



**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
Master Degree of Science in Applied Geophysics**

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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.

LIST OF CONTENTS	
Subject	Page no.
Aknolgements.....	ii
Abstract.....	iii
CHAPTER ONE	INTRODUCTION
1.1 Location of Study Area and Available Data.....	1
1.2 Exploration History.....	2
1.3 Features of a Gas Chimney Province	3
1.3.1 Gas Hydrates	3
1.3.2 Bottom Simulating Reflection.....	5
1.3.3 Pockmarks.....	6
1.3.4 Gas Chminey.....	7
1.3.5 Schematic Model of Gas Chimney.....	9
CHAPTER TWO	GEOLOGICAL SETTING
2.1 Geological Framework of Nile Delta.....	14
2.2. Structural Pattern.....	16
2.3 Tectonic History.....	17
2.4 Subsurface Stratigraphy and Depositional Regime.....	21
2.5 Baltim Field Depositional Regime	24

CHAPTER THREE		METHODS AND TECHNIQUES	
3.1	Materials and methods.....		30
3.2	Seismic data interpretation.....		31
3.3	Synthetic generation		32
3.4	Picking horizons and structural features		33
3.5	Abu-Madi reservoir Two way time (TWT) map.....		36
3.6	Gas chimney interpretation.....		37
Chapter FOUR		BALTIM GENETIC DELTAIC ROCK TYPES	
4.1	Baltim Genetic Deltaic Rock Types based on log curve shapes.....		40
4.2	Baltim Field Reservoir Rocks Genetic Types.....		42
4.2.1	Distributary channels.....		42
4.2.2	Meandering channels		44
4.2.3	Braided stream alluvium.....		46
4.2.4	Distributary mouth bars.....		48
4.3	Depositional History.....		49
CHAPTER FIVE		BOREHOLE LOG ANALYSIS AND RESERVOIR EVALUATION	
5.1	Borehole Log Analysis.....		52
5.1.1	Petrography analysis of Abu-Madi formation.....		52
5.2.1	Petrophysical evaluation of Abu-Madi reservoir.....		55
5.2.2	Determination of volume of shale.....		56
5.2.3	Effective porosity calculation.....		61
5.3	Lithological Interpretation.....		63
5.4	Saturation Dual Water Caluclation.....		66

5.5 Well Analysis Results.....	70
5.6 Abu-Madi formation Evaluation.....	73
5.6.1 Net pay thickness contour map.....	73
5.6.2 Average porosity contour map.....	74
5.6.3 Water saturation contour map.....	75
5.6.4 Volume of shale contour map.....	76
CHAPTER SIX	PETROLEUM SYSTEM
6.1 Petroleum System.....	77
6.2 Source Rock.....	79
6.3 Reservoir Rock.....	79
6.4 Seal System.....	80
6.5 Hydrocarbon Accumulation and migration	81
SUMMARY AND CONCLUSIONS.....	88
REFERENCES.....	92

LIST OF FIGURES

Figures	Page no.
Figure 1: Baltim Field Location map.....	1
Figure 2: Gas hydrate recovered from piston corer at 2550 m water depth.....	4
Figure 3: Seismic profiles of a gas chimney with a pockmark at its top.....	5
Figure 4: 3D bathymetric map of the Central Nile Deep Sea Fan.....	6
Figure 5: Pockmarks are frequently located atop gas chimneys.....	7
Figure 6: Seismic line connects the Gas chimney (B).....	9
Figure 7: Schematic model of gas chimney	11
Figure 8: Nile delta screenshot from NASA's globe software World Wind.....	12
Figure 9: Nile delta hinge zone	14
Figure 10: Geological domains of the Nile Cone.....	17
Figure 11: The Temsah Fault and Miocene Salt Basin.....	18
Figure 12: The Rosetta Fault and Miocene Salt Basin.....	20
Figure 13: The E–W normal faults and rotated fault blocks.....	20
Figure 14: Nile delta stratigraphic column (IEOC, 1967).....	21
Figure 15 : Lithostratigraphic column of the Nile Delta in Baltim area.....	26
Figure 16: Sequence stratigraphic Framework of Abu-Madi formation.....	28
Figure 17: Location map of seismic profiles and wells in the Baltim area.....	29
Figure 18: Well BN-1, Depth-OWT relationship with linear depth scales.....	32
Figure 19: Inline Seismic line illustrates Abu-Madi main channel.....	34
Figure 20: Xline Seismic line illustrates Abu-Madi main channel.....	35
Figure 21: 2D time structure map of Abu-Madi main channel.....	36
Figure 22: 3D extracted amplitude time map of Abu-Madi main channel.....	37

