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3D STATIC RESERVOIR MODELING OF SIX HILLS FORMATION IN THE NUQRA BASIN, UPPER EGYPT.

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ABSTRACT

Nuqra basin is located in the south Eastern Desert of Egypt, on the eastern bank of the Nile River. The main objective of the present study is to evaluate the Cretaceous sands, represented by Six Hills Formation, through the integration between seismic and well data. Structure contour maps show regional structures of NW-SE and NE-SW trends. The NW-SE fault trend is a dominant trend. Facies and petrophysical modeling have been made to study the facies and petrophysical property distribution throughout Six Hill Formation. The results of the current study revealed that the area has the necessary elements of petroleum system. Six Hills rock unit is mainly composed of sandstone with good porosities, up to 20 %, but the water saturation seems to be high. The drilled wells are dry holes. Some selected layers within the Six Hills Formation show locations of low water saturation. According to the petrophysical analysis results, prospects were selected in the area of good reservoir properties.

Key words: Nuqra basin

INTRODUCTION

The study area is located to the south of the Eastern Desert of Egypt (Fig.1) between Latitudes 24° 25/ and 24° 35/ N, and Longitudes 33° 15/ and 33° 45/ E. it is bordered by the Nile River from the west and the high hills of Precambrian rocks from the east within the Nuqra/Komombo rift basin. Nuqra basin is a new concession where no information have been published on the structural framework of this area. However, the general structures were discussed by Yousef (1968), Yousef and El Assy (1998) and others.

Location of Nuqra Basin

The study area is located in the south Eastern Desert of Egypt, near of the city of Luxor, on the east bank of the Nile River (Fig. 1) between Latitudes 24° 25 and 24° 35` N and Longitudes 33° 15 and 33° 45 E. It is a part of the Nuqra/Komombo rift basin.

Stratigraphy

Said (1962) studied two sections of the Nubia sandstones at Wadi Kharit and Gabal El-Nuqra at Wadi Natash, and concluded that, the cross-bedded feature indicates that, these sandstones were developed largely in the basins, characterized by standing bodies of water, separated from the sea. The grain size analysis shows that, the sandstones of Wadi Natash are fine, unimodal and well sorted. Meanwhile, at Wadi Kharit, they are very fine, unimodal and moderately to poorly sorted. These sandstones probably were deposited in a beach environment (Centurion and Transglobe, 2007). The stratigraphic sedimentary sequence (Fig.2) penetrated in Nuqra Basin comprises from bottom to top Six Hills, Abu Ballas, Sabaya, Maghrabi, Quseir and Duwi Formations. This sequence could be described in terms of Late Jurassic, Cretaceous and Paleocene succession. The major NW-SW and NE-SW fault-trends cut all the rock units in the area, indicating rejuvenation of these fault-trends during the geologic history of the area.

Structural setting of Nuqra basin

Faults and joints are the most deformational features observed at the cliffs bordering the Nile stream (Said, 1962 and 1981). These faults have different directions. The most abundant are the NW-SE and NNW-SSE trends, while others have the WNW-ESE, ENE-WSW and NE-SW directions. In the present study, the structural setting of Nuqra basin was reviewed by the interpreted 2D seismic sections. Depth structure contour maps and the structural model were constructed to

illustrate the subsurface structural features on the top of the stratigraphic formations penetrated in the area. The constructed depth structure maps show, that the area is affected by two main fault trends NW-SE and NE-SW, where NW-SE fault trend is the dominant trend while the NE-SW is the less dominant trend. These have been found cutting through all rock types among the study area.

Structure contour map

Five horizon tops were picked in the study area, including the Basement complex, Structure contour maps for these formation at

