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Stratigraphic Prospects and Structural Analysis of the Rois Anticline Thanu Bula Khan, Jamshoro, Sindh

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Abstract: The Rois Anticline anticline which is located in the South West of Thanu Bula Khan City of Khoistan area was selected to detect out the Structural style with respect to its Fold axis ,Axial plane, Plunge of angle and Interlimb angle besides this the geological and tectonics of the area is discussed. The pi diagaram show that the studied anticline is an asymmetrical type of fold .Geologically the area is characterized by detrital and non-detrital type of sediments, ranging in age from Eocene to Oligocene.The Eocene rocks belong to Laki and tiyon Formations and Oligocene rocks belong to Nari Formation. These rock contain rich assemblage of larger benthic foraminifera and mollusk shells marine clastics are shale and clay while non-clastic rocks are limestone and in places it is dolomitic in nature where as the non-marine rocks belongs to Mancher formation of Pleistocene and mostly are sandstones ranging from medium grain to very coarse graine sands.it contains common accurence of petrified wood and rare accurence of vertebrate bones .In this area the Gaj formation of Miocene is found missing which is an indicator of local unconformity

Keywords: Structural Analysis, Geology, Tectonics, Rois Anticline,Thano Bula Khan

1. INTRODUCTION

The area of study lies 15 km southwest of Thano Bula Khan in the district Jamshoro and belongs to Kohistan region. The area of investigation lies in Survey of Pakistan, Toposheet No: 35 O/15, between Latitude 25° 15' 25'' to 25° 25' 00''N and Longitude 67° 46' 35'' to 67° 53' 46'' E**. (Fig. 1)** . The area is accessable only by Four wheel vehicle in fair weather and an ideal season for field work is from November to February.

The area has distinct Geomorphic features. The general topography of the area is that of alternate valleys and hills with their long axes in North- South direction. The Rois hill is located in the south west of Thanu Bula Khan City and it is elongated in the direction of NE-SW. This hill reaches a maximum height of 800 feet. The hill is severely dissected by faults and channels. The south eastern slope of the hill is steeper than that of north western slope. The streams and channels found in the area are ephemeral which flow only during rainy season and remain dry most time of the year. The drainage pattern of the area is controlled by the structure and type of the rocks exposed. The major drainage pattern of the studied area is dendrite type and radial.

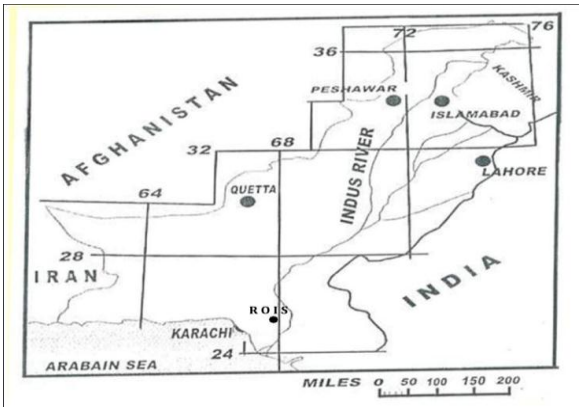

Fig. 1- Map Showing the location of the area of study, modified

Previous work

Regarding the structural analysis no previous work is done in the area and this for the first time to produce such type of work but he pioneer work regarding the Geology is of Hunting Survey Corporation 1960 and the concerned stratigraphy of this area is of Noetling in 1903, Vredenburg (1906), Blanford, (1876, 1879, 1867, 1876), Shah, (2009).

2. MATERIALS AND METHODS:

Total eight locations were selected for the measurement of Dip and strikes. The Axis of fold, Orientation of Axial plane and interlimb angles were detected out by using Wolf Stereo net and related softwares.

The latitude-longitude values of the studied area were taken by the direct readings by using of Global Position System (GPS). These values were plotted on index map of Pakistan and geological map of the area was prepared by using Global mapper software. The mapping was carried out directly on 1:50000 scale. The toposheet No. 35 O / 15 of Survey of Pakistan is used as base map. The section measurement for the

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thickness control of formations in the studied area was carried out by three methods i.e. Jacobs Staff method, Tape and Brunton method and direct method was used for the measurement of thin layers. To get the good vertical columnar section offsets were also used during the measurements.