Figure 23: Seismic line shows the chaotic behavior of gas chimneys.....	39
Figure 24: General gamma-ray responses to variation in size	41
Figure 25: Log curve shapes of algyo-2 rock sequence.....	42
Figure 26: BN-1 well Distributary channel log curve shapes	43
Figure 27: BN-2 well Distributary channel log curve shapes.....	44
Figure 28: BN-1 well meandering fluvial channel log curve shapes.....	45
Figure 29: BN-2 well meandering fluvial channel log curve shapes.....	46
Figure 30: BN-1 well braided stream alluvium log curve shapes.....	47
Figure 31: BN-2 well braided stream alluvium log curve shapes.....	47
Figure 32: BN-2 well distributaries mouth bars log curve shapes.....	48
Figure 33: Samples depths for the two wells	53
Figure 34: Pore network thin section of Abu-Madi formation at depth 3686 m..	54
Figure 35: Thin section of Abu-Madi at depth 3689.3 m.....	51
Figure 36: Volume of Shale Caluclation plot.....	55
Figure 37: Dia porosity cross-plot containing the volume of shale points.....	57
Figure 38: Effective porosity calculation plot.....	60
Figure 39: Lithologies Schlumberger Diaporostiy cross plot.....	63
Figure 40: Cross plot illustrating the Lithological elements of Abu-Madi.....	64
Figure 41: Rw calculated from Kafr El Sheikh formation.....	65
Figure 42: Pickett plot to calculate water saturation	67
Figure 43: BN-1 well Petrophysical plot to calculate Water saturation.....	68
Figure 44: Final Petrophysical plot of BN-1 well.....	69
Figure 45: Abu-Madi Net Pay Map.....	71
Figure 46: Abu-Madi Average Porosity Map.....	73

Figure 47: Abu-Madi Water Saturation Map.....	74
Figure 48: Abu-Madi Shale Volume Map.....	75
Figure 49: Hydrocarbon reservoirs and migration pathways.....	76
Figure 50: Nile Delta schematic X-section for HC migration.....	83
Figure 51: Seismic section illustrating source rock maturation.....	84

LIST OF TABLES

Table	Page no.
1. The Log Curve Shapes Results.....	51
2. Volume of Shale Results.....	58
3. Shale Volume from porosity.....	59
4. Effective Porosity Results.....	62
5. Average Water Saturation Results.....	70
6. Final Petrophysical Results.....	72

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 impact 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 $31^{\circ}37'25''$ and $31^{\circ}56'19''N$ and longitudes $31^{\circ}1'12''$ and $31^{\circ}26'7''E$, 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.

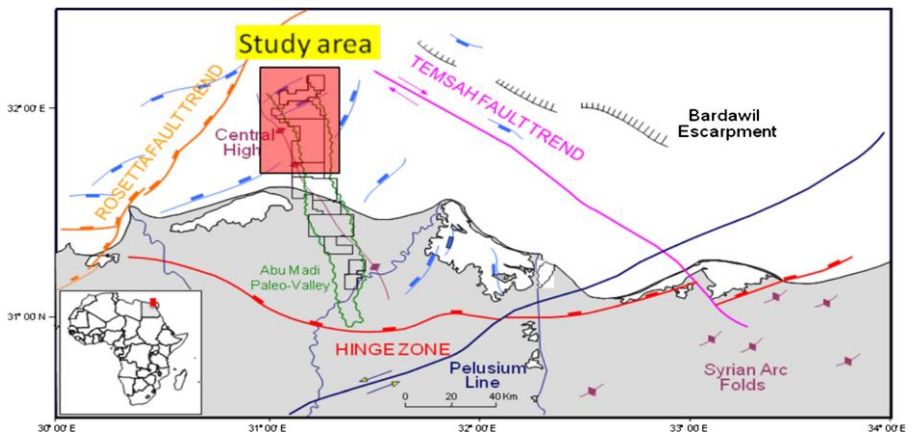


Figure-1: Nile Delta location map with main structure elements (Barsoum et al., 2004).

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).