper models and products. PPP precision varies based on observation type (single or dual frequency) and the duration of observations among other factors. This research presents an evaluation study for the variability of kinematic GPS–PPP precision based on different observation types (single and dual frequency) with two different software packages.

**Performance Prediction of Diamond Sawblades Using Artificial Neural Network and Regression Analysis**

- Gokhan Aydin , Izzet Karakurt , Coskun Hamzacebi

**Abstract:**

This paper is concerned with the application of artificial neural networks (ANNs) and regression analysis for the performance prediction of diamond sawblades in rock sawing. A particular hard rock (granitic) is sawn by diamond sawblades, and specific energy (SE) is considered as a performance criterion. Operating variables namely peripheral speed ( $V_p$ ), traverse speed ( $V_c$ ) and cutting depth ( $d$ ) are varied at four levels for obtaining different results for the SE. Using the experimental results, the SE is modeled using ANN and regression analysis based on the operating variables. The developed models are then tested and compared using a test data set which is not utilized during construction of models. The regression model is also validated using various statistical approaches. The results reveal that both modeling approaches are capable of giving adequate prediction for the SE with an acceptable accuracy level. Additionally, the compared results show that the corresponding ANN model is more reliable than the regression model for the prediction of the SE.

**Factors Governing Groundwater Chemistry in Paleozoic Sedimentary Aquifers in an Arid Environment: A Case Study from Hail Province in Saudi Arabia**

- Faisal K. Zaidi, Osama M. K. Kassem , Abdulaziz M. Al-Bassam , Saad Al-Humidan

**Abstract:**

The present study focuses on evaluating the groundwater quality in parts of the Hail Province of Saudi Arabia. Hail province is the home to the Hail Agricultural Development Company and is dependent entirely on the groundwater resources available from the Saq aquifer for agricultural productivity. Twenty-four groundwater samples from agricultural farms were analyzed for their major ion concentrations. The TDS content of the collected samples ranged from 245.9 to 869.20 mg/l, whereas the EC values were below the maximum permissible limit of 1,400 $\mu$ S/cm prescribed by WHO for drinking water. The cation and anion concentrations were in the following order:  $\text{Na}^+ > \text{Ca}^{2+} > \text{Mg}^{2+} > \text{K}^+$  and  $\text{HCO}_3^- > \text{Cl}^- > \text{SO}_4^{2-} > \text{NO}_3^-$ . The major groundwater facies identified included the Ca(Mg)-Na(K)-Cl-SO<sub>4</sub>-HCO<sub>3</sub> type, Ca(Mg)-Na(K)-HCO<sub>3</sub>-Cl-SO<sub>4</sub> type and the Na(K)-Ca(Mg)-Cl-SO<sub>4</sub>-HCO<sub>3</sub> type. The samples fall in the rock-water interaction zone on the Gibb's plot. Carbonate weathering, silicate weathering and reverse ion exchange are the major chemical processes which govern the chemistry of the groundwater in the area. The sodium adsorption ratio values for all the samples are below 10 and are excellent for irrigation. In terms of residual sodium carbonate, the values are <1.25 and are considered good for irrigation.

**A Case Study of Seismic Hazard Analysis at Al-Tajiat and Al-Zawraa Stadiums in Baghdad/Iraq Region**

- Nazi Norouzi , Masoud Mojarab , Zeinab Asadi , Mehdi Zare

**Abstract:**

The purpose of this study was to conduct seismic hazard analysis for Al-Tajiat and Al-Zawraa stadiums using probabilistic and deterministic approaches. The stadiums of Al-Tajiat and Al-Zawraa are located at latitude of  $33^{\circ} 25'25.80''N$ , longitude of  $44^{\circ} 17'9.28''E$  and latitude of  $33^{\circ} 20'39''N$ , longitude of  $44^{\circ} 22'5.81''E$ , respectively. To assess the seismic hazard, the region was divided into five seismic sources, and the seismic parameters were calculated for each selected seismic source. According to the results obtained from probabilistic seismic hazard analysis, the maximum horizontal accelerations on bedrock for return periods of 75, 475, and 2,475 years are equal to 0.06, 0.12, and 0.21 g, respectively. The result of deterministic seismic hazard assessment proves that the maximum horizontal and vertical acceleration on bedrock are 0.31 and 0.16 g, respectively. In order to analyze the response of structures against calculated acceleration, studies related to response spectrum and design spectrum have been carried out based on statistical analysis of appropriate time histories. The computer program Equivalent linear Earthquake Response Analysis was used to process the selected records and to consider the effect of soil conditions. Design spectrum has also been presented based on the response spectrum of the selected time histories and then was compared with the corresponding ones in UBC 1997 and ISIRI 2800 codes. The comparison shows that the presented design spectrum is more conservative than the results provided by the above codes.

