

**2D SEISMIC INTERPRETATION OF GHAUSPUR AREA
AND PETROPHYSICAL ANALYSIS OF INDUS-1B AND
BADAR SOUTH-O1 CENTRAL INDUS BASIN,
PAKISTAN**



By

ARSALAN SAEED

**Department of Earth and Environmental Sciences
Bahria University, Islamabad**

2014

ABSTRACT

The research work is carried out in Ghauspur block district Sukkur, Pakistan. The block covers the area of 2435.40 Km² and is almost 71 meter above the sea level. Geologically the area lies on the southern margin of Central Indus Basin. There is no outcrop exposed but subsurface strata ranging from Jurassic to recent represents extensional regime. The main objective of the research work was to model the productive zones from seismic and well log data. Study was conducted by acquiring ten seismic lines and well log data of Badar south-1 and Indus-1B by the Directorate General of Petroleum Concession. During the study of Seismic sections, firstly interested reflectors i.e Sui main and Sui upper limestone were picked along the faults from the seismic sections with the help of synthetic seismic section. Then the time and depth contours were generated by using Kingdom software by the help of which structure was interpreted. In Petrophysical studies, reservoir zone was identified and reservoir parameters that are volume of shale, porosity, net pay calculation after application of cut-off, resistivity of water, water saturation, hydrocarbon saturation, Lithology was determined. During petrophysical interpretation, water Saturation against depth interval shows the behavior of the key reservoir. 3D Structural correlation between both wells was carried out through VuPak module of Kingdom in order to check the behavior of structure and as a validation of seismic interpretation. The seismic interpretation shows that the area is majorly comprise of normal faulting and negative flower structures in the area indicates presence of strike slip component. Over all the structure is getting shallower toward western side and is deeper in eastern side of the study area. An anticlinal structure is confirmed on western side by time and depth contouring. Petrophysically both the wells are water wet with hydrocarbon saturation of 33% and 35.1% in Badar south-1 and Indus-1B respectively at Sui main limestone level. In both wells good porosity lies only in top portion but do not have enough hydrocarbon saturation to be produced as commercially.

ACKNOWLEDGEMENTS

I wish to express my sincere and deep sense of gratitude to my supervisor, Mr. Saqib Mehmood, Assistant Professor, Bahria University, Islamabad, who provided me invaluable guidance, continuous support, advice, and supervision throughout this work. I owe special thanks to Dr. Tahseenullah Khan, Professor, Bahria University, Islamabad, who reviewed this research work and endowed me with his valuable time. I will also pay my thanks to Head of Department, Prof. Dr. Muhammad Zafar and all the teachers for their cooperation and assistance that made me able to complete this research. I am also not forgetting my friends especially Ehtisham Javed, Abdul Shakoor, Kamran Wali, Abdul Hadi, Abid Jan and Mohammad Mohiuddin who always appreciated, encouraged, and helped me guiding my way ahead in the future endeavors and have remained my greatest moral and spiritual support throughout.

Last but not least, I am indebted to my family members for their moral and financial support throughout my educational career.

CONTENTS

	Page
ABSTRACT	i
ACKNOWLEDGEMENTS	ii
CONTENTS	iii
FIGURES	v
TABLES	vii

CHAPTER 1

INTRODUCTION

1.1	Area of study	1
1.2	Aim and objectives	2
1.3	Data set	2
1.4	Methodology for research work	4

CHAPTER 2

REGIONAL GEOLOGY

2.1	Regional geological settings	5
2.2	Pakistan basins	6
2.2.1	Central Indus Platform Basin	7
2.3	Tectonic setting of study area	8
2.4	Petroleum system	10
2.4.1	Source	10
2.4.2	Reservoir	10
2.4.3	Seal	10

CHAPTER 3

SEISMIC DATA INTERPRETATION

3.1	Seismic interpretation	11
3.1.1	Structural interpretation	11
3.1.2	Stratigraphic interpretation	12
3.2	Sequences for interpretation of project lines	12
3.2.1	Reflection identification	12
3.2.2	Synthetic seismogram of well data of Indus-1B	12
3.2.3	Correction applied on mistie	14
3.2.4	Fault identification and loop tying	15

