AIN SHAMS UNIVERSITY
FACULTY OF SCIENCE

GAS CHIMNEY DETECTION AND RESERVOIR ROCK GENETIC TYPES USING SEISMIC DATA AND LOG CURVE SHAPES: BALTIM FIELD, MEDITERRANEAN SEA.

A Thesis Submitted for Partial Fulfillment for the Requirements of

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Note

The present thesis is submitted to faculty of science, Ain Shams University in partial fulfillment for the requirements of the Master degree of science in Geophysics.

Beside the research work materialized in the thesis, the candidate has attended ten post Graduate courses for one year in the following topics:

1. Geophysical field measurements
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6. Reservoir Evaluation
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10. Fluid Dynamics

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ABSTRACT

Baltim North Field is located in the offshore Nile Delta. Exploration of this field added an additional play concept for gas, condensate and oil prospecting.

The main object of the present research work is to understanding the mutual relationship between gas chimneys and their direct impact on the Gas reservoirs characteristics. Using analysis of 20 Seismic 2D lines and borehole logs of four wells (BN-1, BN-2, BNE-1, and BN-4) in Baltim Field, the present study was performed. Chimneys are found in the Nile delta while, chimney structures are completely different in their characteristics and in their sedimentology. Escaping of gas and gaseous fluids to the water bottom form pockmarks which are highly abundant in these areas is proved. Pockmarks are nearly circular depressions that form where fluids escape upward through fine-grained seafloor sediments.

The Methodology used on this study qualitative analysis (Log curve shapes) carried out on Abu-Madi formation in the Baltim area gives us a good history of deposition in deltaic environment.

The using of quantitative techniques (Petrel 2015.1,Techlog 2013.4) was very useful in identifying the stratigraphic framework of Abu-Madi formation which is composed mainly of shales with two major sandstone reservoir intervals which are pay zones for gas production (the Level III Main and Level III Lower) and also identifying the areas of Gas acculmation.

Using the Results of Genetic Reservoir Rock Types in this research work gives a good history of deposition in the area and integrated with seismic gives good visualization for tracking the channel sand system in the area.

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CHAPTER 1

INTRODUCTION

In this work a trial has been done to explain the basic information about gas chimneys structure and different terminology used about chimneys in oil industry to clarify the geophysical situation and gas reservoir characterization in the Baltim Field. For this purpose the Log curve shapes of Gama-ray and Resistivity profiles are used to define the Deltaic Genetic Rock Types, and making integration between seismic and logging techniques to reveal the story of gas chimneys; their characteristics and their impaction on gas accumulation in Baltim field.

1.1 Location of Study Area and Available Data

Baltim area lies to the north of the Nile Delta between latitudes 31°37′25″ and 31°56′19″N and longitudes 31°1′12″ and 31°26′7″E, about 25 km off the Mediterranean sea shoreline, Egypt. It covers an area of about 450 km², with a length of 25 km and a width of 18.75 km (Fig.1). Baltim area is considered as the northwest extension of Abu-Madi, El-Qar'a main channel or paleo valley. The area of study is a part of Nile Delta offshore area which is characterized by the presence of large number of gas fields that have a big amount of gas reserves.

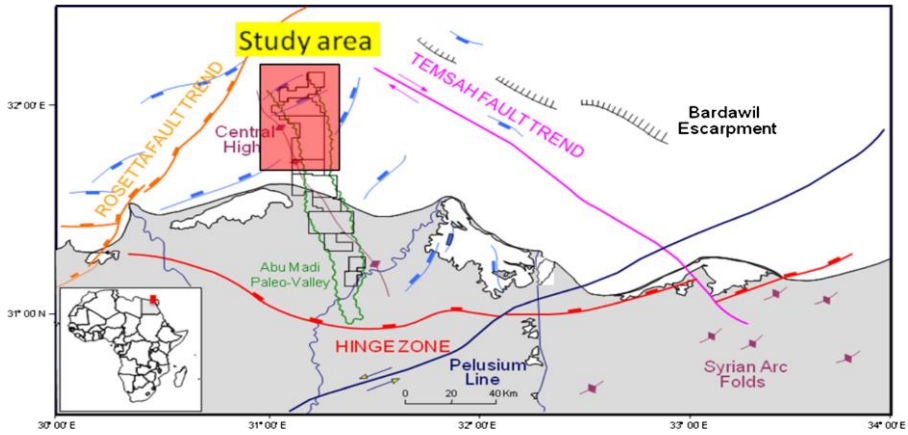

Figure-1: Nile Delta location map with main structure elements (Barsoum et al., 2004).