**Geomorphologic Characteristics of Indiana Basins**

- A. S. Al-Wagdany

**Abstract:**

In this study, ten Indiana basins were selected to investigate their geomorphologic characteristics. The drainage area of these basins covers a wide range. Stream networks of these basins are classified according to both Strahler's and Shreve's ordering systems. Based on these ordering systems, more than twenty primary and secondary geomorphologic parameters were determined for each study basin. Horton's laws of stream numbers, stream length and stream area were checked and found valid for these Indiana basins. Values of cumulative drainage area were used to investigate the exceedance probability distribution of mean annual discharge and energy fluxes in the study watersheds. The results of the study show that discharge and energy fluxes were found to follow power law distributions. Exponent of the resulting power laws does not show the universality suggested by previous investigations.

**Neoproterozoic Tectonic Evolution of Gabal Abu Houdied Area, South Eastern Desert, Egypt: As a Part of Arabian–Nubian Shield Tectonics**

- W. S. Ibrahim , K. Watanabe , M. E. Ibrahim , K. Yonezu

**Abstract:**

The Neoproterozoic-related structures have provided important insights into the tectonic history of the Egyptian Eastern Desert as well as the Arabian–Nubian Shield (ANS). The Gabal Abu Houdeid (GAH) area is in the extreme northern portion of the Hamisana shear zone (HSZ), one of the major high-strain zones in the ANS. The Neoproterozoic rocks exposed around GAH include ophiolitic ultramafic–mafic rocks, island-arc metasediments, metavolcanic rocks, intrusive syn-tectonic granodiorites, post-tectonic gabbros, and granites. The analysis of large-scale structures and fault kinematic data in terms of ductile and brittle deformation indicates that the sequence of folding and faulting events was constrained by available litho-tectonic units. Four deformational events are distinguished in the Neoproterozoic rocks. Event D1 a pure compression stress regime with  $\sigma_1$  stress axis trending NNW–SSE to N–S represents an early shortening event associated with the Pan-African thrusting, during which intra-oceanic arcs and plateaus were accreted. Event D2 characterized by structures developed under ENE–WSW compressional regime (shortening event) and considered as the early stage of the second episode of collision within the Pan-African orogeny. Event D3 transpressional deformation associated with E–W contraction and N–S extension. It is the main event that controlled the deformation along the HSZ during the late stages of the collision between the East and West Gondwana in terms of escape tectonics. The D4 event is interpreted as a post-orogenic extensional event manifested by E–W dextral strike-slip and dip-slip normal faults striking NNW–SSE to N–S and E–W, which began to occur after the emplacement of post-tectonic granites.

**Geo-Engineering Properties and Swelling Potential of Quaternary Lacustrine Clays in North of Burdur, Turkey**

- Mahmut Mutlutürk , Emre Balcıoğlu

**Abstract:**

In areas surrounding the city of Burdur, Turkey, where water contents are high, no swelling–shrinkage-dependent deformations are visible because the active zone depth is adjacent to the surface. There are some deformations in areas with low water levels, especially those with low-rise construction. Thus, in some areas around Lake Burdur, increased swelling–shrinkage-dependent deformation is inevitable owing to a steadily decreasing water level of the lake. However, development around Lake Burdur, such as an organized industrial area, a civilian airport, and a military airport currently under construction, exacerbates the problem. Therefore, we examined swelling potentials of lacustrine clay in the active zone within a selected area around lake. Lacustrine soils in the selected area were studied using a hand auger, with a total of 379 samples at 50 points, through depths of 1–3 m. Clayey levels in the research area were separated into three different clay–clayey levels and were analyzed by X-ray diffraction and scanning electron microscope. Results showed that clay minerals at all levels averaged 39–52 % and that most were smectite group clays. Microstructures were plate-like and were aligned face to face. It was also determined that swelling potentials of all examined clayey levels were high to low, with change between 0.22 and 2.59 % and swelling pressures between 2.9 and 71 kPa. Because the water level was close to the surface, so was the active zone; therefore, deformation was noticeable. Swelling–shrinkage-dependent deformations are inevitable in the future with decreasing lake water level.

