PETROPHYSICAL CHARACTERISTICS OF THE MESSINIAN ABU MADI FORMATION IN THE BALTIM EAST AND NORTH FIELDS, OFFSHORE NILE DELTA, EGYPT

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Baltim East and North fields in the offshore Nile Delta produce gas-condensate from accumulations located in the northern portion of the Abu Madi palaeovalley. The hydrocarbons in the Abu Madi Formation are present in sandstone reservoir units referred to as the Level III Main and Level III Lower. In this paper, the petrophysical characteristics of these reservoir units in the Baltim area are described using data from wireline logs (gamma-ray, density, neutron, sonic and resistivity) from fourteen wells and core data from one well. Results of wireline log and core analyses indicate that the Level III Main can be subdivided into two sandstone-dominated intervals (both interpreted as sandbar deposits) separated by a shale-rich interval which is a partial barrier to fluid flow. Effective porosity is 9-18.5% and permeability 40-100 mD. Sandstones in the Level III Lower are interpreted as braided channel facies and have effective porosity of 12.5-22% and permeability of 100-500 mD. Isopachometric maps for the Abu Madi Formation sandstone reservoirs based on log and core interpretations show the influence of depositional facies on petrophysical characteristics and can be used to assess possible targets for future exploration and development.
Seismic interpretation of the Aptian Alamein Dolomite in the Razzak oil field, Western Desert, Egypt

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Abstract The Razzak oil field lies in the northern part of Abu Gharadig Basin (northern part of the Western Desert). Aptian Alamein Dolomite is a reservoir rock, in which the oil is trapped in the fractures of the dolomite, depending on structural framework affecting it. The Razzak field structure is one of the most complex structures in the Western Desert of Egypt. The integration of borehole data and 3D seismic interpretation shows that the Jurassic forms a horst block separating the Razzak field into north and south Razzak fields. This horst block is bounded on the southeast by NE-SW trending normal faults (sigma fault) and on the north by several normal faults which step down into the Alamein Basin to the north. The behavior of the sigma fault gives a new concept that the migration of hydrocarbons from the south to the north direction could not be sealed by the NE-SW horst block. Time- and depth-structure maps of Alamein Dolomite illustrate different structure features that play an important role in the hydrocarbon potentialities and prospect identification in the area. One primary component of exploration and development success is to identify the faults that provide structural closure and traps. Two main faults run in the NE-SW direction and form a pattern of horst and graben blocks. In addition, NW-SW trending faults cut these blocks and form a right-lateral strike-slip component of displacement. Four- and three-way dip structural closures represent the fruitful locations for high production and new prospect wells in the Razzak oil field and other similar setting elsewhere.

Keywords Aptian Alamein Dolomite · Razzak field · Seismic interpretation · Sigma fault · Western Desert

Introduction

The Razzak oil field area lies in the north of the Western Desert of Egypt, about 150 km southwest of Alexandria (Fig. 1). It is located between latitudes of 30° 24' and 30° 36' N and longitudes of 28° 24' and 28°36' E. It lies north of the Qattara Depression and covers an area of about 260 km². In petroleum potential, the northern part of the Western Desert of Egypt has become one of the most promising localities of Egypt since the discovery of the Razzak oil field by Amoco (Abdine et al. 1993). The oil production from the Razzak field comes from Aptian rocks. The Aptian Alamein Dolomite is considered the most important and interesting among the lower Cretaceous sedi-
Seismic stratigraphy of the Messinian Nile Delta coastal plain: Recognition of the fluvial Regressive Systems Tract and its potential for hydrocarbon exploration

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**ABSTRACT**

The Upper Miocene strata of the Nile Delta (Egypt) record the dramatic events of the Messinian opening and closing of the Mediterranean Sea. Furthermore, the complexity of the associated stratigraphic relations within the Lower Messinian Qawasim and the Upper Messinian Abu Madi formations contribute to present challenges in their effective gas exploration and production. Through recognition and delineation of the Regressive Systems Tract on the Messinian Nile coastal plain, a new understanding of fluvial responses to changes in sea level as observed in the sedimentary record and to its optimal hydrocarbon reservoir exploration may be obtained.