General Geology of the Area

Thanu Bula Khan is located in the District Jamshoro and southwest to the Hyderabad. In Sindh, this is one of the important areas to understand the Tertiary Geology of Lower Indus Basin and structures associated with collision tectonics between Indian plate and Eurasian Plate and other blocks. The rocks exposed in the studied area belong to sedimentary rock type. The rocks are composed of clastic and non-clastic sediments. They range in age from Eocene to Pliocene. The clastic rocks are sandstone, shale and claystone and the non-clastc rocks contain limestone. The oldest formation exposed in the area is Laki Formation while the youngest Formation exposed is the Manchhar Formation.

The area is well known for its structures. Eocene and Oligocene sequence are folded and faulted in the region in number of anticlines and synclines. Marine sequence is rich in fossils especially in larger forams. The size of larger forams ranges from 0.5 mm to 2 cm.

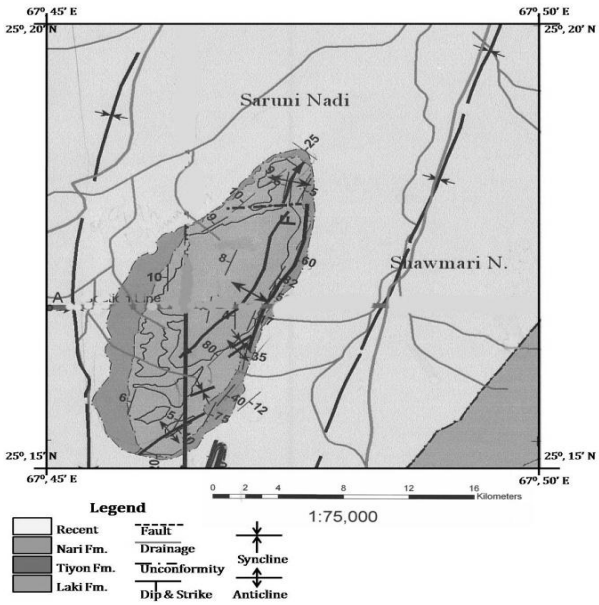


Fig. 2 area is well known for its structures. Eocene and Oligocene s

Tectonics Setting

Pakistan straddles the boundaries between the Indian, Arabian and Eurasian plates, and its structure is predominantly affected by their past and present interrelationships. Two composite plates, comprising both continental and oceanic crust (Indian & Arabian) are separated by an intra-oceanic transform boundary, which within the Pakistan offshore area is expressed as the Murray Ridge. The Eurasian Plate is a collage of three microplates which amalgamated in Iran-Afghanistan and western Pakistan area during Cretaceous to Paleogene times. The most easterly of these microplates, the Afghan Block, forms a considerable part of Pakistan's northwestern edge, and is bounded by the two major transform fault systems of Herat and Chamman. The boundaries between microplates can be traced by belts of ophiolite assemblages.

The majority of Pakistan, east of the Chamman transform fault system comprise the Indus Basin including Kohat-Potwar Plateau, Hazara and Kalachitta Ranges, Kirthar and Sulaiman ranges representing a foreland fold and thrust belt system, which lies in the mid Tertiary collision zone formed as Indo-Pakistan Plate was obducted by Eurasia.

The birth of the Indus Basin can be placed in Precambrian age. Ongoing Tectonic processes further enhanced and gave rise to new sedimentary Basin including the Lower Indus Basin during Early Cretaceous breakup of India. During Lower to middle Cretaceous the Lower Indus Basin was subjected to extensional Tectonics and Block-faulting followed by volcanic activity here witnessed as Deccan Trap. Eocene-Oligocene collisions of India with Eurasia resulted with large scale transform movement and compressional forces throughout the region and are manifested in the form of fold and thrust belts.

The main tectonic features of the Lower Indus Basin are the platform, foredeep comprising depression. The platform known as Indian platform coincide with the present Indus plain and is divided into Sukker rift zone and Sindh monocline. The foredeep includes Kirthar foredeep and Karachi depression. The province Sindh is located in the Lower Indus Basin and includes the Sukkur Rift Zone comprising Kandhkot- Mari Horst, Pano Aqil graben and Jacobabad-Khairpur Horst, Sindh monocline, Kirthar foredeep and Karachi depression. **(Fig. 3)** Our area of study lies in the domain of Karachi

