

# RESERVOIR ESTIMATION OF JOYA MAIR 04



**Muhammad Kashif**

**(01-161071-022)**

**Haider Shabbir**

**(01-161071-010)**

**Department of Earth and Environmental sciences**

**Bahria University Islamabad**

## **ABSTRACT**

The seismic lines 93-MN-04, 93-MN-05 and 93-MN-06 lies in Joya mair area south-east of the Potwar foreland basin. Seismic sections are very important for imaging the subsurface formations and structures of the subsurface of the earth particularly for the exploration of hydrocarbons, in seismic reflection surveys the travel times are measured with waves reflected from subsurface between media of different acoustic impedance and this construct a reflector on a seismic time section. Sections show most probably the thin-skinned deformation in cover rocks i.e. a thrust salt core anticline. These types of structure are formed due to the movement of salt below the cover rocks. In Joya Mair area thin-skinned deformation in cover rocks resulted in pop-up anticline, Snake-head anticlines, thrust salt cored anticlines and triangle zones. These structures form compressional traps for oil and gas accumulation. There are two major breaks in the burial history of the area .One is from Ordovician to Carboniferous because the whole Potwar basin was uplifted during that time. The other is from late Permian to Cretaceous because the rocks from west to east in the Potwar Basin were eroded due to significant Pre-Paleocene tectonic uplift.

Two prominent reflectors were marked on the basis of their reflection, which represent top Eocene Formations and Khewra Formation respectively. Reflectors were identified with the help of well top data. Two-way time (TWT) from the seismic sections and average velocities were used to create TWT map and then calculate the area with graph paper according to the scale of the base map.

Then petrophysical study has been carried out in Joya Mair well 04, in this study we interpret the different logs and applied various techniques of petrophysics to evaluate the lithology, porosity, saturation, resistivity and the volume of shale and estimate the reservoir volume of Khewra sandstone.

## **ACKNOWLEDGEMENT**

All adoration and veneration to THE ALLMIGHTY ALLAH. We thank ALLAH for His endless blessings He bestowed upon us. We thank Him for the strength and will that He gave us for the completion of this dissertation and making our frail efforts a success.

We thank our parents whose constant encouragement, belief in our abilities and support helped us through the completion of the degree and dissertation, and their guidance which always guided us through dark patches.

We acknowledge the efforts of our supervisor, Mr. Rai Hamood Inam, who guided us through the technical aspects of the dissertation and helped us, related theory to the practical application. He took out his precious time to help settle down all our queries.

We would like to pay special thanks to our HOD, Dr. Zafar whose supervision and guidance bring this research to success. We would like to thank Mr. Saqib Mehmood who overviewed our exposition and gave ideas to improve it a lot.

Kashif, Haider

## **DEDICATION**

*We dedicate this dissertation to our families, especially our parents, whose patience and love got us where we are and friends.*

# Contents

1	INTRODUCTION.....	1
1.1	Introduction to the Study Area:.....	1
1.2	Objectives:.....	2
1.3	General Physiology:.....	2
1.4	Base Map:.....	4
1.5	Seismic Lines:.....	5
1.6	Survey Parameters:.....	5
1.6.1	General Acquisition Parameters:.....	5
1.6.2	Source Information:.....	5
1.6.3	Receiver Information:.....	5
1.7	Data Processing:.....	6
1.7.1	Processing Sequence:.....	6
1.8	Display Parameters:.....	7
2	GEOLOGY OF THE AREA.....	8
2.1	Introduction:.....	8
2.2	Regional Depositional History:.....	8
2.3	General Stratigraphy of the Area:.....	10
2.4	Structure and Tectonics:.....	12
2.5	Potential Decollement and Faulting:.....	13
2.6	Petroleum Prospects:.....	14
2.6.1	Source Rocks:.....	14
2.6.2	Traps:.....	<b>Error! Bookmark not defined.</b>
2.6.3	Reservoir Rocks:.....	<b>Error! Bookmark not defined.</b>
2.6.4	Seal & Cap Rocks:.....	<b>Error! Bookmark not defined.</b>
3	SEISMIC ACQUISITION AND PROCESSING.....	<b>Error! Bookmark not defined.</b>
3.1	Seismic Data Acquisition:.....	<b>Error! Bookmark not defined.</b>

