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PALEOCURRENT ANALYSIS OF DHOK PATHAN FORMATION, FROM THATHI NORTHEASTERN POTWAR DIST. RAWALPINDI

BY

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Abstract: *Paleocurrent studies of the Dhok Pathan Formation was comprehensively carried out around Thathi village in northeastern Potwar. In the study area trough cross bedding was used to collect the data. A total of 50 sampling station were selected for the collection of data. Data was corrected for tectonic tilt and plotted on the rose diagram for the paleoflow and source direction of the Dhok Pathan Formation. The analysis shows that source is from northwest direction and paleoflow was in southeast direction.*

INTRODUCTION

Paleocurrent analysis involves using sedimentary structures to determine the direction of flow or orientation of flow like that of a river, a group of streams within a basin, the wind direction within a region, or the direction of oceanic currents. Individual sedimentary structures tell you the flow direction at that geographic point and at that instant in time but in solving true regional scale problems we need to look statistically at populations of sedimentary structures (Boggs, 1995). These will give us a collective average of the current directions within a region over a period of time. All sedimentary structures did not provide flow direction information and even those that do, do not provide the same kind of information. For those that do provide flow information we have those that point down stream (down flow direction) like asymmetric ripples and trough cross-bedding and we have those like tool marks (skips, groves, and prods) and parting lineation that give us a current orientation, but we can not go upstream from downstream.

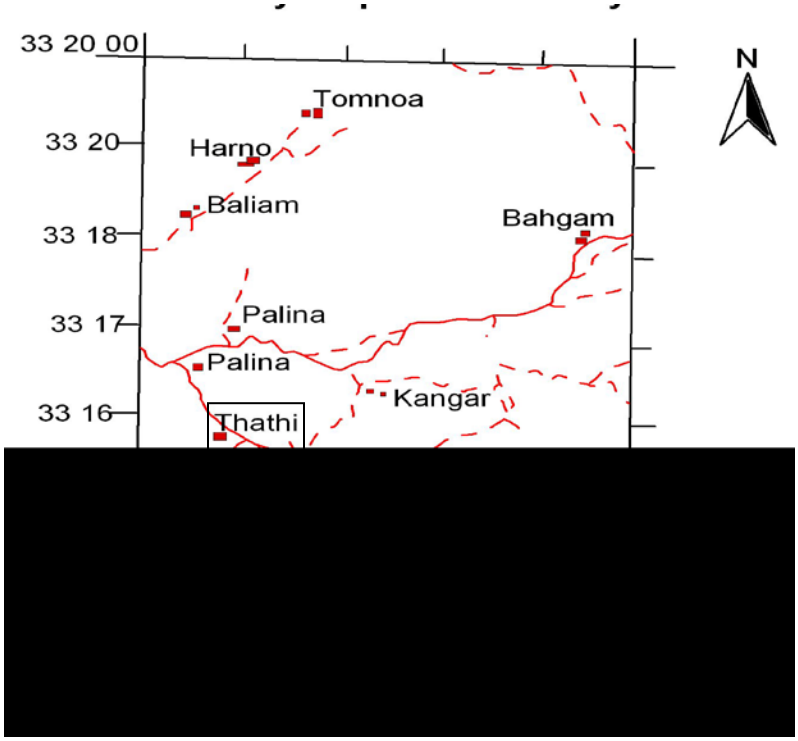
"Siwaliks" of Meddlicot (1864) are the fluvial deposits formed in the foothills of the Himalaya mountain i.e. foreland basin. Potwar is part of this foreland basin (Fig.2) and Siwaliks stretch nearly to all of the Potwar. Siwaliks are of Late Miocene Chinji Formation, Early Pliocene Nagri Formation, Early to Middle Pliocene Dhok Pathan Formation and the Late Pliocene to Early Pleistocene Soan Formation (Shah, 1977). All these formations are mainly composed of sandstone, shale, claystone and conglomerate and pebbles. Dhok Pathan as a part of lower Siwaliks is comprised of monotonous cyclic alternations of sandstone and claystone and minor alternations of yellowish brown siltstone & conglomerates in the form of lenses and layers. Good exposures of trough cross bedding (Plate 1) are present in the study area which is the part of the Jabbar Anticline. The main purpose of the study is to know the paleocurrent direction of the Dhok Pathan Formation.