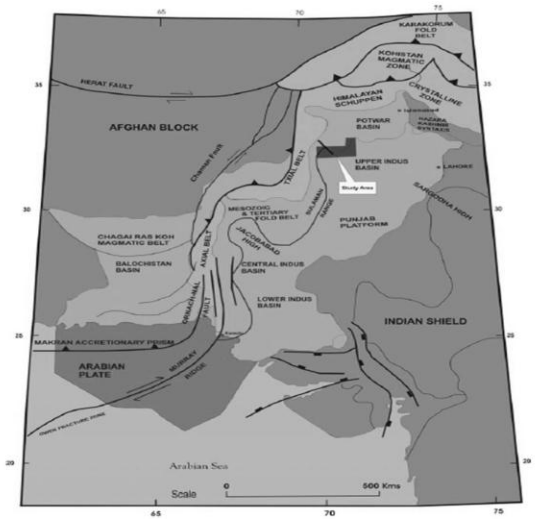


Fig.: 3- Map showing Tectonic elements of Pakistan, modified after Kazmi & Rana, 1982

Embayment. Karachi depression is one of the interesting geological features in the Geology of Pakistan. It is an embayment opening up into the Arabian Sea. Geologically, Karachi depression is located in the southern most continuation of Kirthar Fold Belt and the southwestern margin of Lower Indus Basin. It is bounded by Ornach-Nal Fault in the west and Hyderabad High in the east. **(Fig. 4,5)**

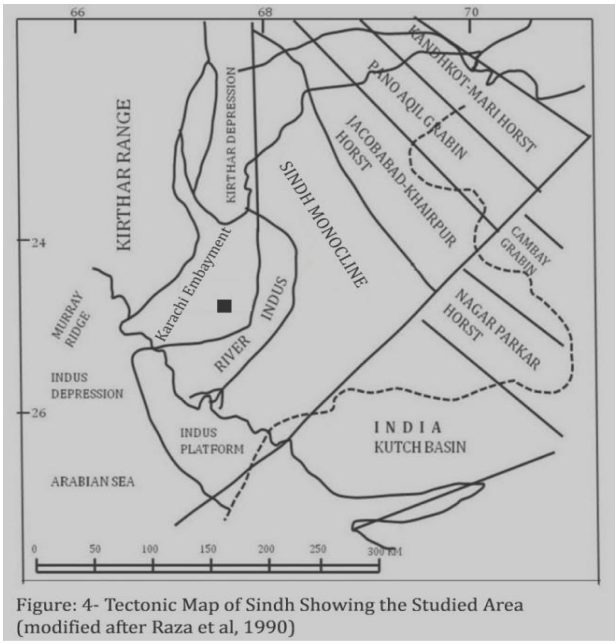


Figure: 4- Tectonic Map of Sindh Showing the Studied Area (modified after Raza et al, 1990)

Fig. 4- Map showing Tectonic elements of Pakistan, modified .

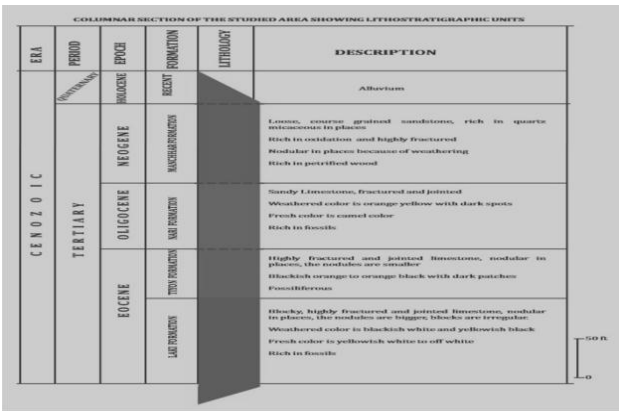
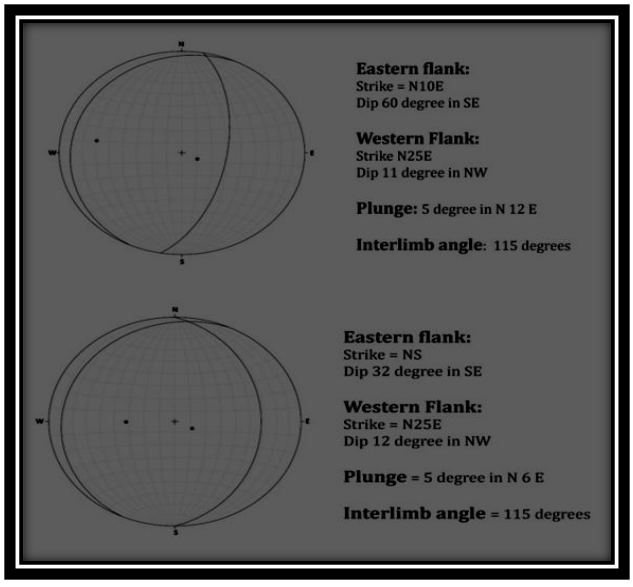