Seismic stratigraphic analysis of 1800 km of 2D seismic with eighteen boreholes of these two formations reveals the dynamic interplay between fluvial downcutting and fill as a response to global and Mediterranean sea level oscillations. The observation of fluvial channel terraces on the delta plain during downstepping relative sea level falls reveal correlatable RST (Regressive Systems Tract) terraces incised by LST channels and then subsequent flooding by TST delta incised back stepping channel fills culminating in HST (High Systems Tract) deposition. While the Qawasim fluvial downcutting and fill are in response to global sea level changes, the Abu Madi responses are antithetic to global sea level changes.

Specifically, the RST channels of the Qawasim Formation are represented by fluvial terraces of lateral accretion units in response to downward stepping base levels owing to a slowly falling global sea level base and shale channel fill during a global sea level rise. The RST channels of the Abu Madi Formation are represented by incised valley fluvial channels which eroded most of Qawasim Formation deposits especially in the northward of Nile Delta in response to rapidly falling local sea level as the Mediterranean Sea was cut off from the global ocean then are capped by a rapid transgression when the Mediterranean suddenly reopened. The RST and LST in both the Qawasim and Abu Madi fluvial channels exhibit potentially good reservoir continuity, sand quality, and charging potential. Productive boreholes confirm the hydrocarbon potential of the RST and LST in the Qawasim and the LST in the Abu Madi.

Proper understanding and interpretation of the coastal fluvial RST stages on sand deposition as a response to sea level changes are a key issue in assessing Messinian reservoir quality of the Nile Delta and for coastal fluvial deposits elsewhere in the world.

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Geo-Environmental Assessment of the Suez Canal Area,
using Remote sensing and GIS Techniques

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Abstract

The impacts of geologic, topographic and hydrologic characters on the thermal environment were assessed in the Ismailia-Bitter Lakes area. Digital Elevation Model extracted from the SRTM data shows that the waterlogged areas are distributed at low topographic localities. The drainage pattern extracted from the ETM+ image data and SRTM (DEM) using ArcGIS techniques show that all tributaries are accumulated toward the waterlogging localities. Image classification identified five land use categories at the concerned site, including surface water, sand cover, limestone, salt crust and Nile deposits & cultivated areas. Surface water were outlined and measured during 1987-2012; its surface areas increase from 56 km² in year 1987 to 150 km² in year 2012 with a rate of 3.8 km²/year. Thermal bands were processed to obtain radiant surface temperatures to investigate spatial and temporal Urban Heat Island effects associated with increasing waterlogged areas. Land Surface Temperature (LST) decreases from very high in year 1987 to moderate and low in year 2012. This study provides useful information for understanding the relationship between the expansion of surface water and land surface temperature.

Keywords: Urban Heat Island, Land use/Land cover changes, water logging, Image classification, Ismailia-Bitter lakes area.
Environmental hazards and distribution of radioactive black sand along the Rosetta coastal zone in Egypt using airborne spectrometric and remote sensing data