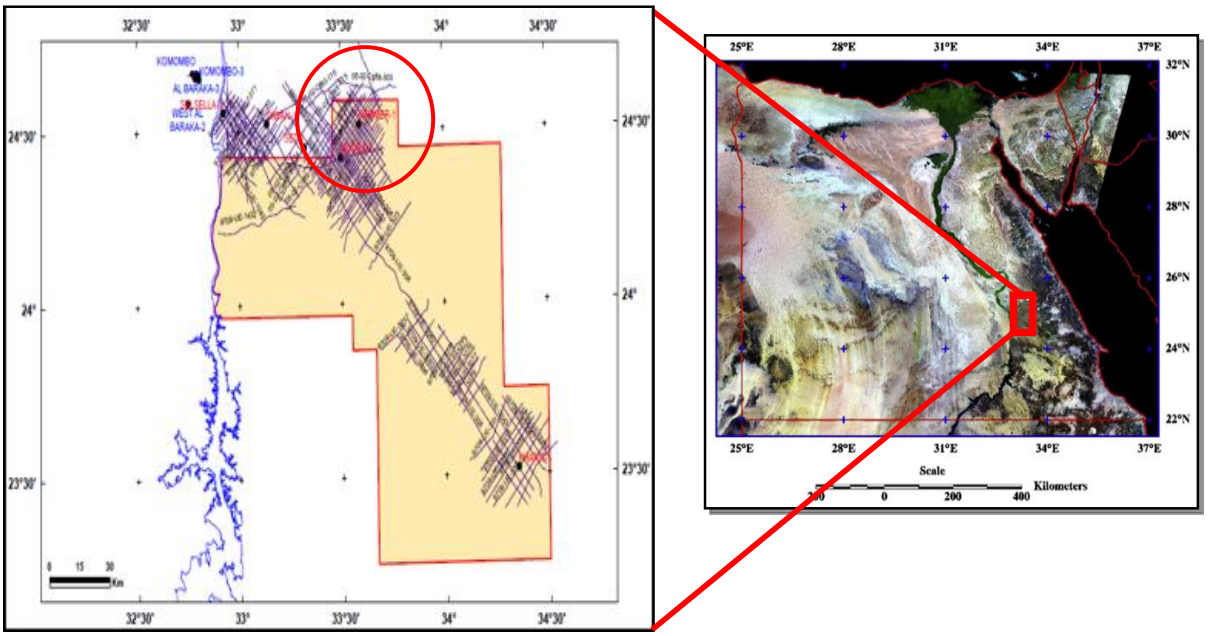

Figure (1): Location of the study area (Nuqra basin), Upper Egypt.

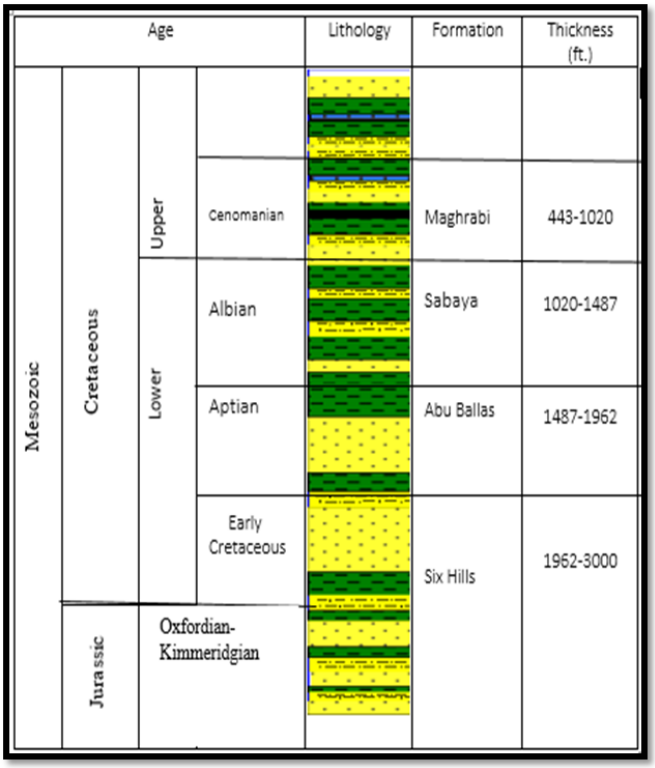

Figure (2): General Lithostratigraphic succession of South Eastern Desert, Egypt.

tops were constructed. The Six Hills and Abu Ballas depth structure contour maps are discussed and displayed later.

Depth structure contour map on top Six Hills Formation

The depth structure contour map constructed on top Six Hills Formation (Fig.3) shows two main fault trends (NW-SE and NE-SW). The NW-SE trending faults represent the dominant faults in this area. This map reveals significant variations in depth to the top of Six Hills Formation, ranging from 1200ft to 2800ft.The Six Hills Formation sands of Jurassic to Early- Cretaceous age are the main target in this study as a possible reservoir in the area

Depth structure contour map on top Abu Ballas Formation

The depth structure contour map on top Abu Ballas Formation (Fig.3), also, shows the two main fault trends (NW-SE and NE-SW). The NW-SE trending faults represents the dominant trend in this area. The interpreted depth values reveal significant variations in depth to the top of Abu Ballas formation where it ranges from 900 ft. in the south of the study area to 2200 ft. in the deepest areas (Fig. 5).