3.2	Two-dimensional survey (2-D):.....	<b>Error! Bookmark not defined.</b>
3.3	Seismic Data Processing: .....	<b>Error! Bookmark not defined.</b>
3.3.1	Multiplex & Demultiplex:.....	<b>Error! Bookmark not defined.</b>
3.3.2	Data Editing .....	<b>Error! Bookmark not defined.</b>
3.3.3	Sorting: .....	<b>Error! Bookmark not defined.</b>
3.3.4	Static Correction:.....	<b>Error! Bookmark not defined.</b>
3.3.5	NMO Correction: .....	<b>Error! Bookmark not defined.</b>
3.3.6	NMO Velocity:.....	<b>Error! Bookmark not defined.</b>
3.3.7	CDP Stacking:.....	<b>Error! Bookmark not defined.</b>
3.3.8	Digital Filtering:.....	<b>Error! Bookmark not defined.</b>
3.3.9	Migration: .....	<b>Error! Bookmark not defined.</b>
3.3.10	Data Presentation and Storage: .....	<b>Error! Bookmark not defined.</b>
4	INTERPRETATION .....	<b>Error! Bookmark not defined.</b>
4.1	Introduction: .....	<b>Error! Bookmark not defined.</b>
4.2	Stratigraphic Analysis .....	<b>Error! Bookmark not defined.</b>
4.3	Structural Analysis:.....	<b>Error! Bookmark not defined.</b>
4.4	Interpretation Work Flow:.....	<b>Error! Bookmark not defined.</b>
4.5	Interpretation of Available Seismic Data: .....	<b>Error! Bookmark not defined.</b>
4.5.1	Available Data.....	<b>Error! Bookmark not defined.</b>
4.6	Marking of Prominent Reflectors: .....	<b>Error! Bookmark not defined.</b>
4.6.1	Tracing the marked reflectors and adjusting miss ties:..	<b>Error! Bookmark not defined.</b>
4.6.2	Reflector Identification:.....	<b>Error! Bookmark not defined.</b>
4.6.3	Faults Identification:.....	<b>Error! Bookmark not defined.</b>
4.6.4	Two way time contour maps:.....	<b>Error! Bookmark not defined.</b>
4.6.5	Calculate The Area:.....	<b>Error! Bookmark not defined.</b>
4.7	Analysis of available seismic lines: .....	<b>Error! Bookmark not defined.</b>
4.7.1	Line 93-MN-04: .....	<b>Error! Bookmark not defined.</b>
4.7.2	Line 93-MN-05: .....	<b>Error! Bookmark not defined.</b>

4.7.3	Line 93-MN-06: .....	<b>Error! Bookmark not defined.</b>
4.8	Time contour Map(Sakesar): .....	<b>Error! Bookmark not defined.</b>
4.9	Time contour Map(Khewra): .....	28
4.10	Calculation of the Area: .....	<b>Error! Bookmark not defined.9</b>
5	Well Logging.....	30
5.1	Introduction: .....	30
5.2	Classification of Logging Tools:.....	<b>Error! Bookmark not defined.</b>
5.2.1	Lithology Logs - These logs are designed to: .....	<b>Error! Bookmark not defined.</b>
5.2.2	Porosity Logs - These logs are designed to:.....	<b>Error! Bookmark not defined.</b>
5.2.3	Saturation (Resistivity) Logs -These logs are designed to:.....	<b>Error! Bookmark not defined.</b>
5.3	Well Logs: .....	<b>Error! Bookmark not defined.</b>
5.3.1	Gamma Ray and Spectral Log: .....	<b>Error! Bookmark not defined.</b>
5.3.2	Density Log and photoelectric factor log:.....	<b>Error! Bookmark not defined.</b>
5.3.3	Sonic Log:.....	<b>Error! Bookmark not defined.</b>
5.3.4	Neutron Log:.....	<b>Error! Bookmark not defined.</b>
5.3.5	Caliper Log: .....	<b>Error! Bookmark not defined.</b>
5.3.6	SP Log: .....	<b>Error! Bookmark not defined.</b>
5.3.7	Resistivity and Conductivity Log:.....	<b>Error! Bookmark not defined.</b>
5.4	Reserves Estimation: .....	<b>Error! Bookmark not defined.</b>
	Basic Reserve Estimation Methods: .....	<b>Error! Bookmark not defined.</b>
5.5	Volumetric Method: .....	<b>Error! Bookmark not defined.</b>
5.6	Log Interpretation Work Flow: .....	<b>Error! Bookmark not defined.</b>
6	Well Logs Interpretation .....	<b>Error! Bookmark not defined.</b>
6.1	Determination of Basic Reservoir Characteristics from Logs: .....	<b>Error! Bookmark not defined.</b>
6.1.1	Porosity Determination: .....	<b>Error! Bookmark not defined.</b>
6.1.2	Permeable Bed Location: .....	<b>Error! Bookmark not defined.</b>
6.1.3	Hydrocarbon Saturation Indications:.....	<b>Error! Bookmark not defined.</b>