**Prediction of Source Rock Characteristics of Hydrocarbon Gases in the Camurlu Field (South Eastern Turkey) by Isotopic Modeling**

- H. Hoşgörmez, C. Soylu , İ. Bahtiyar

**Abstract:**

From six different production wells in the Camurlu Field, which is one of the important production regions in South Eastern Turkey, gas samples were investigated for their molecular and isotopic composition in order to determine origin of gases and probable source rocks. TOC measurements, kerogen isotope analysis and Rock-Eval pyrolysis analyses were also performed using cutting samples taken from three different wells in order to determine the characteristics of probable source rocks and to utilize this data for isotopic modeling. It was specified that kerogen isotope values of these samples varied between  $\delta^{13}\text{C}$   $-28.0$  and  $-22.9$  ‰. Stable carbon isotope ratios of Camurlu gases were determined as  $\delta^{13}\text{C}_1$ :  $-38.2$  to  $-33.6$  ‰,  $\delta^{13}\text{C}_2$ :  $-32.9$  to  $-29.1$  ‰,  $\delta^{13}\text{C}_3$ :  $-31.1$  to  $-29.1$  ‰, respectively. In the classifications conducted according to methane, ethane and propane  $\delta^{13}\text{C}$  and methane  $\delta\text{D}$  isotope values, it was observed that Camurlu gases are thermogenic gases. Isotope modeling was applied in order to determine the characteristics of the probable source rock that generated the thermogenic Camurlu gases. In the isotope modeling according to methane–ethane, ethane–propane isotopes, it was determined that hydrocarbon gases were generated from a single source rock and its maturity varies between 0.8 and 1.0 (%Ro). Organic matter type of the source rock was specified as a mixture of Type II and Type III kerogen. As a result of the assessments made, it was found that the source rock of Camurlu gases can be the Paleozoic source rocks.

**Correlation of Schmidt Rebound Hardness with Uniaxial Compressive Strength and P-Wave Velocity of Rock Materials**

- Kadir Karaman , Ayhan Kesimal

**Abstract:**

The Schmidt hammer is widely used for various applications since 1950s due to its simplicity and portability. The purpose of this study was to compare two Schmidt hammer test methods: earlier ( $R_{ISRM-EV}$ ) and revised version ( $R_{ISRM-RV}$ ) of ISRM in terms of estimation capabilities of uniaxial compressive strength (UCS) and ultrasonic P-wave velocity (UPV). Multiple regression analysis was also performed between Schmidt hardness ( $R$ ) and the ratio of UPV/UCS. A total of 46 rocks [28 volcanic, 8 metamorphic (metabasalt) and 10 sedimentary (carbonate rocks)] were sampled and tested. The validity of obtained coefficients of correlation was confirmed using the correlation analyses. In the present study, the result of the correlation analysis indicated strong relationships between  $R$  with UCS, UPV and UPV/UCS ratio. Relationships between  $R_{ISRM-RV}$  and UCS,  $R_{ISRM-EV}$  and UPV/UCS ratio,  $R_{ISRM-RV}$  and UPV/UCS ratio are not significant at a 95 % confidence limit for metamorphic rocks due to the presence of micro-cracks that cause fluctuations in the test results. Other relations are statistically significant according to the correlation analyses with 95 % confidence limit. This study also revealed that UPV/UCS ratios decrease exponentially with increasing  $R$  values. It was shown that the ratio of UPV/UCS would be dependent on  $R$  for rocks.

**Application of an In Situ Electrical Resistivity Device to Monitor Water and Salt Transport in Shandong Coastal Saline Soil**

- Teng-fei Fu , Hong-jun Yu , Yong-gang Jia , Xing-yong Xu , Lei Guo

**Abstract:**

In situ monitoring of water and salt transport in saline soil is a valuable tool for the rational exploitation and conservation of water and soil resources in coastal areas. In this paper, an automatic monitoring device was used to monitor the vertical variation of soil resistivity during leaching in laboratory and field experiments. The experimental results showed that the resistivity peak moved downwards and eventually disappeared during leaching. An equation describing the change in leaching speed over time was obtained. It was found that the desalination occurred from top to bottom and that the desalination depth was constant when the same volume of leaching fluid was applied. Resistivity indication and salinity content showed a significant exponential correlation ( $R^2 > 0.9$ ). The field experiment demonstrated the stability of data transmission, and variations in apparent resistivity in one day and over a longer period were observed. Rainfall resulted in the downward migration of salt from surface soil, whereas evaporation led to migration of salt upward. The temporal and spatial resolution of this monitoring device can be adjusted to achieve dynamic monitoring, providing an easy means to manage soil and water conservation.

