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Deducing the subsurface geological conditions and structural framework of the NE Gulf of Suez area, using 2-D and 3-D seismic data

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Abstract An interpretation of the seismic data of Ras Budran and Abu Zenima oil fields, northern central Gulf of Suez, is carried out to evaluate its subsurface tectonic setting. The structural configuration, as well as the tectonic features of the concerned area is criticized through the study of 2D and 3D seismic data interpretation with the available geological data, in which the geo-seismic depth maps for the main interesting levels (Kareem, Nukhul, Matulla, Raha and Nubia Formations) are depicted. Such maps reflect that, the Miocene structure of Ras Budran area is a nearly NE–SW trending anticlinal feature, which broken into several panels by a set of NWSE and NE–SW trending faults. The Pre-Miocene structure of the studied area is very complex, where Ras Budran area consists of step faults down stepping to the south and southwest, which have been subjected to cross faults of NE–SW trend with lateral and vertical displacements.

1. Introduction

Ras Budran field is located in the northern of Abu Rudeis offshore area, approximately 4 km from the eastern coast of the Gulf of Suez at a water depth of about forty-two meters. Appraisal drilling of EE85-2, RB-Cl and RB-A1 wells confirmed the presence of a major field with estimated seven hundred million-barrels of oil-in place. The field, which developed from three wellhead platforms, has been producing since 1983. To date, twenty-nine wells have been drilled in the area.

Abu Zenima field is located between the oil fields of Rudeis–Sidri, October and Ras Budran. The concession occupies an area of almost 180 km^2 (Fig. 1). In this concession, twelve wells are drilled without any commercial discovery. South east Abu Zenima development lease by Petrobel occupies an area of 14 km^2 in the South eastern corner of Abu Zenima exploratory concession, between Ras Budran and Rudeis–Sidri oil fields, where two producing wells were drilled (AZ 13-1 and AZSE-1).

Abu Zenima area is covered by about 1500 km of 2D seismic lines acquired by GUPCO and SUCO companies in 1976, 1979, 1988 and 1989. The reprocessing of 86 seismic lines for a

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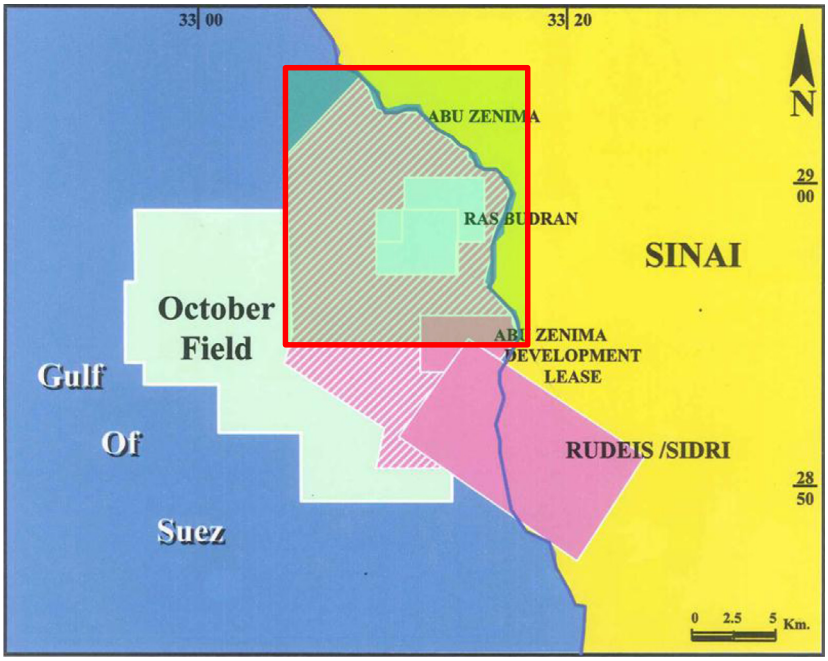

Figure 1 Location map of the study area.

total of 1050 km started in August 1994 and was completed in March 1995, to improve the quality and resolution of both the Miocene and Pre-Miocene reflectors, to get a better definition of the structural elements and to attenuate the multiples in a good way.

The 2D and 3D seismic surveys were performed in Ras Budran area. Due to the poor quality data, the deepest continuous and reliable seismic event was always believed to be the top Kareem or top Rudeis. The interpretation of the 3D deep marine survey (1980) showed that, this survey was not reliable. The seismic interpretation of the new 3D survey was performed at 1997. The discrepancy between the seismic prognosis and the actual well results indicates that, even the last 3D interpretation is still not reliable.

The geophysical problems in Ras Budran area are due to small acoustic impedance contrasts at all levels below top Rudeis, the absorption of most seismic energy at the shallow evaporitic sequence and the difficulties with effective multiple attenuation due to the thick sequence of interbedded shales, sands, salts and anhydrite of the Miocene section.

Generally, the interpretation of the 2D seismic lines covered the investigated area on the tops of different Miocene horizons (South Gharib, Belayim, Kareem, Rudeis and Nukhul formations) showed a very good quality, as those Miocene horizons (Kareem and Nukhul formations) are easily picked and mapped over the whole area. The quality of the Pre-Miocene seismic data is fair to poor due to multiples and diffractions.

As far as the interpretation is concerned, the main problems were encountered in the imaging and definition of the Pre-Miocene horizons. All the Pre-Miocene reflectors are completely obscured by over-migrated disturbs and often, especially in Abu Rudeis, seismic horizons appear to have an opposite inclination with respect to the interpretation of the well data. The seismic interpretation allowed the production, by means of the workstation based on Zycor software of the TWT contour maps. The well velocity data were used to execute the needed depth conversions.

The velocity survey data of the Miocene and Pre-Miocene rocks were detected from some drilled wells. Also, the reprocessing of seismic lines was done and achieved some improvement in the resolution of the Pre-Miocene horizons. As a result of the above mentioned steps, the picking of the Pre-Miocene horizons in most of the seismic lines was controlled by plotting the Pre-Miocene well data. The Lower Senonian and Nubia horizons were picked and mapped.

2. Geological setting

The stratigraphic sequence of the area under investigation represents an ideal succession of the central part of the Gulf of Suez. Such a succession is observed not only on the surface outcrops at the different locations in the eastern side of the Gulf of Suez, but also in the drilled wells scattered in the area. A sedimentary sequence ranging in age from Paleozoic to Recent with non-depositional and erosional hiatuses was penetrated in the area of consideration. Fig. 2 shows the stratigraphic column of the area, as well as the tectonic events which affected the deposition of the various rock units.

The Gulf of Suez is an elongated tectonic basin that separates the Pre-Cambrian ridge of Sinai with its overlying sedimentary platform from the main Egyptian Craton on the western side. The central part of the basin is covered by waters of the gulf, but the maritime plains on either side are blanketed by sedimentary Miocene and younger strata, that overly the Eocene and Cretaceous and probably the older rocks in depth. Several elongated fault blocks of Pre-Cambrian basement and younger sediments (Paleozoic and younger) flank both sides of the coastal strip. Throughout most of its geological history, the gulf was essentially an elongated embayment of the old Tethys

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