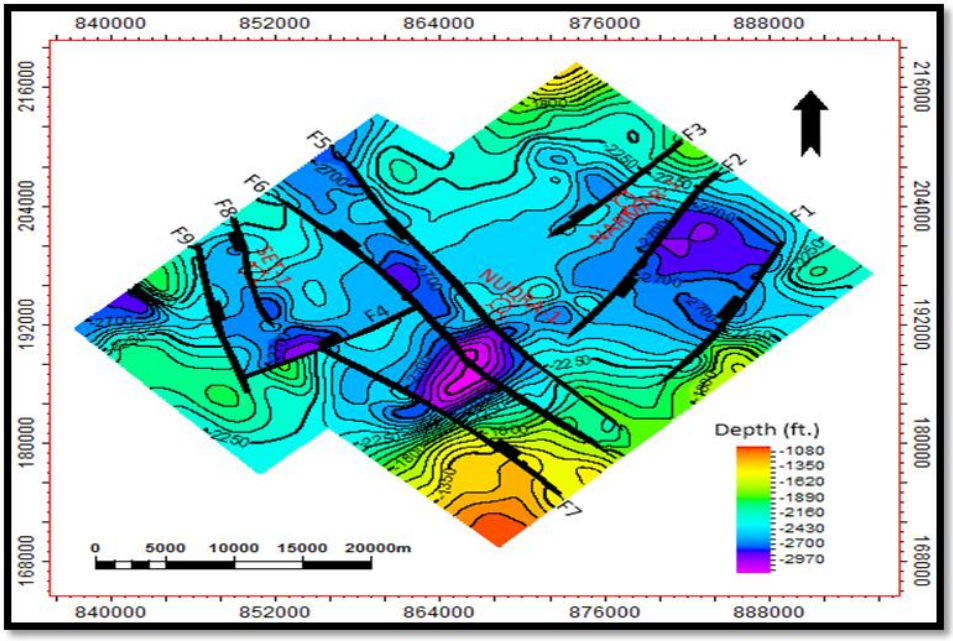

Figure (3): Depth structure map of Six Hills Formation in Nuqra basin.

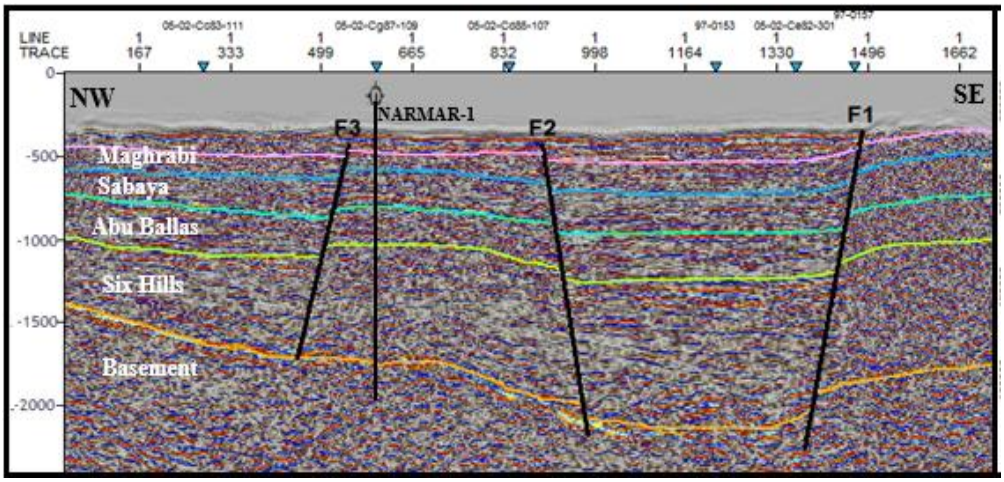

Figure (4): Interpreted seismic line (05-02-Cc-83-111), showing the major faults in Nuqra basin, Egypt.

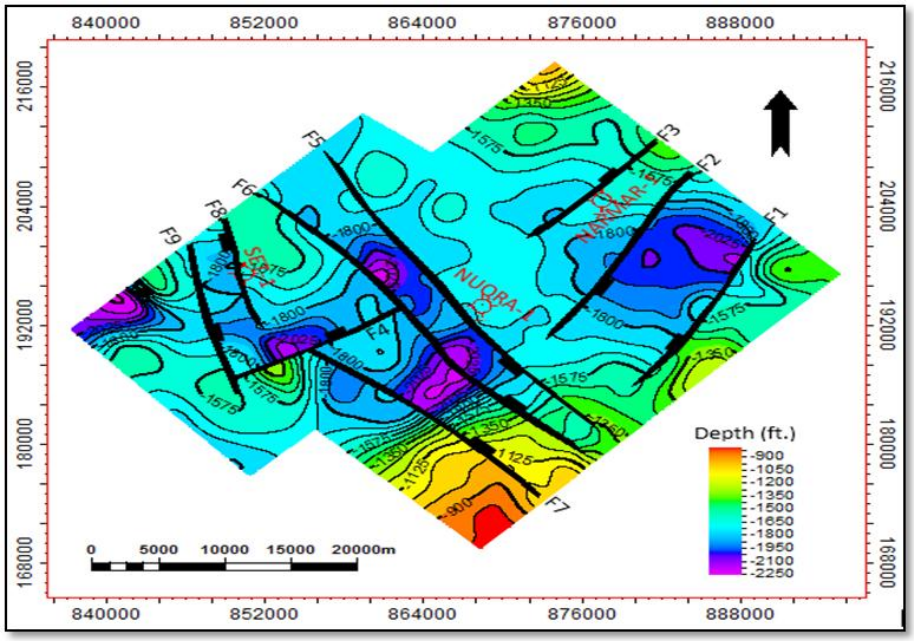

Figure (5): Depth structure map of Abu Ballas Formation in Nuqra Basin.