**Examining Spatio-Temporal Change Detection in the Indus River Delta with the Help of Satellite Data**

- Gohar A. Mahar, Nayyer A. Zaigham

**Abstract:**

The morphology of a river thalweg in a deltaic environment is continuously reshaped by the interactive balancing of the fluvial and marine hydrodynamic processes. Fluvial flow parameters such as volume and flow velocity are favorable to increase the width of thalweg and develop a braided pattern in river course within a delta region. The present study utilized historical satellite images to show that as result of the development of the world largest water divergent networks, the Indus River discharge and sediments load discharge into the Indus delta have been enormously depleted in the last 150 years. Satellite images revealed significant and successive narrowing of the thalweg and distinct widening of the course of the Indus River near the delta. Based on the model results, we show that the style of the rapid morphological changes demonstrates seaward widening and the landward narrowing of the Indus river course and its thalweg. Our results indicate that anthropogenic diversions of the flow in the upstream region of the Indus River have resulted in the devastating domination of marine hydrodynamic processes over the weakened and destabilized natural fluvial processes in the delta region.

### **An Integrated Seismic Interpretation and Rock Physics Attribute Analysis for Pore Fluid Discrimination**

- Perveiz Khalil, Nisar Ahmed, Azhar Mahmood, Muhammad Ammar Saleem, Hassan

#### **Abstract**

Accurate prediction of subsurface structures, lithologies and pore fluids, is of great interest for petroleum prospecting and reservoir characterization. Seismic reflection data are widely used to mark subsurface structures and lithologies. However, only seismic data are not sufficient to mark fluid heterogeneities present into the pores. Therefore, the use of integrated approach is vital to map subsurface heterogeneities with more accuracy. Based on seismic interpretation, the limestone of Chorgali Formation present in Ratana area of Northern Potwar, Pakistan is interpreted as reservoir rock. Structural interpretation revealed that the study area lies in compressional regime and structures formed are thrust and popups. The reservoir properties such as lithology, porosity, permeability, depositional environments, shale volume, fluid saturation, net pay thickness are determined from petrophysical analysis which confirms that reservoir characteristics of Chorgali limestone are enough to permit hydrocarbon production. Fluid substitution modeling is used to estimate different rock physics attributes such as compressibility, Lamé's parameters and their product with density, P to S-wave velocity ratio, impedances and Poisson's ratio are computed as a function of pore fluid type (oil, gas, brine etc.). Sensitivity analysis is performed to derive fluid indicator coefficient which indicates the most appropriate and sensitive rock physics attribute that can be crossplotted to discriminate the rock saturated with different pore fluids (gas/brine/oil).

**Man-Made Change Detection Using High-Resolution Cosmo-SkyMed SAR Interferometry**

- Azzedine Bouaraba, Aichouche Belhadj-Aissa, Damien Closson

**Abstract**

The technique of coherent change detection (CCD) in repeat-pass synthetic aperture radar (SAR) imagery has the potential to detect very subtle scene changes. With the advent of high-resolution space-borne SAR images, CCD has received a lot of interest. In CCD, the interferometric coherence is evaluated and analyzed to detect changes. The sample coherence estimator is biased, especially for low-coherence values, which complicates CCD map analysis and interpretation. The bias decreases when the number of samples used to evaluate the coherence increases. However, a large number of samples causes the loss of the small size changes. In this work, an adaptive method for coherence estimation is described and evaluated. The local fringe frequency is used as an additional change indicator to adapt the number of samples used to estimate the coherence. The results obtained using Cosmo-SkyMed (CSK) SAR images indicate that the proposed adaptive method improves detection performance while preserving the small size changes.

**Spatial–Temporal Evolution of Soil Erosion in a Typical Mountainous Karst Basin in SW China, Based on GIS and RUSLE**

- Yue Li, Xiaoyong Bai, Yunchao Zhou, Luoyi Qin, Xiao Tian, Yichao Tian, Panlong Li