3.2.5	Seismic sections interpretation	16
3.2.6	Time contour maps	25
3.2.7	Velocity interpretation	26
3.2.8	Depth contour maps	28
3.2.9	3D visualization of Sui Main Limestone	29

CHAPTER 4

PETROPHYSICAL ANALYSIS

4.1	Introduction	32
4.2.	Logs used in interpretation of Badar South-01 and Indus-1B	32
4.2.1	Gamma ray log	32
4.2.2	Neutron log	32
4.2.3	Density log	33
4.2.4	Resistivity Log	33
4.3	Petrophysical Interpretation	34
4.3.1	Lithological cross plots	37
4.3.2	Determination of shale volume	38
4.3.3	Porosity	38
4.3.4	Water saturation	42
4.3.5	Hydrocarbon saturation	42
4.3.6	Reservoir characteristics	45
4.4	Log correlation	45
4.4.1	Structural correlation	45
4.4.2	Stratigraphic correlation	47
	CONCLUSION	48
	RECOMMENDATIONS	49
	REFERENCES	50

FIGURES

	Page
Figure 1.1. Location of the study area.	2
Figure 1.2. Seismic base map across study area.	3
Figure 2.1. Regional geological map (after Iqbal and Shah, 1980)	6
Figure 2.2. Sedimentary basins of Pakistan (modified after Kadri, 1995)	7
Figure 2.3. Location of Sukkur Field on Punjab Platform (modified after Kadri, 1995)	9
Figure 3.1. Synthetic seismogram of Indus- 1B (wavelet type 0 phase clauder).	13
Figure 3.2. Synthetic seismogram overlaid on line GHA-96-04.	14
Figure 3.3. Loop tie between GHA-94-16, 07 and 08.	15
Figure 3.4. Interpreted seismic line GHA-94-07.	16
Figure 3.5. Interpreted seismic line GHA94-09.	17
Figure 3.6. Interpreted seismic line GHA-96-11.	18
Figure 3.7. Interpreted seismic line GHA-96-03.	19
Figure 3.8. Interpreted seismic line GHA-94-05.	20
Figure 3.9. Interpreted seismic line GHA-96-04.	21
Figure 3.10. Interpreted seismic line GHA-94-08.	22
Figure 3.11. Seismic line GHA-94-06.	23
Figure 3.12. Interpreted seismic line GHA-94-18.	24
Figure 3.13. Time contour map of Sui Upper Limestone.	25
Figure 3.14. Time contour map of Sui Main Limestone.	26
Figure 3.15. Regression analysis graph for seismic line GHA-94-07.	27
Figure 3.16. Depth contour map of Sui Upper Limestone.	28
Figure 3.17. Depth contour map of Sui Main Limestone.	29
Figure 3.18. Fence diagram at SML level.	30
Figure 3.19. 3D visualization of SML.	31
Figure 3.20. 3D model showing Indus-1B and Badar South-01.	31
Figure 4.1. Log suite of well Badar South-01 used for petrophysical interpretation.	35
Figure 4.2. Log suite of well Indus-1B, used for petrophysical interpretation.	36
Figure 4.3. Lithological cross plot (RHOB vs NPHI) for Badar South-01.	37

Figure 4.4.	Lithological cross plot (RHOB vs NPHI) for Indus-1B.	38
Figure 4.5.	Shale volume of SML at Badar South-01.	40
Figure 4.6.	Shale volume of SML at Indus-1B.	41
Figure 4.7.	Petrophysical interpretation of well Badar South-01.	43
Figure 4.8.	Petrophysical interpretation of well Indus-1B.	44
Figure 4.9.	Structural correlation between well Indus-01B and Badar South-01.	46
Figure 4.10.	Stratigraphic correlation between well Indus-01B and Badar South-01.	47

TABLES

	Page
Table 1.1. Available seismic data across study area.	3
Table 4.1. Reservoir characteristics of Sui Main Limestone.	45