Fig.: 5, Columnar Section of the studied area showing lithostratigraphic units

Structural Configuration And Analysis

Fig. 6, Structurally, Karachi Embayment has a large number of structures in the eastern part, where the anticlines are small to large, asymmetrical with steep eastern flank and gentle western limbs. The structural style of the focused anticlines is influenced and controlled by the compressive forces generated by the regional collision Tectonics and Himalayan Orogeny. Attempts are made to analyze these structures in terms of Tectonics, resulting stress, strain distribution. Equal angle Stereographic projections are used for the geometrical analysis and interpretation of structures. Interlimb angles, plunge and plunge trend is calculated with the help of these Stereographic Projections. In our present work detailed study of the Rois anticline is carried out in terms of its Stratigraphy, Tectonics and



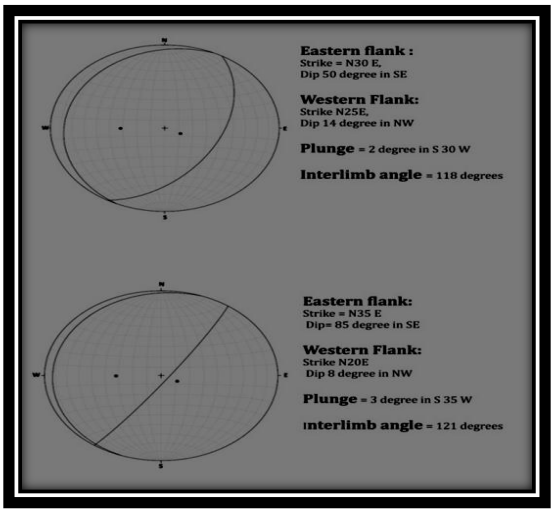


Fig. 6. Stereographic projections showing the Plunge and Interlimb angles of the Rois anticline

The Rois anticline is located in South West of Thanu Bula Khan city. It is characterized by NE-SW trend and is cylindrical as well as culminated anticline. The anticline is the folded structure of Eocene-Oligocene marine sequence. The sequence along with folding is highly jointed. The anticline is disturbed by faults at number of locations. The single anticline because of faults looks like culminated anticline. Ephemeral channels also cut the anticline at various places and exposed the oldest formation in the core that is Laki Formation.

Fig. 7, Stereographic projection showing the trend and plunge of fold axis, strike and dip of axial plane, and interlimb angle of Rois s anticline

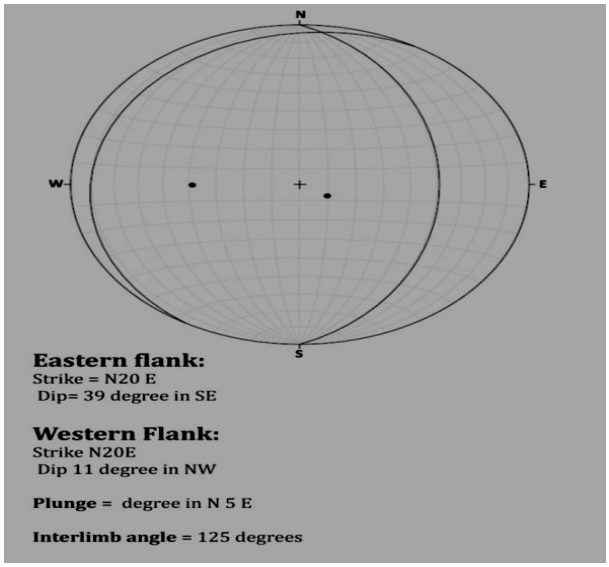


Fig.:7, Stereographic projections showing the Plunge and Interlimb angles of the Rois anticline

Trend and Plunge of fold Axis:
263.9, 07.2

Strike and Dip of Axial Plane:
253.7, 35.6 N

Fig. 8, The dip of the limbs of the anticline is measured at number of locations to understand the strain distribution over the structure and intensity of the stress. The mean interlimb angle of the structure is 125 degrees calculated on the Stereographic Projection from the mean strike of the structure is N20oE and average dip of the south eastern limb is 39 degrees and that of the north western limb is 11 degrees. The anticline is very gently plunging in the direction of North East as the plunge is 5 degrees and it is in the direction of N 5o E.