**Abstract**

In this study, we address the characteristics of the spatial and temporal evolution of soil erosion in karstic mountainous area of Houzhai River Basin of southwest China. The study uses GIS, erodibility test results, actual surveys of soil types, a revised universal soil loss equation for estimating soil erosion in 1973, 1990, 2002, and 2013, and an analysis of the spatial and temporal distribution of the evolution law of soil erosion for almost 40 years. Results show the following: (1) The soil erosion modulus of the Houzhai River Basin exhibits a decrease from  $222.72 \text{ t km}^{-2} \text{ year}^{-1}$  in 1973 to  $103.82 \text{ t km}^{-2} \text{ year}^{-1}$  in 2013. (2) The intensity level of soil erosion changes across space. The most active area is mainly concentrated in the upstream peak cluster depression. Areas with a slope of  $8^{\circ}$ – $25^{\circ}$  account for 40.81 % of the total erosion contribution rate, indicating that these are the main areas where erosion occurs. (3) The global and universal classification standard of soil erosion shows that the Houzhai River Basin areas above 65 % do not undergo micro-erosion. The rocky desertification is a serious problem, which explains why grading standard soil erosion intensity is inapplicable to karst areas. (4) The average soil erosion modulus in the basin is generally low (i.e., below  $1000 \text{ t km}^{-2} \text{ year}^{-1}$ ), which indicates strong karstification in the karst areas. This process can occur through subsurface pores, fissures, holes, and underground leakage phenomena, which underestimate the amount of soil erosion in the karst areas. A comprehensive analysis of a long time series reveals that soil erosion in the karst areas is a complex process which requires further detailed studies.

**Petrophysical Evaluation of the Tensleep Sandstone Formation Using Well Logs and Limited Core Data at Teapot Dome, Powder River Basin, Wyoming, USA**

- Muhammad Kamran Jafri, Aref Lashin, Elkhedr Ibrahim, Muhammad Naeem

**Abstract**

This study presents a petrophysical analysis carried out to evaluate the rock properties of the Tensleep Sandstone Formation (TSF) at Teapot Dome, Powder River Basin, Wyoming. The TSF is dominated by porous and permeable eolian cross-bedded sandstones of dune and interdune origin, but also contains marine carbonate/dolomite beds. A-sandstone, B-dolomite, and B-sandstone units of TSF were identified by the stratigraphic well log correlations and further evaluated for hydrocarbon potentiality. Shale volume, lithofacies, porosity, and fluid saturation were identified from the well logs. Permeability was empirically driven from available core data from one well. The computed effective porosity range in TSF subunits is 4–8, 5–14, and 5–20% for A-sandstone, B-dolomite, and B-sandstone, respectively. Permeability was deduced to be 0.001–3.9, 0.01–14, and 0.1–234 mD, respectively. B-sandstone was identified as the most hydrocarbon-bearing potential zone in the TSF with its hydrocarbon saturation ranging up to 72%.

**Performance Analysis of Two Different Conical Picks Used in Linear Cutting Operation of Coal**

- Saurabh Dewangan, Somnath Chattopadhyaya

**Abstract**

This paper examines linear cutting operation of coal samples by using two kinds of conical picks, each made of different materials. The first one is the conventional pick. It has an abrasive-resistant WC–Co conical tip. The second tool has newly been developed by using cast iron mixed with 21 % (by weight) mild steel. The tip of the newly developed pick has been coated with an alloy LH710 (hardness 40 RC). Coal sample was cut linearly by using the picks at different tilt angles. The most optimum tilt angle was selected on the basis of two criteria: (1) the amount of coal removed and (2) the temperature generated during coal cutting. A comparative analysis of both the picks has been carried out on the basis of these findings. A combined multiple attribute decision-making method has also been used to select the best tilt angle and to simultaneously corroborate the results obtained by the experiments. After linear cutting of coals, a brief wear analysis of both the tools has been performed to compare their deteriorated condition.

**Onshore Sandstone Facies Characteristics and Reservoir Quality of Nyalau Formation, Sarawak, East Malaysia: An Analogue to Subsurface Reservoir Quality Evaluation**

- Numair A. Siddiqui, Abdul Hadi A. Rahman, Chow W. Sum, Manoj J. Mathew.  
David Meni

