

CHAPTER (1)

INTRODUCTION

CHAPTER (1)**INTRODUCTION****1.1 General**

The Western Desert of Egypt covers an area of about 700,000 Km² and comprises almost two thirds of the whole area of Egypt. It extends 1000 Km from the Mediterranean shoreline at the north to the Sudan border at the south and from 600-800 Km from the Nile Valley at the east to the Libyan border at the west. The exploration efforts were mainly concentrated in the northern half, north of Lat. 28°, with minor efforts in the offshore area and the southern half due to the configuration of the basement rocks. The Egyptian commercial accumulations of petroleum (oil and gas) are divided territorially into three main petroleum provinces: the Gulf of Suez, north Western Desert and the Nile Delta. In north Western Desert, petroleum exploration and exploitation started in 1966 by the discovery of Alamein oil field followed by El-Razzak, Abu-Gharadig and Yidma oil fields. Alamein, El-Razzak and Yidma fields produced crude oil from the Lower Cretaceous dolomite pay zones, while Abu Gharadig field produced oil from Cenomanian clastics. Several discoveries have been achieved since early eighties of the last century. Since then, and despite of the sporadic nature of exploration in the early stage, exploration and production activities continued in the Western Desert at a brisk pace. In north Western Desert of Egypt, a series of rift and pull-apart basins were developed since the Early Mesozoic, where Abu Gharadig basin is one of these basins. Abu Gharadig basin is Late Mesozoic, approximately E-W trending, half-graben, intracratonic basin, bounded to the north and south respectively by Qattara Ridge and Sitra platform. Several oil

and gas fields have been discovered in this basin as GPTSW and BED-1 fields.

1.2 Location

The present study deals with the geology and petrophysics (porosity, permeability and capillary pressure) of the Bahariya Formation and Abu Roash Members ('G' and 'F'). For this aim, two fields were studied, (Fig. 1.1). The first field is GPTSW field in Abu Sennan area, north Western Desert, which is approximately bounded by Long. $28^{\circ} 00' - 29^{\circ} 00'$ E and by Lat. $29^{\circ} 25' - 29^{\circ} 48'$ N. In this field, the upper part of the Bahariya Formation (Lower Cenomanian), Abu Roash 'G' and Abu Roash 'F' Members (Upper Cenomanian) have been penetrated. The second field is BED-1 field in Badr El Din concession, north Western Desert, which is approximately bounded by Long. $26^{\circ} 29' - 28^{\circ} 35'$ E and by Lat. $29^{\circ} 35' - 30^{\circ} 10'$ N. In this field, the lower part of the Bahariya Formation (Lower Cenomanian) has been penetrated.

1.3 Exploration history

1.3.1 North Western Desert

During the last 50 years, particularly during the sixties of the 20th century, north Western Desert of Egypt has had much oil-exploration activity. The Western Desert is the second petroleum province in Egypt. The oil-exploration activity in the Western Desert was accelerated after the 1967 war and the invasion of Sinai by the Israeli aggression which resulted into a great shortage of the oil supply from the Gulf of Suez oil fields which were the main source of the petroleum production and demands of energy consumption in Egypt. Such activity of petroleum exploration in the Western Desert was carried out by Phillips Petroleum Company (PPCO), Western Desert Operating Petroleum Company (WEPCO), American Oil Company (AMOCO) and General Petroleum Company of Egypt (GPC).