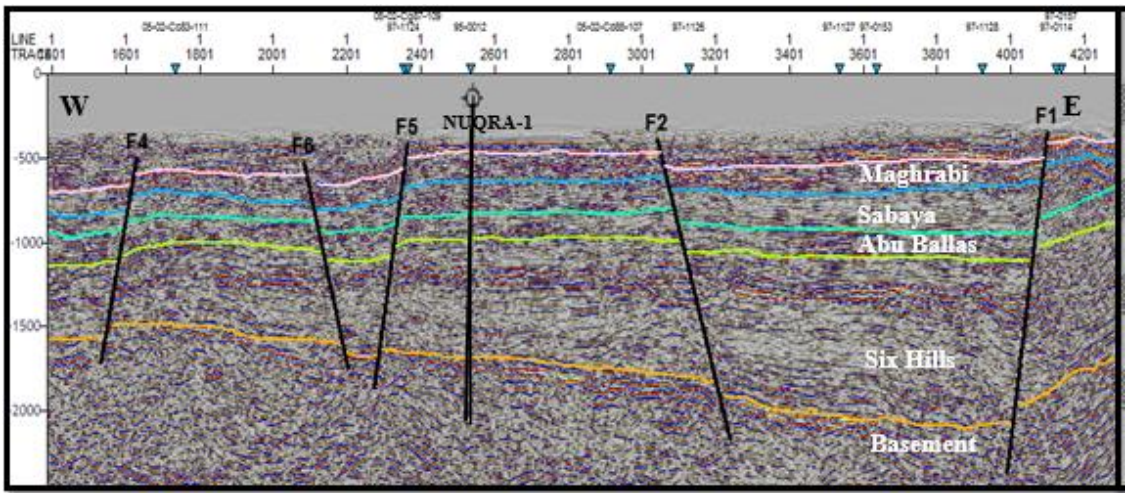

Figure (6): Interpreted seismic line (05-02-Ce82301) showing the major faults in Nuqra basin, Egypt.

Structural cross section

The constructed E-W structural cross section illustrates the structures that effect the study area, as shown (**Fig.7**). Faults are characterized by set of normal faults which are forming grabens and horsts. These faults are NW-SE and NE-SW trends with the downthrown sides towards northeast, southwest, northwest and southeast respectively. The NW-SE oriented faults are major faults in the study area.

Property Modeling

Introduction

Property modeling is a process of filling the cells of a constructed grid with the petrophysical properties to understand the property distribution throughout the geological model. The main input properties that have been distributed in the grid include shale volume, effective porosity and water saturation. Property modeling was accomplished using Petrel software workflow tools. Property modeling split into two processes including facies modeling and petrophysical modeling.