METHODOLOGY

Following Steps were carried out in the study of paleocurrent analysis of the Dhok Pathan Formation from the surroundings of the Thathi village northeastern Potwar (Fig. 1).

COLLECTION OF DATA

The way to ascertain a paleocurrent direction is first to go into the field and gather the data, that is make measurements with the Brunton Compass on the orientation of the structure. For those that point down stream we record the down current direction while for those which only give us a stream orientation we record the bearing for that trend expressed as so many degrees east of north or west of north. We do this for all available structures within the area of interest (allowing or time constraints of course if the region has a generous supply of structures). This is recorded in field book. Cross bedding data were collected from the sandstone units, which contained well preserved trough cross beds for paleocurrent flow direction. Total 50 sampling stations were selected for the collection of data.



Accessibility Map of the Study Area
Fig.1 Location Map of Thathi Area

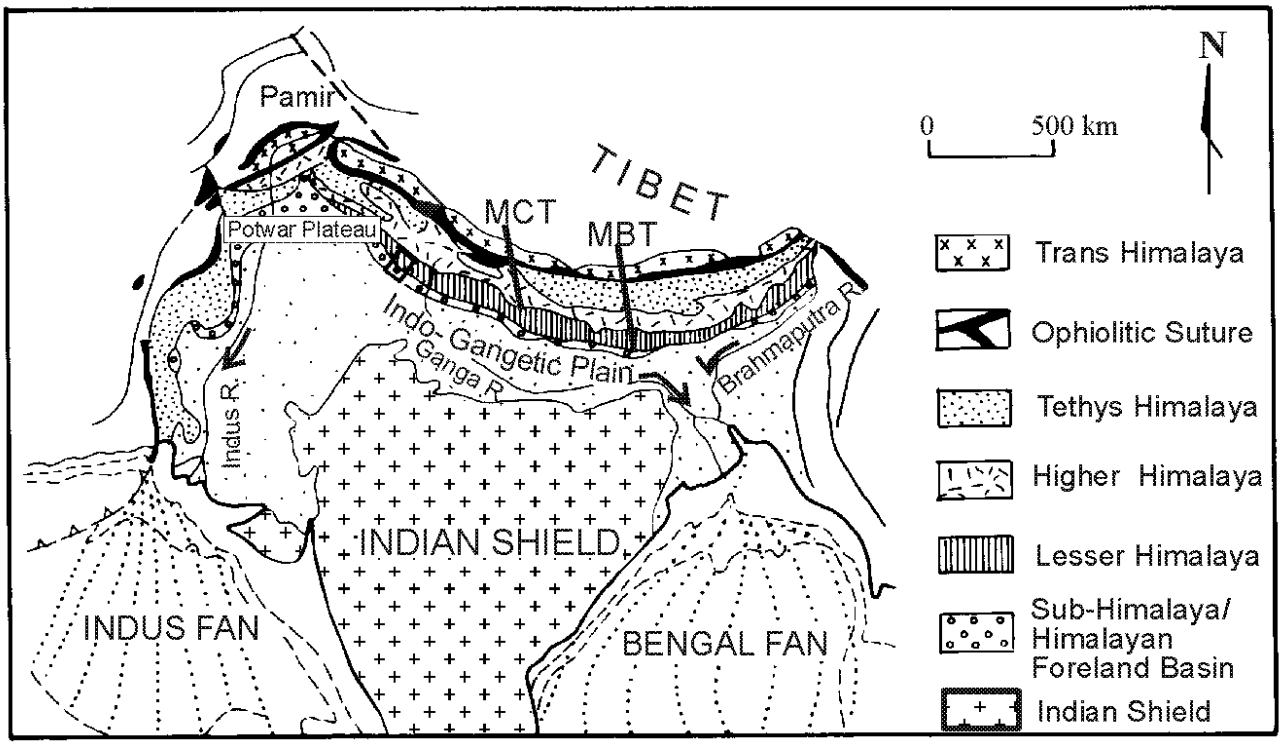


Fig.2 Simplified geological map of the Potwar (after Rohtash Kumar, 2003)