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ABSTRACT

High-resolution airborne gamma ray spectrometry, conducted in 2003, was used to estimate radioactive elements spatial abundance along the Rosetta coastal zone area. It was noticed that both Uranium and Thorium are concentrated in the black sand deposits along the beach. In contrary, Potassium was observed in high level abundance at the cultivated Nile Delta lands due to the accumulated usage of fertilizers. Exposure Rate (ER), Absorbed Dose Rate (ADR) and Annual Effective Dose Rate (AEDR) were calculated to evaluate the radiation background influence in human. Results indicated that the human body in the study sites is subjected to radiation hazards exceeds the accepted limit for long duration exposure. In addition, the areas covered by the highest concentration of Uranium and Thorium show the highest level of radiogenic heat production. Detection of the environmental hazards of the radioactive black sands in the study site encouraged this research to monitor the spatial and temporal distribution of these sediments. The Landsat Thematic Mapper images acquired in 1990, 2000 and 2013 were analyzed using remote sensing image processing techniques. Image enhancements, classification and changes detection indicated a positive significant relationship between the patterns of coastline changes and distribution of the radioactive black sand in the study sites. The radioactive black sands are usually concentrated in the eroded areas. Therefore, in 1990 high concentration of the radioactive black sands were observed along the eastern and western flanks of the Rosetta promontory. Distribution of these sediments decreased due to the construction of the protective sea walls. Most of the radioactive black sands are transported toward the east in Abu Khashaba bay under the effect of the longshore currents and toward the west in Alexandria and Abu Qir bay under the action of the seasonal reverse currents.

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Monitoring Spatial and Temporal Seaweeds Variation Using Remote Sensing Data in Al-Shoaiba Coast, Red Sea

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Authors' contributions

This work was carried out in collaboration between the two authors. Author GAES managed macroalgal vegetation, physical analyses and performed the statistical analysis and, author MFK managed remote sensing data and image processing analyses of this study. Both authors wrote the protocol, designed the study and wrote the first draft of the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Aims: Spatial variability and temporal dynamics of benthic seaweeds using the field investigation and Landsat Thematic Mapper images.

Place and Duration of Study: Al-Shoaiba area, Saudi Arabia, Red Sea was investigated and the study area was divided into four sites extending about 10 km. The study period extended seasonally from summer 2011 to spring 2012.

Methodology: The assessment of seaweeds abundance and distribution were performed using quadrat method. Methodology includes analyses of the Enhanced Landsat Thematic Mapper (ETM+) images.

Results: A total of 46 seaweed taxa were collected from Al-Shoaiba region belonging to

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Background matrix subtraction (BMS): A novel background removal algorithm for GPR data

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ABSTRACT

Background noise is a common type of coherent noise that severely compromises the integrity of the high-resolution images provided by ground penetrating radar survey. Several existing techniques employ different approaches to attenuate background noise. In this study, we present the background matrix subtraction (BMS) as an alternative technique to remove horizontal background noise and we compare its efficiency to that of the conventional background removal technique. Instead of calculating an average trace that is subtracted from the GPR data in the conventional background removal methods, the BMS technique is based on calculating a complete background matrix of the same size of the GPR section. The background matrix is created through a series of windowing, sample exclusion, weighting, and iteration. This series of processes guarantees that the background matrix is least affected by target response and is composed purely of horizontal background noise. The computed background matrix is then subtracted from the GPR data to remove horizontal events. Results of experiments conducted on both synthetic and real GPR data show that the BMS technique yields better results than the commonly used background removal technique.

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1. Introduction

Ground penetrating radar (GPR) is one of the most increasingly spreading geophysical tools that has found a wide range of applications during the past two decades. GPR applications include, but are not limited to, geological, geotechnical, environmental, engineering, archeological and even forensic investigations. The reason for the wide spreading of GPR technique is its capability to provide high-resolution images of the investigated targets in a relatively short period of time. Horizontal background noise is a common type of coherent noise that severely degrades the resolution of GPR data and makes target identification difficult. Background noise can be caused by nearby ground objects and sources of electromagnetic waves (Dojack, 2012). However, the most dominant source of background noise is antenna ringing. Ringing noise appears as strong vertically periodical, horizontal bands that may mask genuine reflections on a GPR section. There are two main sources of ringing noise. The first source of ringing is related to the electronic design of the GPR antenna, which is caused by residual electric currents reverberating between the tips of the transmitter antenna and the input feed. These currents are created by the remaining energy after the original pulse has traveled the full length of the antenna. Every time these currents travel between the tip of the antenna and the input feed, a secondary pulse is generated. At the end, the transmitter sends several pulses that decay with time rather than sending a single clean pulse (Daniels et al., 2008).