**Abstract**

Shallow marine sandstones are substantial hydrocarbon reservoirs located around the globe and in Southeast Asia. Understanding the internal characteristics, distribution, geometry and lateral extent of these sandstones are essential parts of successful exploration and production strategy. This study presents the first detailed work on reservoir sandstone facies including textural characteristics of shallow marine sandstones (well-exposed outcrops) of the Nyalau Formation (Oligocene–Middle Miocene), Bintulu area, Sarawak, East Malaysia. This formation is the onshore equivalent of the offshore cycles II and III. We examined five different major types of sandstone facies on the basis of sedimentological characteristics, grain size distribution, porosity ( $\phi$ ) and permeability ( $k$ ). The analyzed sandstone facies are: (1) hummocky cross-stratified sandstones ( $\phi = 32.07\%$ ,  $k = 20.78$  md; thickness from 1 to 2 m); (2) herringbone cross-bedded sandstones ( $\phi = 31.31\%$ ,  $k = 7.7$  m; thickness from 1 to 10 m); (3) trough cross-bedded sandstones ( $\phi = 35.80\%$ ,  $k = 5.97$  md; thickness from 0.5 to 1 m); (4) wavy- to flaser-bedded sandstones ( $\phi = 19.84\%$ ,  $k = 2.31$  md; thickness from 0.5 to 3.5 m); and (5) bioturbated sandstones ( $\phi = 8.21\%$ ,  $k = 3.46$  md; thickness from 1 to 2 m). By integrating these parameters, we observed that the best reservoir quality sandstones are hummocky cross-stratified sandstone and herringbone cross-bedded sandstone, because they have better porosity–permeability than that of other sandstone facies, despite having similar grain distribution with probability curves having steep trends and almost same grain size, roundness and sorting. Upon comparing the different facies, inferences can be made that porosity–permeability is distributed randomly. We conclude that there exist heterogeneities within different sandstone facies which may apply to the reservoir properties in the subsurface.

**Geological and Petrophysical Characterization of the Lower Senonian Matulla Formation in Southern and Central Gulf of Suez, Egypt**

- Mohamed S. El Sharawy, Bassem S. Nabawy

**Abstract**

The Lower Senonian Matulla Formation is well developed in the southern and central Gulf of Suez. It can be subdivided into three depositional units (M1–M3). An obvious unconformity separated the middle unit (M2) from the upper unit (M3). The three units are corresponding to a second-order depositional sequence. This sequence consists of two systems tracts; the lower lowstand systems tract consists of slope fan, followed by a prograding complex. An erosion surface separated the lower from the upper transgressive systems tract. The Matulla Formation is mostly composed of sandstones and pelagic sediment intercalations. Such intercalations show obvious facies change throughout the study area, causing further subdivision of the Matulla Formation into seven rock types (RT1–RT7). The petrophysical reservoir evaluation has been achieved via determination of the effective porosity, permeability, shale content, water saturation and net-pay thickness from the environmentally corrected well log data. It indicates that the Matulla Formation can be considered as a good reservoir quality especially in its lower unit and sometimes in its middle unit as well. The available core data indicate a lithological heterogeneity of the studied Matulla Formation. Lithologically, it can be subdivided into four petrophysical and lithological facies; namely, they are sandstones, ferruginous sandstones, argillaceous sandstones and limestones. The best petrophysical properties were assigned for the ferruginous sandstones with good to excellent porosity, very good to excellent permeability, and poor to fair flow zone indicator.

**Hydrogeophysical Characterization of Shallow Unconsolidated Alluvial Aquifer in Yenagoa and Environs, Southern Nigeria**

- K. S. Okiongbo, E. Akpofure

**Abstract**

Groundwater of the Quaternary shallow alluvial aquifer is the only safe and reliable water resource in Yenagoa and environs, Southern Nigeria. The determination of the aquifer hydrogeophysical parameters is thus critical and constitutes the basic foundation for optimizing the short- and long-term groundwater utilization strategies. In this study, 29 Schlumberger vertical electrical soundings, borehole data, pump test, hydrochemical analysis, and measured and/or calculated hydrogeophysical parameters were integrated to reconnaissance the local aquifer conditions. Aquifer qualitative and quantitative properties in terms of electric and hydraulic conditions were also investigated. The freshwater aquifer was delineated with true resistivity and thickness ranges of 134–664  $\Omega\text{m}$  and 6.7–41.4 m respectively. Transmissivity and hydraulic conductivity values vary between 189–2609  $\text{m}^2/\text{day}$  and 28–118  $\text{m}/\text{day}$ , respectively. Porosity ranges between 0.40 and 0.45 and tortuosity ranges between 1.28 and 1.31. Correlation of the results of the geochemical analysis of the groundwater samples with the layer resistivities shows that in the locations where the aquifer is overlain by clay layer ( $\rho \sim 10 \Omega\text{m}$ ) have higher concentrations of dissolved iron ( $\text{Fe} > 0.1 \text{ mg/L}$ ), whereas the iron concentrations are remarkably low ( $\text{Fe} < 0.1 \text{ mg/l}$ ) in areas the aquifer is underneath relatively thin silty sand layer ( $\rho \sim 349 \Omega\text{m}$ ). The near-surface lithology acts as a controlling factor for spatial distribution of groundwater iron within the very shallow depths (<20 m). The geochemistry of the groundwater was observed to be controlled mainly by weathering of silicate group of minerals.