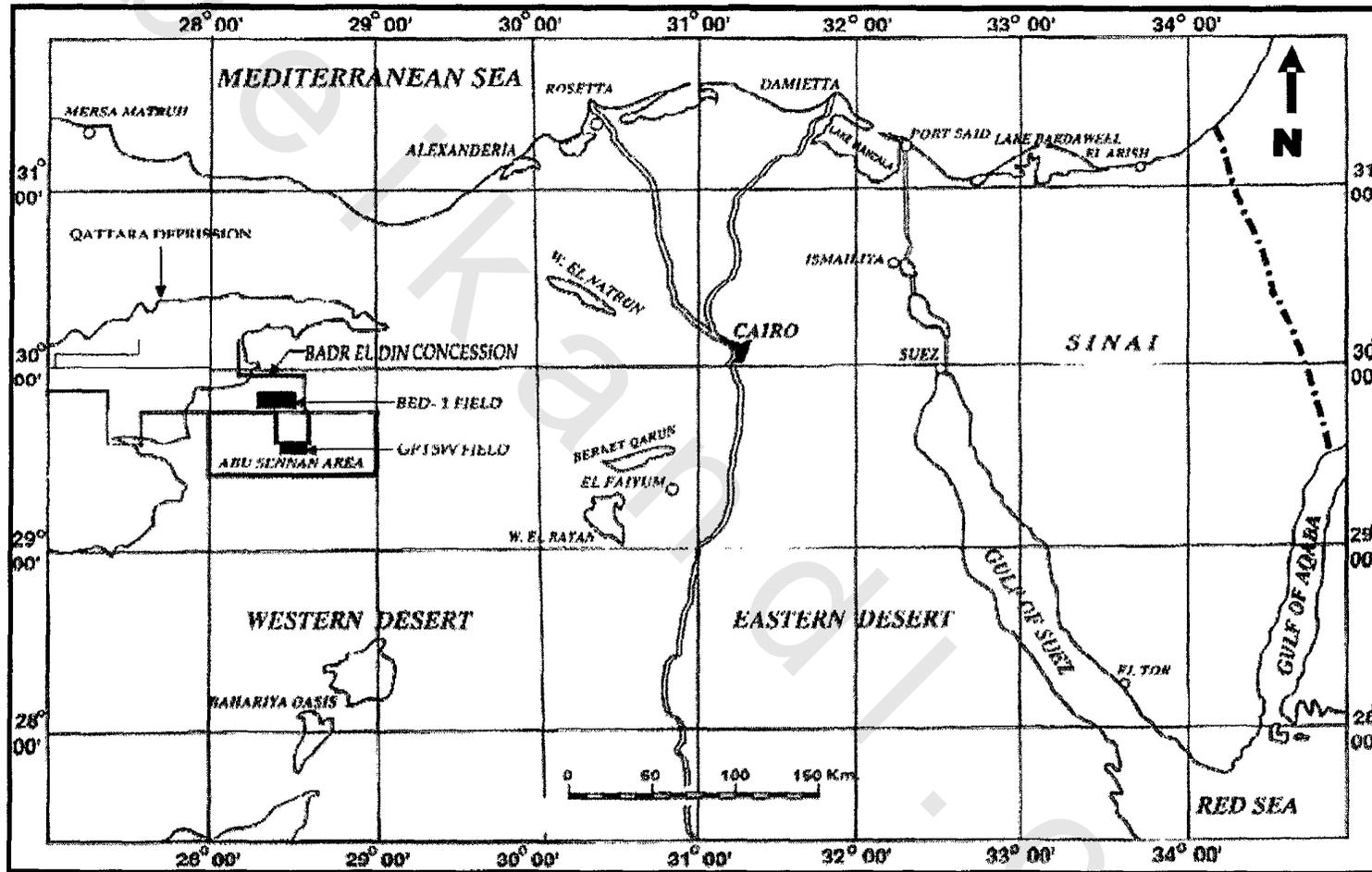


Fig. (1.1): Location map of the studied fields (GPTSW & BED-1), Western Desert, Egypt.

The history of petroleum exploration in the Western Desert of Egypt started in 1938, by Standard Oil Company of Egypt. The petroleum exploration in the Western Desert started again in 1940, by Anglo-Egyptian Oil Company (AEO) which drilled the Dabaa exploratory well between Long. 28° - 29° and Lat. 31° at the coastal area. In 1944, the South Mediterranean Oil Company (SOMED) drilled the Khatatba well, while Abu Roash wells no. 1 and 2 were drilled by (SOE) in 1946. In 1945, Sahara Petroleum Company (SAPETCO) was granted a prospecting lease in the Western Desert covering an area of $230,000 \text{ km}^2$. SAPETCO drilled nine deep test wells but they were proved to be dry wells. Accordingly, this company withdrew from its lease in 1958. In 1963, Egyptian government granted two concessions to ENI, two concessions to Pan American Oil Company and one concession to Phillips Oil Company (PPCO). Phillips Oil Company, Western Desert Operating Petroleum Company, American Oil Company and General Petroleum Company of Egypt, have had much oil- exploration activity in north Western Desert in the half of the sixties of the 20th century. The history of oil-producing fields in north Western Desert started in 1966 with the discovery of Alamein oil field by PPCO, which lies between Long. $28^{\circ} 40'$ - $28^{\circ} 48'$ E and Lat. $30^{\circ} 32'$ - $30^{\circ} 38'$ N, (Metwalli and Abd El-Hady (1973a, 1973b; 1975a and 1975b). The discovery of Alamein field was followed by the discoveries of Umbarka abandoned field (1968), Abu Gharadig oil and gas-gas condensate field (1969), Abu Qir gas field in the offshore limits of the Western Desert and the Nile Delta, Yidma field (1971), El-Razzak and Meleiha fields (1972), Abu Sennan field (1980), GPT (1981), GPY(1982), Badr El-Din (1983), Khalda field (1983) and El-Salam oil field in (1985). The petroleum production in north Western Desert comes mainly from Aptian Dolomite (Alamein Fm.) and Cenomanian clastics (Bahariya Fm.). The Bahariya Formation clastic

sequence (the Upper and Lower Bahariya Members), are the target of the petroleum exploration in north Western Desert till now. In 1985 to 1986 a group of other discoveries (around the formerly mentioned fields which produce from the Upper and/or Lower Bahariya) are included e.g.: Meleiha south-east, Aman, Lotus, Zahra, Karnak, Emry, Falak and Badry fields.