Another type of ringing noise results from the impedance mismatch between the antenna and the ground. Antennas are designed to minimize the contrast in electrical properties between the antenna and the ground by matching the electrical impedance between the antenna and the ground surface. A perfect impedance matching would make the antenna and the ground act as one medium and all the energy will be transmitted from the antenna to the ground. Practically, perfect impedance matching is impossible and some of the transmitted energy is backscattered from the ground surface causing antenna ringing (Daniels et al., 2008). Metallic objects also introduce periodic features like ringing but these are spatially-limited to the object area (Radzevicius et al., 2000).

The standard procedure to attenuate horizontal background noise is the average trace or moving average trace subtraction, which is commonly known as background removal (Nobes, 1995). Because conventional background removal does not always yield satisfactory results, many alternative processing techniques to attenuate background noise have been proposed and tested with various levels of success in the past few years. These techniques include domain filtering (Young and Sun, 1999), eigenimage processing (Cagnoni and Ulych, 2001), deterministic deconvolution (Xia et al., 2003), Radon transform (Nuzzo and Quarta, 2004), predictive deconvolution and filtering in the waveform domain (Kim et al., 2005), eigenimage filtering through singular value decomposition (Kim et al., 2007), multisresolution wavelet analysis (Jeng et al., 2009), fuzzy weighted background calculation

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Fifty Years of Stacking

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Abstract

Common-Mid-Point (CMP) stacking is a major process to enhance signal-to-noise ratio in seismic data. Since its appearance fifty years ago, CMP stacking has gone through different phases of prosperity and negligence within the geophysical community. During those times, CMP stacking developed from a simple process of averaging into a sophisticated process that involves complicated mathematics and state-of-the-art computation. This article summarizes the basic principles, assumptions, and violations related to the CMP stacking technique, presents a historical overview on the development stages of CMP stacking, and discusses its future potentiality.

Key words: CMP, stacking, seismic, processing.

1. INTRODUCTION

In the field of geophysical exploration, the term stacking generally refers to averaging a number of geophysical measurements instead of taking one measurement in each field station in the hope of enhancing the coherent signal and attenuating the random noise. In the world of seismic exploration, however, stacking is used extensively in different stages of data acquisition and processing. The simplest and earliest stacking in seismic exploration is vertical stacking or the use of multiple sources and/or receivers data acquisition. In seismic data processing, the concept of stacking is used on several occasions. The summation of traces in velocity semblance, constant velocity
Geophysical Constraints on the Hydrogeologic and Structural Settings of the Gulf of Suez Rift-Related Basins: Case Study from the El Qaa Plain, Sinai, Egypt

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Abstract Groundwater has been identified as one of the major freshwater sources that can potentially meet the growing demands of Egypt’s population. Gravity data (from 381 ground gravity stations) were collected, processed, and analyzed together with the available aeromagnetic (800 line-km) data to investigate the hydrogeologic and structural settings, areal distribution, geometry, and water storage of the aquifers in El Qaa coastal plain in the southwest Sinai Peninsula, and to assess their longevity given projected extraction rates. Findings include (1) complete Bouguer anomaly and total magnetic intensity maps show two connected sub-basins separated by a narrow saddle with an average basin length of 43 km and an average width of 12 km; (2) two-dimensional modeling of both gravity and magnetic data indicates basin fill with a maximum thickness of 3.5 km; (3) using anomalous residual gravity, the volume of water in storage was estimated at 40–56 km$^3$; and (4) progressive increases in extraction rates over time will deplete up to 40% of the aquifers’ volume in 200–230 years and will cause the water quality to deteriorate due to seawater intrusion in 45 years. Similar geophysical exploration campaigns, if conducted over the entire coastal plains of the Red Sea and the Gulfs of Suez and Aqaba, could assist in the development of sound and sustainable management schemes for the freshwater resources in these areas. The adopted techniques could pave the way toward the establishment of sustainable utilization schemes for a much larger suite of similar aquifers worldwide.

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