**Late Cretaceous Calcareous Nannofossil Biostratigraphy and Paleoecology in the Northwestern Desert, Egypt**

- Medhat M. M. Mandur

**Abstract**

The Upper Cretaceous succession of the northwestern desert in Egypt comprises two distinctive formations distributed throughout the studied subsurface succession. These formations are the Abu Roash and the Khoman from base to top, respectively. The examination of the studied samples resulted in the identification of thirty-six calcareous nannoplankton species belonging to twenty-three genera. Based on calcareous nannoplankton assemblages, the studied El-Noor-1 borehole succession was subdivided into seven calcareous nannoplankton biozones. These biozones were correlated with those recorded in Egypt and in other parts of the world. The analyses of calcareous nannofossils revealed the presence of hiatuses between the Late Santonian and Late Campanian. Abundance, diversity, preservation, fertility indices and temperature indices of the Late Cretaceous calcareous nannofossils were analyzed to determine the paleoecology of the studied succession. According to the calcareous nannoplankton content, the studied successions are subdivided into five ecozones. The environment of each ecozone is interpreted. The environmental indicators point to warmer climate oligotrophic environments for the *Lucianorhabdus cayeuxii*, *Reinhardtites levis*, *Arkhangelskiella cymbiformis* and *Micula murus* zones and cooler climate eutrophic environments for the *Quadrum trifidum*, *Tranolithus orionatus* and *Lithraphidites quadratus* zones.

### **Micro-topographic and Geotechnical Investigations of sandstone Wall on Weathering Progress, Aachen City, Germany, case study**

- G. M. E. Kamh, Serdar Koltuk

#### **Abstract**

Rock's surface micro-topography and geotechnical properties' limits are almost altered, on weathering progress, to a new form(s) and limits, respectively. The quantification of weathering damage for a given rock is of value, e.g., to compute weathering rate, weathering intensity, and rock's durability to weathering processes and to take a decision regarding restoration urgency. The current study aims to examine the variation/constancy of micro-topography and geotechnical properties' limits of the sandstone constituting well-aged wall, at Aachen City, on weathering progress over short duration (7 years of investigation from 2007 to 2014). The micro-erosion meter and Equotip hardness tester are tools used for micro-topographic and rock's surface hardness investigations on one hand, and the mercury intrusion porosimetry has been used for pore size distribution and salt susceptibility investigations on the other hand. These tools are accurate, numerical, comprehensive, easily applicable, and preferable particularly for ancient buildings where sampling is not recommended or prohibited. The wall side under consideration has been selected as its constructional blocks present a wide spectrum of weathering forms as well as rock's surface micro-topography (over 7 years of investigation) through increasing the weathering forms' dimensions and/or creation of new weathering forms. The net result of the current study indicated a noticeable variation in stone's micro-topography on weathering progress particularly for stones' surface with scaling, exfoliation, and a decrease in stone's surface hardness. The critical pore size distribution that has increased rock's susceptibility to weathering particularly by salts has been defined.

**Wavelet-Based Multifractal Analysis of DEMETER Satellite Data Before the L'Aquila Earthquake of 2009**

- Sid-Ali Ouadfeul, Victor Tourtchine, Leila Aliouane

**Abstract**

The main goal of this paper is to demonstrate the multifractal behavior of the ionospheric plasma signals recorded by the ISL instrument installed onboard of the DEMETER satellite before the L'Aquila earthquake of 2009. Multifractal analysis is performed using the so-called the wavelet transform modulus maxima lines (WTMM) method. Signals to be analyzed are: density of electrons and ions, temperature of electrons, and the potential of the plasma. WTMM analysis of the data recorded during April 4, 2009 which recognizes many ionospheric disturbances before the L'Aquila earthquake clearly shows the multifractal behavior of the ionosphere plasma physical response. WTMM analysis of data recorded by the DEMETER satellite two months after the L'Aquila earthquake main shock shows the monofractal behavior of the plasma response.