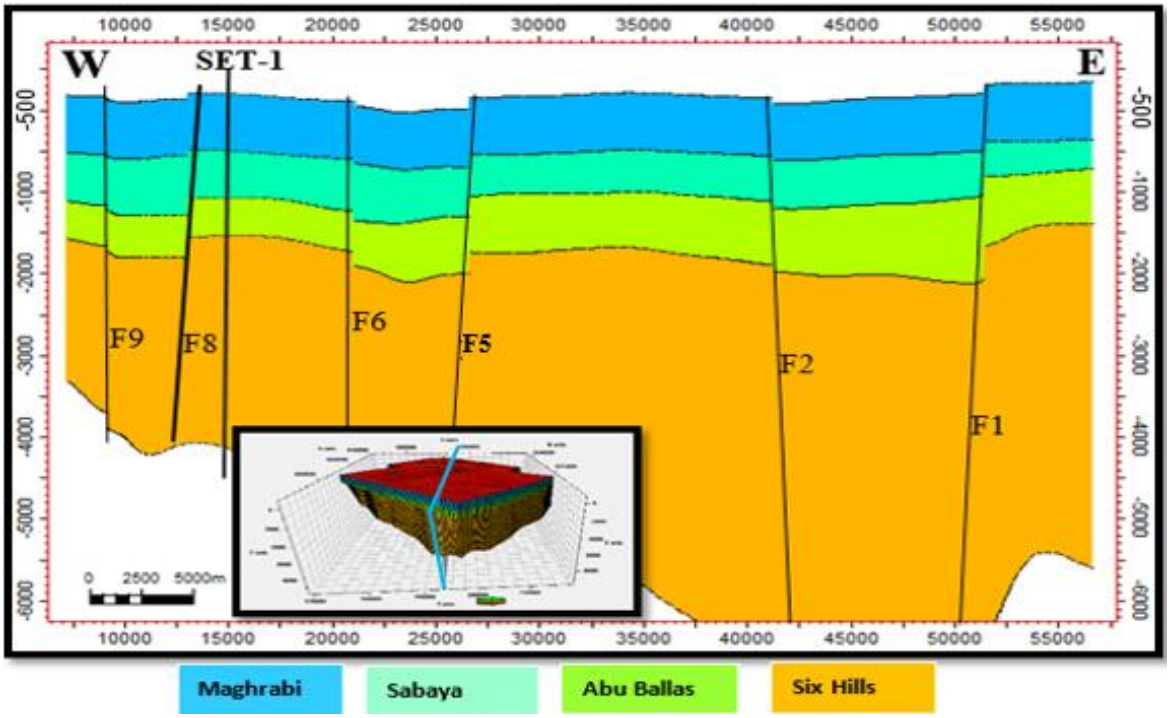

Figure (7): S-W Structural cross section showing the faults affected the study area.

Six Hills Formation

Interpreted shale volume, effective porosity and water saturation logs for the Six Hills reservoir from the wells (Nuqra-1, Narmar-1 and Set-1) were used for property modeling. Figure (8) shows a selected layer at the top of Six Hills Formation and it shows that the water saturation distribution values ranging between 60% and100%). The distribution of the effective porosity shows values ranging between 0% and 20%). The distribution of shale volume values less than 5%. Figure (9) shows a selected layer at the bottom of Six Hills Formation and it shows that the water saturation distribution values ranging between 60% and 100%). The distribution of effective porosity shows values ranging between 0% and 20%). The distribution of shale volume of the selected layer shows values less than 5%. Also porosity and water saturation cross section were done to show the vertical distribution of reservoir property in the Six Hills Formation.

Prospects

Six Hills Formation remains the main interest in the study. The present wells were drilled alongside the major faults and became dry holes. Facies and petrophysical models have been applied to review the lateral and vertical distribution of the reservoir parameters. New wells can be drilled on the basis of stratigraphy as shown in (Fig. 12 and 13).