1.2 Exploration History

Petroleum exploration in the Nile Delta began with gravity, magnetic and seismic data acquisition in the 1940s, and intensive exploration began in 1963 when the International Egyptian Oil Company (IEOC) acquired the first concession (EGPC, 1994). The first detailed seismic survey was performed in the offshore Abu-Madi area in the 1960s and identified a number of Petrophysical characteristics of the Messinian Abu-Madi formation, offshore Nile Delta of promising structural features (EGPC,1994).Two of these structures were drilled but resulted in dry holes (Mit Ghamr-1 and Kafr El Sheikh-1).

The first off-shore gas discovery, well Abu Qir-1, was announced by Phillips Oil Co. in 1969 (Sestini, 1995). This discovery led to WEPCO's (Western Dessert Operating Petroleum Company) gas and condensate production from sandstone reservoirs in the Abu-Madi and Sidi-Salim Formations (Bruneton et al., 2012). After the discovery of gas in 1993 in the Baltim South-1 well, seven additional wells were drilled and led to the discovery of three fields in the Baltim area; Baltim North, Baltim East and Baltim South.

1.3 The Exploration History Passes through Three Stages:

1.3.1 Early Stage (1966-1989). After the discovery of the gas bearing sandstones of {Abu-Madi-1X well (1966)}, the late Messinian Abu-Madi formation represented one of the Main targets in the present offshore area. The discovery area was related to an elongate and faulted anticline, but the presence of different reservoir levels and the drilling of some dry wells suggested both structural and stratigraphic controls on reservoir distribution. The Tertiary stratigraphy of the Nile Delta Basin was defined in these years (Sidi-Salim, Qawasim, Abu-Madi, and Kafr El Sheikh Formations were described in exploratory wells of the area), and the first sedimentological interpretation referred the Abu-Madi formation to a continental/deltaic depositional

environment. Several wells were drilled and the Abu-Madi Field, now connected to the new discoveries of El Qar'a, started to reveal its present geometry and internal reservoir complexity.

1.3.2 Second Stage (1990-1993). The southward extension of the Abu-Madi incised-valley confirmed the hydrocarbon potential of the late Messinian succession. More sophisticated seismic acquisition and processing were carried out in the East Delta Concession where, in 1990, the East Delta 1 well was successfully drilled, 25 km south of the Abu-Madi Field. This and the other wells drilled in those years, either positive or dry, confirmed the strict relationships between gas accumulations and the Messinian drainage system, an ancestor of the present Nile River Delta. An increasing amount of well data, the elaboration of a sequence stratigraphic model, and an effective technological improvement in seismic acquisition and processing allowed to verify the regional geologic framework and to recognize more and more subtle traps.

1.3.3 Third Stage (1993-1996). The acquisition of a 3D seismic volume in the newly acquired in Baltim concession. After the discovery of gas, in 1993 in Baltim East 1, seven other wells were successfully drilled by the partnership IEOC/Amoco, delineating three fields in the area (Baltim North, East, and South Fields). The Baltim exploratory phase represented not only the confirmation of a geologic stratigraphic model, but also a significant change in the geophysical interpretation as some combinations of seismic attributes showed a good correlation with Lithological and petro physical properties within Abu-Madi deposits.

1.4 Features of a Gas Chimney Province

1.4.1 Gas Hydrates

Gas hydrates or gas reservoir are seated in deep depths so it's under high pressure and Temperature increases with depth, and when it is too deep

underneath several hundred meters of sediments, temperature is too high for gas hydrate stability so it release its gases according migration pathways which resemble a potential future energy resource due to the large amount of methane inside them, But it affect climate, because of their release of methane, Fig (2).

Gas beneath the sediments always tries to migrate upwards and laterally. Gas will migrate by buoyancy with other fluids as for example, brines and formation water, from places with higher pressure to places with lower pressure. On the other hand, gas accumulation in sediments depends on the sediment type and its porosity. Gas hydrates form if the right conditions of temperature, pressure and gas source are given (Barsoum et.al, 2004).

Figure-2: Gas hydrate recovered from piston corer at 2550 m water (Helen Gibbons, 2010).