**Study of Fully Grouted Rock Bolt in Tabas Coal Mine Using Numerical and Instrumentation Methods**

- Mostafa Ghadimi, Koroush Shahriar, Hossein Jalalifar

**Abstract**

Understanding the interaction between rock bolts and underground rock movement is critical for safe and cost-effective underground excavation design. Although early research on this subject involved a balance of theoretical analysis and field measurement, the current work focused on analytical and numerical studies. The present study aimed to study fully grouted rock bolt in Tabas Coal Mine using numerical and instrumentation methods. Tabas Coal Mine is the first fully mechanized coal mine in Iran, producing 1.5 million tons of coal per year. The mine extracts coal by both longwall and room and pillar methods. The roadways have a rectangular profile of 4.5 m width and 3.5 m height. The field investigations and geotechnical characteristics of rocks showed that the rock masses are weak, requiring a suitable support system. The roadway is intersected by a major fault zone. For the designed roadway, four patterns (two types of bolt with transfer load capacity of 180 and 195 kN) were considered. FLAC analysis showed that 13 bolt 2.4 m with 2 NO flexi bolt 4-m patterns were better than other patterns within the faulted zone. Assessing the optimum pattern through instrumentation, there was compromise between the results of numerical modeling with instrumentation reading such as telltales, sonic extensometer, and strain gauge rock bolt. Thus, there was an inspiring agreement between numerical and field methods.

**Differentiation of Pore Fluids Using Amplitude versus Offset Attributes in Clastic Reservoirs, Middle Indus Basin, Pakistan**

- Nisar Ahmed, Perveiz Khalid, Taqaddus Ali, Sajid Rashid Ahmad, Shamshad Akhtar

**Abstract**

Lower Goru sand intervals of the Cretaceous age in Kadanwari field of the middle Indus Basin, Pakistan, are interpreted as reservoir intervals. Based on seismic interpretation and geology, several wells were drilled in these sands. However, most of the wells drilled were dry and declared abundant because highly saturated brine was encountered with minute amount of hydrocarbon gas. The main reason for drilling dry wells was limitation of seismic reflection data to differentiate seismic response of hydrocarbon-saturated reservoir interval from non-hydrocarbon-saturated interval. Amplitude versus offset (AVO) analysis is widely used to differentiate hydrocarbon intervals from background lithology. In this work, AVO-derived attributes are used for fluid discrimination in the sand intervals. Amplitude differences are associated with density and compressibility of fluid under in situ temperature and pressure conditions of the reservoir interval. The results reveal that seismic amplitude anomalies associated with AVO analysis can differentiate hydrocarbon fluids from non-hydrocarbon fluids and thus can optimize the exploration of gas. The gas sand anomaly in the study area is of weak impedance as compared to brine sand. The intercept and fluid factor are very promising attribute pairs to discriminate gas sands from background sands. The results may be helpful to discriminate low gas saturation or fizz water from high gas saturation.

**The Retrieved Urban LST in Beijing Based on TM, HJ-1B and MODIS**

- Wenfeng Zheng, Xiaolu Li, Lirong Yin, Yali Wang

**Abstract**

This paper comparatively analyzed the retrieved land surface temperature (LST) with Landsat Thematic Mapper (TM) sensor and HuanJing (HJ)-1B satellite sensor images using a case study in Beijing, China. The Jimenez-Muoz & Sobrino's (JM&S) single-channel algorithm was applied for retrieving the LST from HJ-1B images. In this study, the temperature measured in the same period under the thermal environmental condition is used to test the precision of temperature product from the Moderate-Resolution Imaging Spectroradiometer (MODIS). The results indicated that: (1) The retrieved LST of three remote sensing data were basically concordant to the measured LST, while the retrieved LST of Landsat TM came closer to the measured data and the other two platforms (MODIS and HJ-1B) were poor compared to the measured data; (2) the retrieved LST of TM, HJ-1B and MODIS was slightly different in the same area, while the distribution and the variation trend of the retrieving LST were consistent; (3) the urban heat island effect of Beijing was particularly obvious, and the vegetation showed a cooling effect. Furthermore, the surface multiplicity type is the main factor influencing the distribution of LST in urban areas. The empirical formulas on the basis of the JM&S single-channel algorithm may need to refit in retrieving LST of HJ-1B.

**Permeability from Microscopy: Review of a Dream**

- Gabor Korvin

**Abstract**

The Kozeny–Carman and Timur-type equations connecting porosity and permeability contain rock-textural constants such as tortuosity and specific surface area. Sometimes these are combined in single factors as *Kozeny constant* or *flow zone index*. The partial differential equations of flow in triple-porosity rocks contain *transfer factors*, *interporosity flow shape factors* between different kinds of pores, as well as their individual *storativities*. Without knowing these constants, no meaningful permeability prediction or flow simulation is possible. The paper reviews the main ideas of how to find such rock-textural properties directly from the microscopic image.