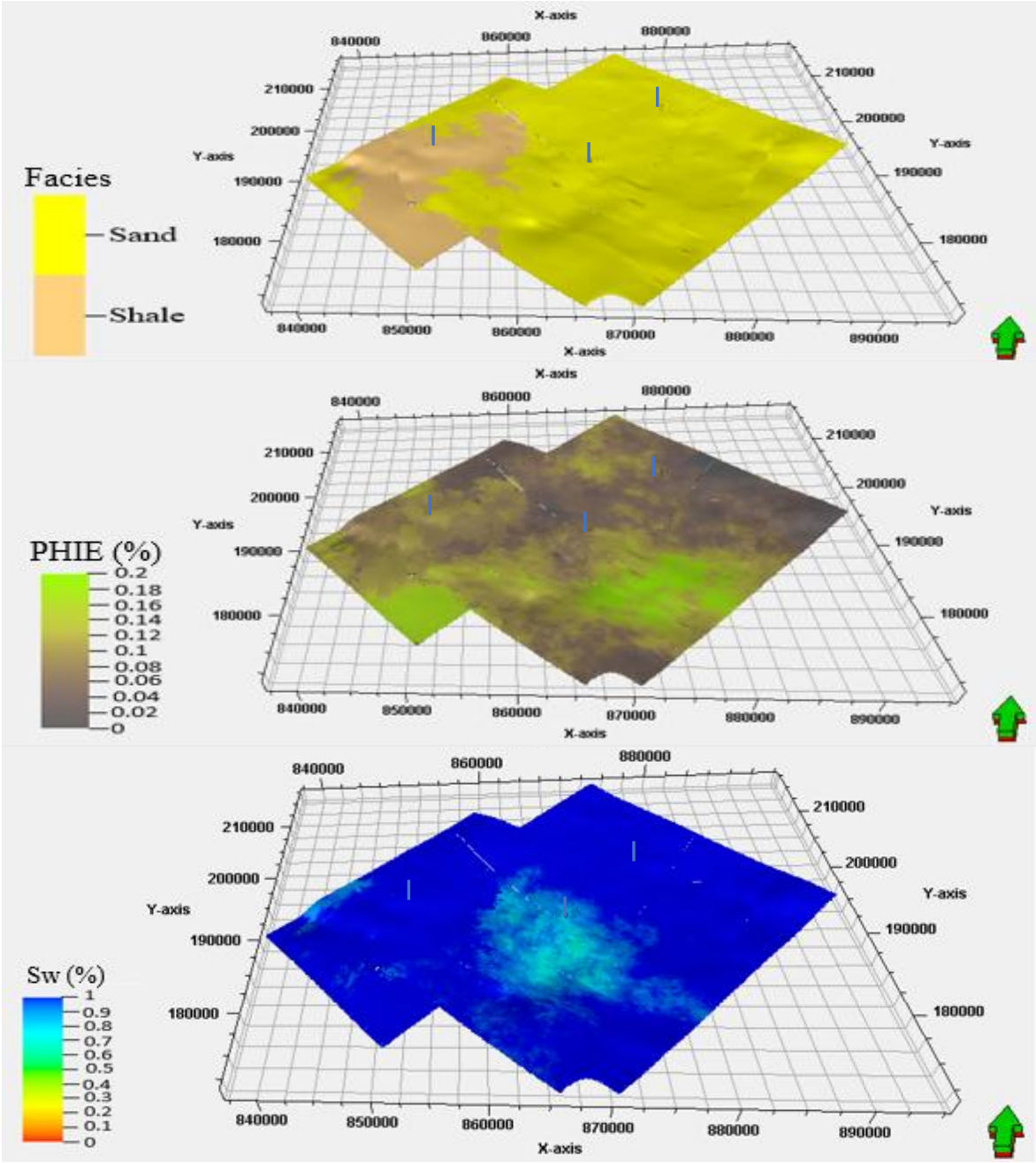

Figure (8): Modeled shale volume, effective porosity and water saturation of a selected layer at the top Six Hills Formation.

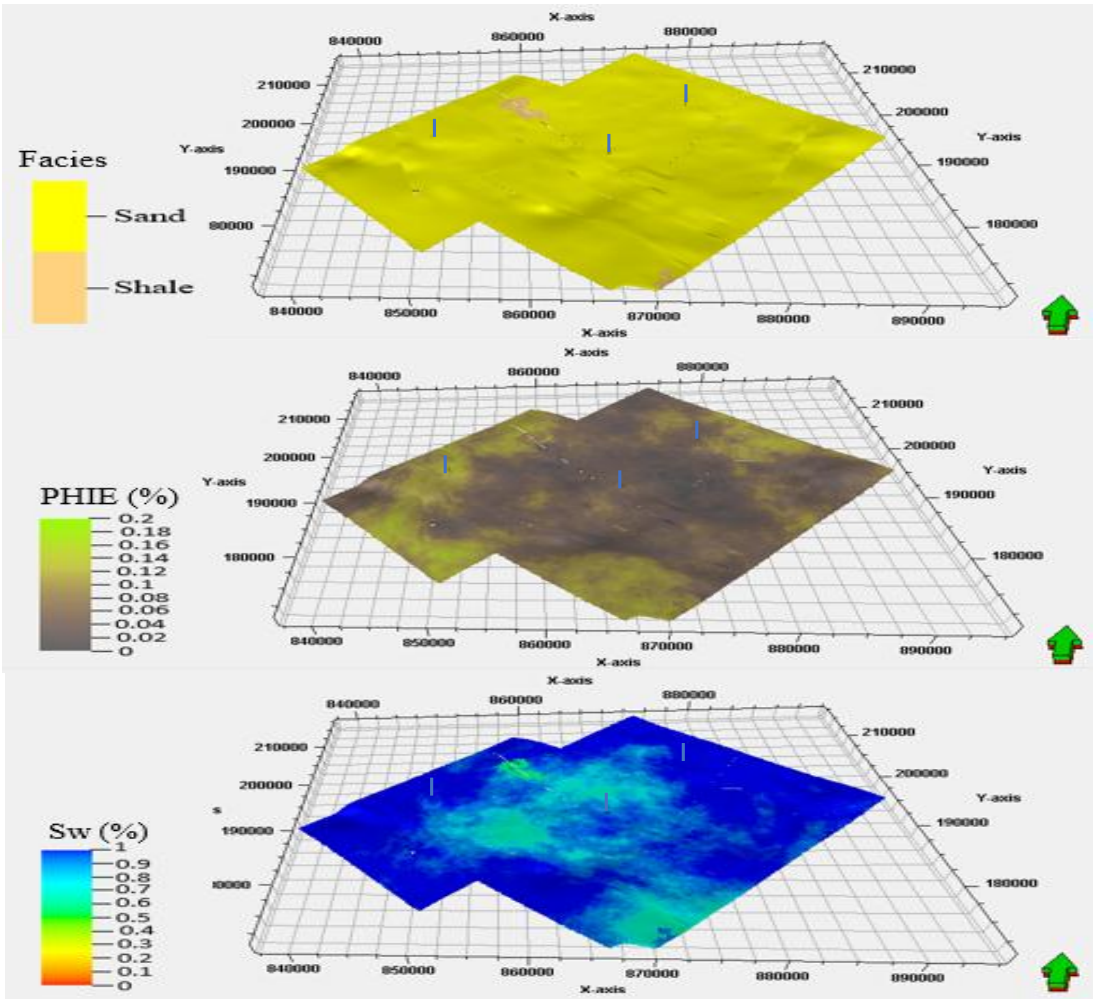

Figure (9): Modeled shale volume effective porosity and water saturation of a selected layer at the bottom Six Hills Formation.