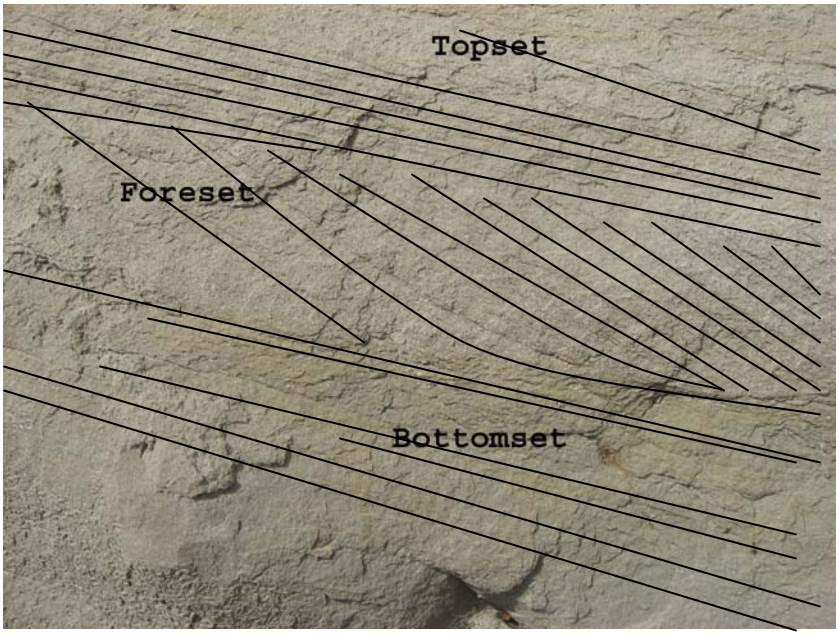


Plate1 Cross bedding in Dhok Pathan Formation near Sehr Village

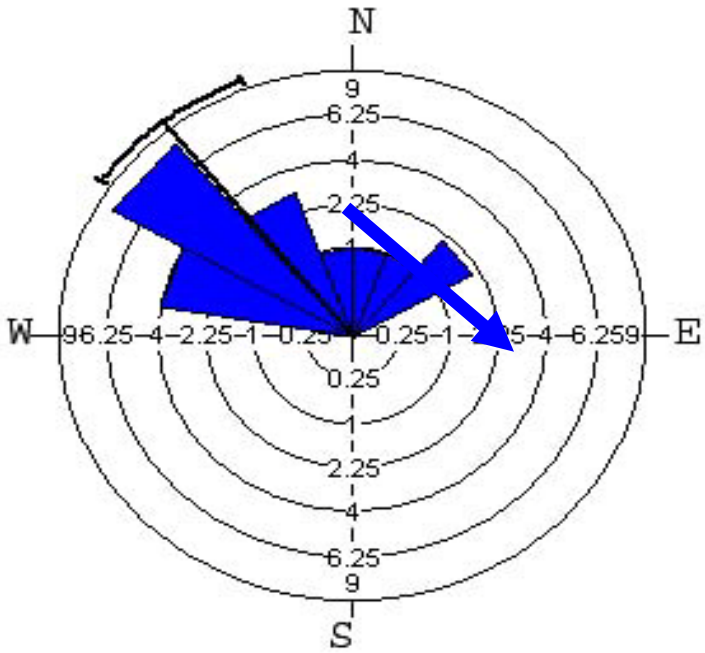


Fig. 3 Paleocurrent Direction of Dhok Pathan Formation

CORRECTION OF DATA FOR TECTONIC TILT

Data are commonly collected from folded or tilted sequences and must be corrected in order to restore the bedding to its original horizontal position. The study area is part of the Northern Potwar Deformed Zone (NPDZ), in which the Jabbar Anticline lies, so the data should be corrected for tectonic tilt. This is done by rotating a line or plane about a horizontal axis using stereographic projection(Lidholm, 1987).

