

**STRUCTURAL INTERPRETATION OF BALKASSAR
ANTICLINE POTWAR SUB BASIN, PAKISTAN
BASED ON 2-D SEISMIC DATA**



BY

MALIK MUHMMAD SHIRAZ

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

TABLE OF CONTENTS

TOPICS	PAGE NO
Acknowledgements	
Abstract	
List of Figures	
List of Tables	
CHAPTER # 1	
Introduction	
1.1 General introduction	1
1.2 Introduction to study area	2
CHAPTER # 2	
Physiography	
2.1 General Physiography	5
CHAPTER # 3	
Geology of the Area	
3.1 Stratigraphy	7
3.2 Lithological description of formations	8
3.3 Paleozoic sedimentary rocks	8
3.3.1 Cambrian	8
3.3.1.1 Khewra Formation	9
3.3.2 Permian	9

3.3.2.1	Tobra Formation	9
3.3.2.2	Dandot Formation	9
3.3.2.3	Warchha Formation	10
3.3.2.4	Sardhai Formation	10
3.4	Tertiary sedimentary rocks	11
3.4.1	Paleogene	11
3.4.1.1	Paleocene	11
3.4.1.1.1	Hangu Formation	11
3.4.1.1.2	Lockhart Formation	12
3.4.1.1.3	Patala Formation	12
3.4.1.2	Eocene	12
3.4.1.2.1	Sakesar Formation	12
3.4.1.2.2	Chorgali Formation	13
3.4.2	Neogene	13
3.4.2.1	Miocene	13
3.4.2.1.1	Murree Formation	13
3.4.2.1.2	Kamlial Formation	14
3.4.2.1.3	Chinji Formation	14
3.4.2.2	Pliocene	14
3.4.2.2.1	Nagri Formation	15
3.5	Regional depositional history	17
3.6	Potential decollement level and faulting	17

3.7	Interpretation of subsurface mapping	18
3.8	Regional tectonic settings	19
3.9	Petroleum geology	22
3.9.1	Hydrocarbon entrapment in Potwar	22
3.10	Hydrocarbon potential of Cambrian	24
3.10.1	Regional distribution of Cambrian	24
3.10.2	Tectonic and depositional setting of Cambrian	24
3.11	Source rocks	25
3.12	Reservoir rocks	25
3.13	Traps	26
3.14	Burial history	26

CHAPTER # 4

Seismic data acquisition

4.1	Introduction	32
4.2	Instruments used	33
4.3	Seismic Energy Sources for Reflection Shooting	33
4.3.1	Vibroseis	34
4.4	Seismic detectors	35
4.4.1	Geophone	35
4.5	Spread geometry	36

CHAPTER # 5

Seismic data processing

5.1	Introduction	37
5.2	Parameters used	38
5.3	Objectives	39
5.4	Seismic data processing	40
5.4.1	Processing Sequence	40
5.4.2	Correlation	41
5.4.2.1	Cross Correlation	42
5.4.2.2	Auto Correlation	42
5.4.3	Vibroseis Correlation	42
5.4.4	Editing and Muting	42
5.4.4.1	Muting	43
5.4.5	Geometric Corrections	43
5.4.5.1	Static correction	44
5.4.5.2	Dynamic correction	44
5.4.6	Filtering	45
5.4.6.1	Digital Filters	45
5.4.7	Deconvolution	46
5.4.8	Velocity Analysis	47
5.4.9	Migration	48

CHAPTER # 6

Seismic velocities

6.1	Introduction	50
6.1.1	The nature of velocity data	50
6.2	Effects of physical properties of rocks on seismic velocities	50
6.3	Velocity Estimation	51
6.4	Types of velocities used in seismic exploration	51
6.4.1	Average Velocity	52
6.4.2	Interval Velocity	53
6.4.3	Root-Mean-Square (RMS) Velocity	53
6.4.4	Normal-Move out Velocity	55
6.4.5	Instantaneous velocity	56
6.5	Correlation between velocity types	56
6.5	Factors affecting velocity	57

CHAPTER # 7

Seismic data interpretation

7.1	Introduction	58
7.2	Structural analysis	59
7.3	Stratigraphic analysis	59
7.4	Methods of preparing depth section	60
7.5	Interpretation plan	60
7.5.1	Interpreter's objective	60

7.5.2	Regional Tectonic, structural, and depositional trends	60
7.5.3	Seismic patter	61
7.5.4	Building and merging data sets	61
7.6	Interpretation techniques	62
7.7	Base map	63
7.8	Reflectors identification	63
7.9	Fault identification	64
7.10	Time Contour Map	65
7.11	Average Velocity Graph	65
7.12	Depth Contour Map	65
7.13	Structure	66

Chapter # 8

CONCLUSIONS	78
REFERENCES	79

ABSTRACT

Balkassar Oil Field discovered in 1945 is one of the oldest known Oil Fields of Pakistan. It lies in the Central Potwar on the southern flank of Soan Syncline. The already interpreted 2-D seismic data, consisting of seismic lines PBJ-04 and PBJ-09 is re-interpreted. This seismic survey was carried out in 1980 to explore the deeper potential of the sedimentary sequence i.e. Khewra Sandstone of Early Cambrian age. The surface geological information does not reflect the subsurface geometry of the Balkassar Anticline.

The major aim of interpretation is to reveal as clearly as possible the subsurface structure of the Balkassar Anticline and to infer the possibility of hydrocarbon occurrence in deeper horizons of the sedimentary sequence. The interpretation includes, the calculation of lateral and horizontal variation in seismic velocities and amplitudes that help in recognizing the structural and stratigraphic variations of the Balkassar Anticline, the construction of time contour map of top Eocene and preparation of depth sections along Seismic dip lines PBJ-04 and PBJ-05.

The Balkassar Structure is a long, northeast southwest trending double plunging anticline. The structure is bounded by tear and reverse faults. The northwestern flank of the structure is steeply dipping and is terminated by southeast dipping reverse fault. Estimated horizontal closure of Balkassar Anticline is 80 sq.km and the vertical closure is 365 meter. Two decollement surfaces are present, one in the Pre-Cambrian Salt, the other in Neogene Sediments. The compressional tectonic of the structure is obvious from the reverse faults that bound the plunge of the structure. The geoseismic section along PBJ-04 show a salt-cored Pop-Up structure, which is one of the most favorable structures for oil and gas accumulation. The well data of Balkassar Oxy # 1 was used to confirm the reflectors depth.