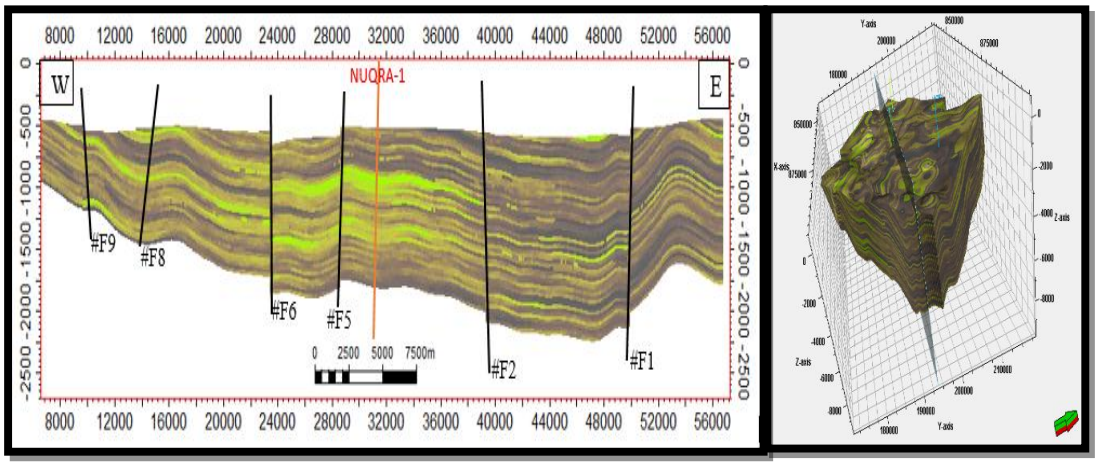

Figure (10): E-W cross section showing the vertical distribution of porosity in Six Hills Formation. It show that the porosity increases towards the western direction. The maximum porosity was revealed in the central part of the area.

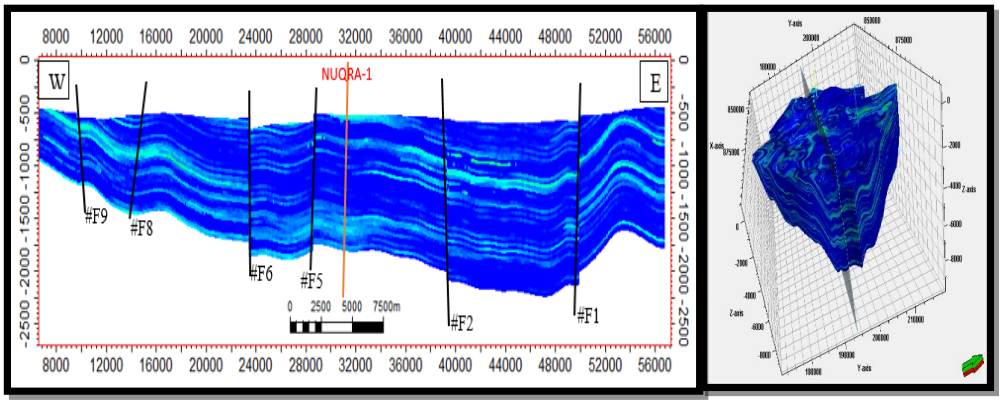

Figure (11): E-W cross section showing the vertical distribution of water saturation in Six Hills Formation. This section displays high water saturation throughout the Six Hills Formation.

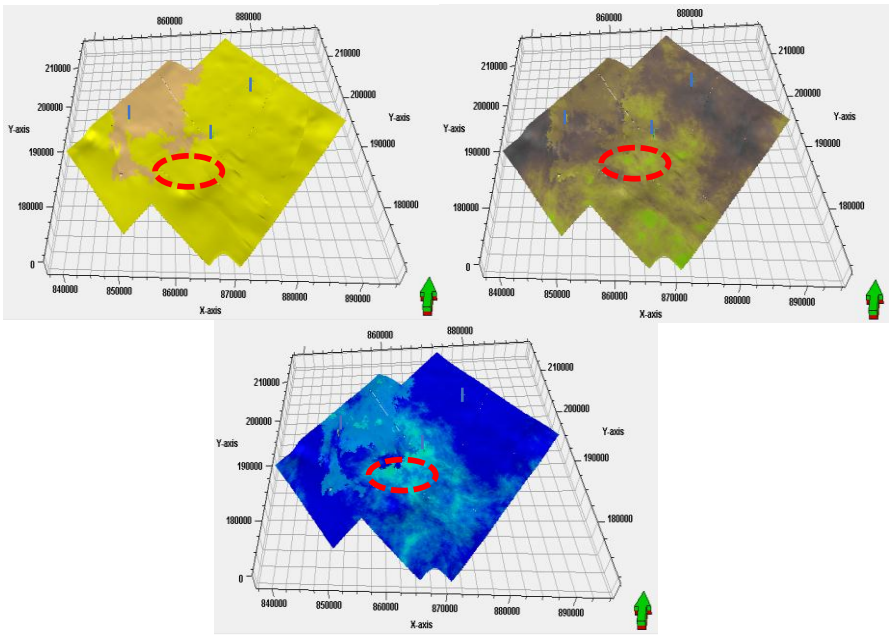

Figure (12): Layer selected at the top of Six Hills Formation showing a prospective location

