

**STRATIGRAPHIC AND STRUCTURAL INSIGHT INTO  
THE KALA KHEL AREA KHYBER AGENCY,  
NORTH WEST PAKISTAN**



**By**

**AHMED KAMAL-UD-DIN**

**ABDUL HAMEED**

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

**2015**

## ACKNOWLEDGEMENT

We are thankful to Almighty Allah Who is the Creator of all world and is the Master of the Day of Judgment. No words of thanks can be appropriate for His immense blessings that He gives us the audacity and prospect to complete our thesis.

We offer our gratitude to HOD Prof Dr. Muhammad Zafar, external supervisor Dr. Suleman Khan Assistant Professor, Department of Geology University of Peshawar, Internal supervisor Mr. Saqib Mehmood, Assistant Professor, Bahria University Islamabad.

We are grateful to our friends Syed Irfanullah Hashmi, Nasir Shafique, Sajid Rahman, Zakir Khan and Ghulam Nabi. Special thanks to our loving parents, caring sisters and brothers who provided us full support through all possible resources with great patience during this thesis.

## **ABSTRACT**

The present study is investigated for Litho-biostratigraphy and structure geology in order to provide reliable stratigraphic framework and to map the rock units and delineate the structural style of the Kala Khel area. Kala Khel area represents the northwestern extremity of the Indus basin. It is situated in the south of Peshawar city. Tectonically, this area is located at the southern part of main collision of the Indian-Eurasian plate and represents the hanging wall of the Main Boundary Thrust (MBT)

Under litho- biostratigraphy investigation the age of the exposed rock units were established using biostratigraphy and law of super position. The exposed rock units are Samana Suk Formation, Chichali Formation, Lumshiwai Formation, Kawagarh Formation, HanguFormation , Lockhart Formation and Patala Formation

Structural investigation suggested that the study area represents the hanging wall of the MBT, as situated in close vicinity of such structure the area has undergone severe deformation. The mapped structures are trending in EW direction suggesting NS compression. Kala Khelbackthrust, Condoli overturned fault, Sawkaibackthrust and Poya thrust faults are key structures of the study area. The Condoli anticlinorium, Sawkai anticlinorium, Preykarai anticline, Condoli syncline, Preykarai syncline and Mirgand syncline are key folds in the study area most of the mapped folds are overturned, north facing folds. The back thrusting in the area represents the later stage of deformation, following the major deformation associated with MBT.

## CONTENTS

	<b>Page</b>
ACKNOWLEDGMENT	i
ABSTRACT	ii
FIGURES	vii

### CHAPTER 1

#### INTRODUCTION

1.1	General description	1
1.2	Literature Review	1
1.3	Aims and Objectives	2
1.4	Location and Accessibility of the study area	3
1.5	Research Methodology	4
1.5.1	Field Work	4
1.5.2	Lab Work	4
1.5.3	Preparation of thin sections	4
1.5.4	Petrographic and Paleontological study	4
1.5.5	Identification and Correlation of Microfossils	4

### CHAPTER 2

#### REGIONAL TECTONICS

2.1	Tectonic setting	6
2.1.1	Karakorum Block	6
2.1.2	Kohistan Island Arc	7
2.1.3	AttockCherat Ranges	7
2.1.4	Hill Range	8
2.1.5	Kurram-Cherat-Margalla Fold-and-Thrust Belt	8
2.1.6	Northern Deformed Fold and Thrust Belt	9
2.1.7	The Southern Deformed Fold and Thrust Belt	9
2.1.8	Kohat Plateau	10
2.1.9	Potwar Plateau	10
2.1.10	Salt Range Thrust	10
2.1.11	The Indo-GangeticForedeep	11

**CHAPTER 3**  
**LITHOBIOSTRATIGRAPHY**

3.1	Methodology	12
3.1.1	Field work	12
3.1.2	Lab work	12
3.1.3.	Preparation of thin sections	13
3.1.4.	Petrographic and paleontological study	13
3.1.5.	Identification and correlation of microfossils	13
3.2	Samana Suk Formation	13
3.2.1	Field description	13
3.2.2	Petrographic description	14
3.2.3	Conclusion	14
3.3	Chichali Formation	15
3.3.1	Field description	15
3.3.2	Petrographic description	16
3.3.3	Conclusion	16
3.4	Lumshiwai Formation	17
3.4.1	Field description	17
3.4.2	Petrographic description	18
3.4.3	Conclusion	18
3.5	Kawagarh Formation	18
3.5.1	Field description	18
3.5.2	Petrographic description	19
3.5.3	Conclusion	20
3.6	Hangu Formation	21
3.6.1	Field description	21
3.7	Lockhart Formation	21
3.7.1	Field description	22
3.7.2	Petrographic description	22
3.7.3	Conclusion	22
3.8	Patala Formation	23
3.8.1	Field description	23
3.8.2	Petrographic description	24