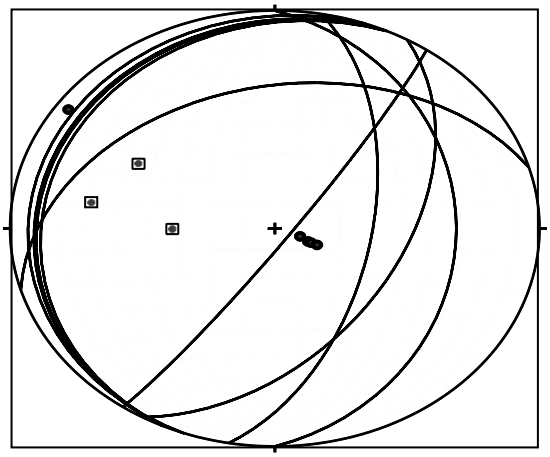


Fig.: 8, Stereographic projections showing the Plunge and Interlimb angles of the Rois anticline

The Stereographic projections are constructed for the individual values of dip and strike taken in the field to draw a clear picture of the interlimb angle as well as plunge and plunge bearing. This data is further analyzed for the stress intensity and strain distribution. Figures given below show the stereographic projections of individual dip and strike value and last one shows the mean stereographic projection of the structure.

3. RESULTS AND DISCUSSION

The structural features are the manifestations of the deforming forces that have acted on the rock bodies since their formation. Each rock type possesses different mechanical and physical properties which vary with conditions under which it deforms. Therefore, diverse varieties of structures are displayed by the rocks which constitute the earth's crust. The systematic study of these structures i.e. the structural analysis reveals the deformational histories of the rock bodies in different parts of the crust. Folds are those structures which develop during the ductile deformation of the layered rocks in response to the tectonic forces. Therefore the

systematic studies and analysis can reveal many aspects of the tectonic events that the rocks have undergone.

It is revealed that the dip of the south eastern flank is steeper than that of the north western flank which indicates that the intensity of stress from south eastern side was greater than that of the north western side. If this is coincided with the regional Tectonics then this also stands true that the Indian plate is travelling in the direction of north faster than the Eurasian Plate. Eurasian Plate is travelling south at the speed lesser than the India. Therefore, the forces generating from Indian Plate are much greater than the Eurasian Plate. These forces are also directed in the direction of north east which produced steeper dips from the south east direction. Eurasian Plate is travelling slower hence generating forces smaller in intensity and therefore gentle dips from the north western side. The Indian Plate is currently moving northeast at 5 cm/yr while the Eurasian Plate is moving north at only 2 cm/yr. This is causing the Eurasian Plate to deform and the India Plate to compress at a rate of 4 mm/yr. The interlimb angle calculation and plunge calculations indicate that the Rois anticline is gentle assymetrical fold with very gentle plunge.

The strain is not uniformly distributed throughout the structure as the dip and strike measured at various locations differs from each other. The intensity of stress and therefore strain exceeded to such an extent that the structure undergone the faulting. These faults can be observed at number of locations shown in the map.

The deformation started from the time of the regional collision of the Plates indicated by the folding of Eocene and post Eocene rocks. The deformational forces were active after the Tertiary period because the Neogene Molasses of Manchhar Formation is also fractured and severally jointed.

4. CONCLUSION

The structural studies has resulted the Rois anticline is an open and asymmetrical Fold.

The dip and srikes of Axial plane of Rois Anticline is 253.7,35.6.

The orientation of the fold axis shows that its direction is 263.9,07.2 As area of study lies in the Kirthar province and is in Lower Indus Basin which has profound effect of Himalyan Orogeny which has resulted number of Faults and Joints in the area. The marine rocks are identified on the basis of Larger Benthic Foraminifera and Marine Moleskin shells. The non Marine formation was separated by the occurrence of Wood Fossils and Vertebrate bones which confirms the Fluvial environment of deposition. The area has resuled a local unconformity which has been recognized by the absence of Gaj Formations

5. ACKNOWLEDGEMENT

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