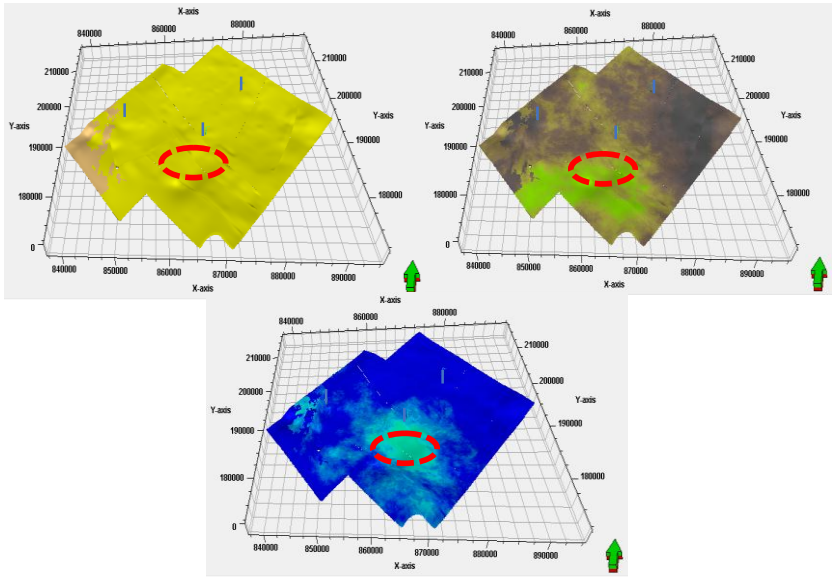

Figure (13): Layer selected at bottom of Six Hills Formation showing a prospective location

CONCLUSION

Six hills Formation in Nuqra Basin is considered a reservoir and it is the main target in the study area. Seismic and well log data were applied to evaluate the Cretaceous sands of Six Hills Formation. Structural maps show regional geological structures, which take the NW-SE and NE-SW trends. Facies and petrophysical modeling results show that Six Hills Formation is mainly composed of sandstone with good porosity of up to 20 %, water saturation values range from 60% to 100% in the studied wells in the area. Some selected layer within the Six Hills Formation show locations of low water saturation. According to the petrophysical analysis results, prospective areas can be recognized based on properties analysis results.

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REFERENCES

Abdelsalam, M.G., Stern, and R. J., 1996: Sutures and shear zones in the Arabian–Nubian shield. Journal of African Earth Sciences 23, 289–310.

Adel A. A. Othman, Tharwat H. Abdel Hafez and M. Ibrahim El-Aswany 2017: Identify a good New Potential Zones for Hydrocarbon Reservoir Formation, Using Seismic Data Interpretation, Attributes and 3d Modeling in Komombo Basin, Southern Western Desert, Upper Egypt. IOSR Journal of Applied Geology and Geophysics. Volume 5. Pp 45-52.

Mo'men A., Darwish M., Abdelhady A., Mahmoud A. Essa (2017): Structural and Lithostratigraphic evolution of Al Baraka Oil field, Komombo Basin, Upper Egypt as deduce from 2D seismic lines and well logging data. J. Bas. and Environ. Sci., 2 149–169.

Mostafa M.S, Ibrahim Hassan, Hassaan A. H.(2010), Tectonic framework of East Gabal Nuqra area, south eastern desert, Egypt Al-Azhar Bull. Sci. Vol. 21, No. 2 (Dec.): PP. 19-43.

Noweir, AM., Nassim, AS., Lebda, EM; El-Khalify, EM (2002): Late Cretaceous transgression-Tertiary extension affecting the Phanerozoic sedimentary formations, East Komombo, South Eastern Desert, Egypt. V. 16, p: 145-165.

Othman AAA, Ewida HF, Fathi MM Ali and Embaby MMAA. (2017): Reservoir Characterization Applying Seismic Inversion Technique and Seismic Attributes for Komombo Basin. Austin J Earth Sci.; 3(1): 1020.

Repsol Exploration Egypt S. A., 1998: Seismic survey and exploration well, in well in Upper Egypt. Environmental Impact Assessment, An Internal Report, 72 p.

Said, R.: 1962: Geology of Egypt. Amsterdam, New York, Elsevier pub. Comp., 377.

Said, R.: 1981: the geological evolution of the river Nile. Springer, 152.

Yousef, M. I. (1968): Structural pattern of Egypt and its interpretation. A.A.P.G. Bull., 52: 601-614.

Yousef, M. S. & El-Assy, A. T. (1998): Quantitative study of the fracture pattern of the area around the western part of Wadi El Karit, Southeastern Desert, Egypt.-Egypt. Jour. Remote Sensing and Space Sciences 1:145-163.