6.1.4	Bed Boundary Determination: .....	<b>Error! Bookmark not defined.</b>
6.2	Porosity: .....	<b>Error! Bookmark not defined.</b>
6.3	Permeability:.....	<b>Error! Bookmark not defined.</b>
6.4	Water Saturation: .....	40
6.5	Formation Water Resistivity:.....	40
6.6	Water Saturation: .....	40
6.7	Volume of Shale: .....	40
6.8	Well data: .....	<b>Error! Bookmark not defined.</b>
6.9	Petrophysical Interpretation:.....	<b>Error! Bookmark not defined.</b>
6.10	Volumetric Reservoir Estimation:.....	<b>Error! Bookmark not defined.</b>
6.10.1	Proved Reserve: .....	<b>Error! Bookmark not defined.</b>
6.10.2	Proved + Probable Reserve:.....	<b>Error! Bookmark not defined.</b>
6.10.3	Proved + Probable + Possible Reserve: .....	<b>Error! Bookmark not defined.</b>
6.11	Conclusion:.....	<b>Error! Bookmark not defined.</b>
REFERENCES:.....		<b>Error! Bookmark not defined.</b>
APPENDIX:.....		<b>Error! Bookmark not defined.</b>

### **List of Tables**

Table 1	Seismic Lines.....	5
Table 2	Band-Pass Filter Parameters.....	7
Table 3	Stratigraphic Column of Potwar(Amir Et AL,2006).....	11
Table 4	Interpretation Work Flow.....	21
Table 5	Log Interpretation Work Flow.....	36
Table 6	Depth of formation.....	41
Table 7	Logs interpretation.....	42

### **List of Figures**

Figure 1	Joya Mair Oil Field.....	1
Figure 2	Geological Map of Upper Indus Basin (Prospective Exploration Licenses Pakistan).....	3



Figure 3 Base Map of the Area .....	4
Figure 4 Generalized Stratigraphy of Potwar sub-Basin (Mughal Et Al 2003) .....	10
Figure 5 Tectonic Map Of The Potwar Plateau.....	12
Figure 6 Seismic Acquisition Using Vibrator Truck (Geology and Geophysics in Oil Exploration by Muhammad Suroor p-36).....	15
Figure 7 2D Seismic Survey (Geology And Geophysics in Oil Exploration by Suroor p-36) .....	16
Figure 8 Line 93-MN-04 .....	24
Figure 9 Line 93-MN-05 .....	25
Figure 10 Line 93-MN-06.....	26
Figure 11 Time Contour Map(Sakesar).....	27
Figure 12 Time Contour Map(Khewra).....	28
Figure 12 Graph Paper.....	29
Figure 13 Logging Operation (after Well Logging Basics by Baker Hughes INTEQ 1992).....	30
Figure 14 A Typical Geological Net Pay Isopach Map.....	35
Figure 15 Gen-9 Used for The Calculation of $R_w$ from Water Salinities and Temp (after Schlumberger Chart Book 2000).....	47
Figure 16 SP-1 Chart Used in SSP Method for Calculation of $R_w$ (after Schlumberger Chart Book 2000).....	48
Figure 17 SP-2 Chart Used in SSP Method for Calculation of $R_w$ (after Schlumberger Chart Book 2000).....	49
Figure 18 RHOMA versus UMAA Chart Used for Lithology Identification (after Schlumberger Chart Book 2000) .....	50
Figure 19 CP-1b Chart Used for the Porosity and Lithology Determination from Density and Neutron Porosity (after Schlumberger Chart Book 2000) .....	51