1.3.2 GPTSW oil field

This field located at Abu Sennan area at the central part of north Western Desert. The exploration history of this area dates back to 1967 when AMOCO drilled Abu Sennan-1 well (A.S.1) which tested noncommercial gas in Abu Roash 'C' Member. The first discovery was in 1969 when oil and gas were commercially tested in Abu Gharadig-1 well (A.G.1) from different stratigraphic zones, including the Bahariya sandstones. Abu Sennan concession has been granted to G.P.C. in 1980. The first exploratory GPX-1 well in 1980 yielded minor gases from the Bahariya sands. The GPT-1 exploratory well was the first discovery in 1981, where condensates and gases were recovered from the Bahariya and Abu Roash Formations. This was followed by the discovery of several commercial hydrocarbon accumulations in the GPY (1982), and GPTSW (1985). Till now the Bahariya sandstones are considered as the most important reservoirs and an optimistic future potential is to be expected.

1.3.3 BED-1 oil field

This field located at Badr El Din Concession at the central part of north Western Desert. The first exploration well to be drilled by Shell Winning N.V. in Badr El Din Concession (late 1981) was primarily aimed at the producing reservoirs of Abu Gharadig field which occur in Abu Roash and the Bahariya Formations. Well (BED1-1) found these main objectives cut out by faulting but discovered a significant oil accumulation in the Kharita

Formation. The structural attitude of the BED-1 field led to subsequent producers (four additional wells) being drilled in a similar position along strike of the main boundary fault. Further exploration drilling in the general BED-1 area was primarily aimed at these attractive Kharita reservoirs which had shown good permeability and sustained productivity. Well BED4-1 was drilled on a low relief anticlinal feature immediately to the north of the BED-1 field. Two further wells (BED5-1 and BED9-1) were drilled along the edge of major terrace boundary faults in a structurally similar position to the BED1-1 discovery well. All these tests have proved only marginally or non-commercial. After review of the area in late 1985 emphasis reverted to the Bahariya and Abu Roash Formations. In early 1986 two wells (BED1-6 and BED4-2) were successfully completed on Abu Roash Formation and a third well, BED11-1 proved the extension of Abu Gharadig field into Badr El Din concession. Overall results from Abu Roash Formation have proved to be somewhat unexpected and production potential has been demonstrated for all members of Abu Roash with the exception of the 'A' member.

1.4 Previous works

The geology of north Western Desert has been studied by many authors. Among them are Zittel (1883); Ball and Beadnell (1903); Shata (1953); Said (1962); El Gezeery et al. (1972); El-Bassyony (1972); Franks (1982); Moussa (1986); Barakat and Darwish (1987); Khalifa (1996) and Watkins et al., (2002). Also north Western Desert has been studied sedimentologically by many authors of mention: Barakat and Arafa (1972); Barakat et al. (1976); El-Sheikh (1990) and Darwish et al. (1994). On the other hand the tectonic and structural setting of north Western Desert has been studied by many workers: Zittel (1883); Krenkel (1925); Hume (1929); Said (1962); Meshrif (1990); Said (1990); Khalil and Moustafa (1994); Moustafa et al. (1998) and

Phelps et al. (2002). Several authors dealt with the study of the petroleum-bearing formations in north Western Desert. Among them are: Amin (1961); Barakat (1982); Meshref (1990); El Shaarawy et al. (1994) and Darwish et al. (2000).

1.5 Aim of the study

The present study aims to characterize the anisotropic reservoir parameters of the lower part of the Bahariya Formation in BED1-11 well in BED-1 oil field, the upper part of the Bahariya Formation and Abu Roash Members in different TSW-wells in GPTSW oil field by investigating the geological and petrophysical characteristics. The available materials and data used herein include the following:

- 1-Conventional core samples that were selected from the penetrated cored intervals to cover both, the Bahariya Formation and Abu Roash Members in order to investigate the petrophysical reservoir characteristics (porosity, permeability and capillary pressure).
- 2-Thin sections to describe the lithological description of the studied cores.
- 3-SEM photos for some selected samples to show the microfeatures of the studied cores.