3.8.3	Conclusion	25
-------	------------	----

## **CHAPTER 4**

### **STRUCTURAL ANALYSIS OF THE KALA KHEL AREA KHYBER AGENCY, NORTH WEST PAKISTAN**

4.1	Introduction	27
4.2	Aims and objectives	27
4.3	Stratigraphic Details	27
4.4	Methodology	27
4.4.1	Field works	27
4.4.2	Laboratory Work	27
4.4.3	Surface mapping	28
4.4.4	Subsurface Mapping	29
4.5	Structure Geology of the Kala Khel Area Khyber Agency	29
4.5.1	Folds	29
4.5.2	SaraiKho anticlinorium	29
4.5.3	Mirgand Anticlinorium	29
4.5.4	Candolianticlinorium	30
4.5.5	Preykarai anticline	30
4.5.6	Poya Anticline	31
4.5.7	Sawkai anticlinorium	31
4.5.8	Mirgand syncline	32
4.5.9	Preykarai syncline	32
4.5.10	Sawkai syncline	32
4.5.11	Condoli syncline	33
4.6	Thrusts fault	33
4.6.1	Kala KhelBackthrust	33
4.6.2	Condoli Overtured Thrust fault	34
4.6.3	Sawkai backthrust Fault	34
4.6.4	PreykaraiOvertured Fault	34
4.6.5	Poya thrust fault	35
4.7	Cross Section	35
4.7.1	Cross section AB	36
4.7.2	Cross section CD	36

**CONCLUSIONS**

38

**REFERENCES**

40

## FIGURES

	<b>Page</b>
Figure 1.1. A generalized tectonic map of northern Pakistan the inset in the map showing the study area.	3
Figure 1.2. Accessibility map of the study area. Inset shows the location of the study area.	4
Figure 2.1. Different tectonic terrains of north Pakistan separated by Regional faults.	6
Figure 2.2. Tectonic map of NW Himalayan Foreland Fold and Thrust belt. Inset shows location of study area.	11
Figure 3.1. Samana Suk Formation, (A)Thick to massive bedding of the Samana Suk Formation , (B)Calcite filled fractures, (C)Bioclasts within Samana Suk Formation, (D)stylolites within Samana Suk Formation.	14
Figure 3.2. Petrographic details of the Samana Suk Formation, (A)Sponge spicules (S SP),(B)Peloids(P), (C)Ooids and Peloids (P) embedded in calcite cement(spare) (CT)	15
Figure3.3. Field photographs of the Chichali Formation. (A and C) Glauconitic sandstone of the Chichali Formation , (B) Belemnite bioclasts within Chichali Formation, (D) Contact between Chichali Formation and Samana Suk Formation.	16
Figure 3.4. Petrographic details of the Chichali Formation, (A)Plane light behavior of quartz (Q) and Glauconitic mineral (G), (B)Cross light properties of the Chichali Formation.	17
Figure 3.5. Field photographs and photomicrographs of the Lumshiwai Formation, (A)Glauconitic sandstone, (B)Light colored ferruginous sandstone of the Lumshiwai Formation, (C)Glauconitic mineral (G), quartz (Q) in plane light polarized light, and ferruginous materials (F M), (D)Cross light properties of the LumshiwaiFormation.	17
Figure 3.6. Field photographs of the Kawagarh Formation, (A)Thinly bedded limestone, (B)Contact between Kawagarh and Lumshiwai formations, (C)Marls of the KawagarhFormation.	19



Figure 3.7. Photomicrographs of the Kawagarh Formation, (A)Globotruncanalinneiana (GL) embedded in matrix, (B)Gorbachikellasp (GO <sub>r</sub> ), (C)Pseudoguenbilinacostulata (Pg C) (D)Heterohelixreussi, (E)Globotruncanitaconica (G C), Praeglobotruncanagibba (P G), PP	20
Figure 3.8. Field photographs of the Hangu Formation, (A)Thick Ferruginous sandstone, (B)Close up view of the sandstone of Hangu Formation, (C)Contact between Hangu and Lockhart formations, (D) Coal mine within Hangu Formation.	21
Figure 3.9. (A) Field photographs of the Lockhart Formation, (B)Nodules within Lockhart Formation.	22
Figure 3.10. Photomicrographs of the Lockhart Formation, Miscellanea miscella(MS), Miscellanea juliettae (MJ) (A), LockhartiaHaimeii(L H) in (A)and (C)Lockhartiaconditi (L C) in (B),PPL.	23
Figure 3.11. Patala Formation, (A)Upper part of Patala Formation and (B)Lower part of the Patala Formation.	24
Figure 3.12. Photomicrographs of the Patala Formation, (A) and (B)Assilinasubspinosa(AS), Miscellanea miscella(MS), (B)Lockhartiaconica (LC) (C), Lockhartiahaimeii (L H) in (D) and Ranikhothaliasindensis(RS) embedded in matrix, PPL.	25
Figure 3.13. Lithologic log of Kala Khel area.	26
Figure 4.1. Structure geology map of Kala Khel area Khyber agency.	28
Figure 4.2. CondoliAnticlorium	30
Figure 4.3. Preykarai Syncline.	31
Figure 4.4. Migrand Syncline.	32
Figure 4.5. Condoli Syncline	33
Figure 4.6. Kala Khelbackthrust	34
Figure 4.7. Poya Thrust Fault	35
Figure 4.8. Cross-section line AB	36
Figure 4.9. Cross-section line CD	37
Figure 4.10. Subsurface 3D model of the study area	37