If the structural dip is less than 25° the measured azimuth of linear structures need no correction. If the dip exceeds 25° the effects of tilting must be removed. This can be done with a stereonet

The situation for planar structures (e.g. cross bedding) is different, because even very low tectonic dip values (anything greater 5°) may introduce an appreciable error. As is the case for linear structures, rotation can be done using stereographic projection. The procedure is more complicated in the case of steeply plunging folds, and double rotation may be required. If the plunge is less than 10°or if the dip is less than 45°, no correction for the plunge is necessary.

If the beds from which you are making paleocurrent measurements are not horizontally lying then you must correct for their structural orientation. If the bed dips more than 15 degrees you need to do this, if not don't bother. Making the correction involves using a stereonet and a sheet of tracing paper or clear acetate film known usually as the plot sheet. In the field, you must measure the strike and the dip of the bed containing the sedimentary structure and you must measure the orientation and down dip rotation of the sedimentary structure. You are defining the orientation in space of the bed as a planar surface with a line of strike and a line of dip and you are defining in space the orientation of the sedimentary structures apparent current direction or orientation (direction of plunge) as a compass direction and a rotation (dip) from the horizontal.

PROCEDURE FOR THE CORRECTION OF DATA

Plot the poles of bedding and cross bedding on the stereogram.

Rotate the stereogram so that the pole of the bedding, B, comes to the equatorial line. In doing this you will also rotate CB the pole of the cross bedding. Mark both points on the stereogram (i.e. on the tracing paper).

Bring bedding to the horizontal by shifting B, the pole of the bedding to the centre of the stereogram. Move CB the pole of the cross bedding, the same number of degrees in the same direction along the nearest small circle (dashed lines).

Rotate the stereogram back, so that its N-S line coincides with the N-S line on the stereonet. To read the dip direction, draw a line from the pole, through the center, to the edge of the stereonet.

All these steps are shown in the Fig.4.

GRAPHIC PRESENTATION OF DIRECTIONAL DATA

In practice there are two approaches that are used for graphic presentation of the directional data. These are current rose or rose diagram and vector mean the later is not applied in this study.

A popular device for presenting directional data is the current rose or rose diagram, which is a histogram converted to a circular distribution. Various class intervals are used but a 30° interval will meet most needs. It is better to plot the observations in each class than to plot the total number of observations. The class interval with the most observations is the modal class. When measurements of structures which show direction of movement are plotted (e.g. cross beds and flute casts) the rose diagram indicates the direction towards which the current moved. Most distribution produce a single dominant mode (unimodal), although some have two or more sub equal modes (bimodal, polymodal). In the case of structures which show line of movement, each measurement is represented by two opposite azimuth values (e.g. 30° and 210°). The resulting current rose consists of two reflected halves. Measurements made from several different structures may be plotted on a single composite rose diagram also called a composite ray diagram radial line diagram or spoke diagram (Potter, 1978).

This method was adopted in the study of paleocurrent analysis of Dhok Pathan and Lower Soan Formations.

There is another method called Vector Mean and Vector Magnitude but not adopted in this study but brief description of this method is given below in the following text.

INTERPRETATION OF ROSE DIAGRAM FOR THE PALEOCURRENT ANALYSIS OF THE DHOK PATHAN

Rose diagram of the Dhok Pthan Formation showed that its source was from the NW direction while the paleoflow was in SE direction. The age of the Dhok Pathan Formation is Early to Middle Pliocene. At that time Himalayan orogeny was on its climax and the Indian Plate was rotating in anticlock wise direction. The tectonically

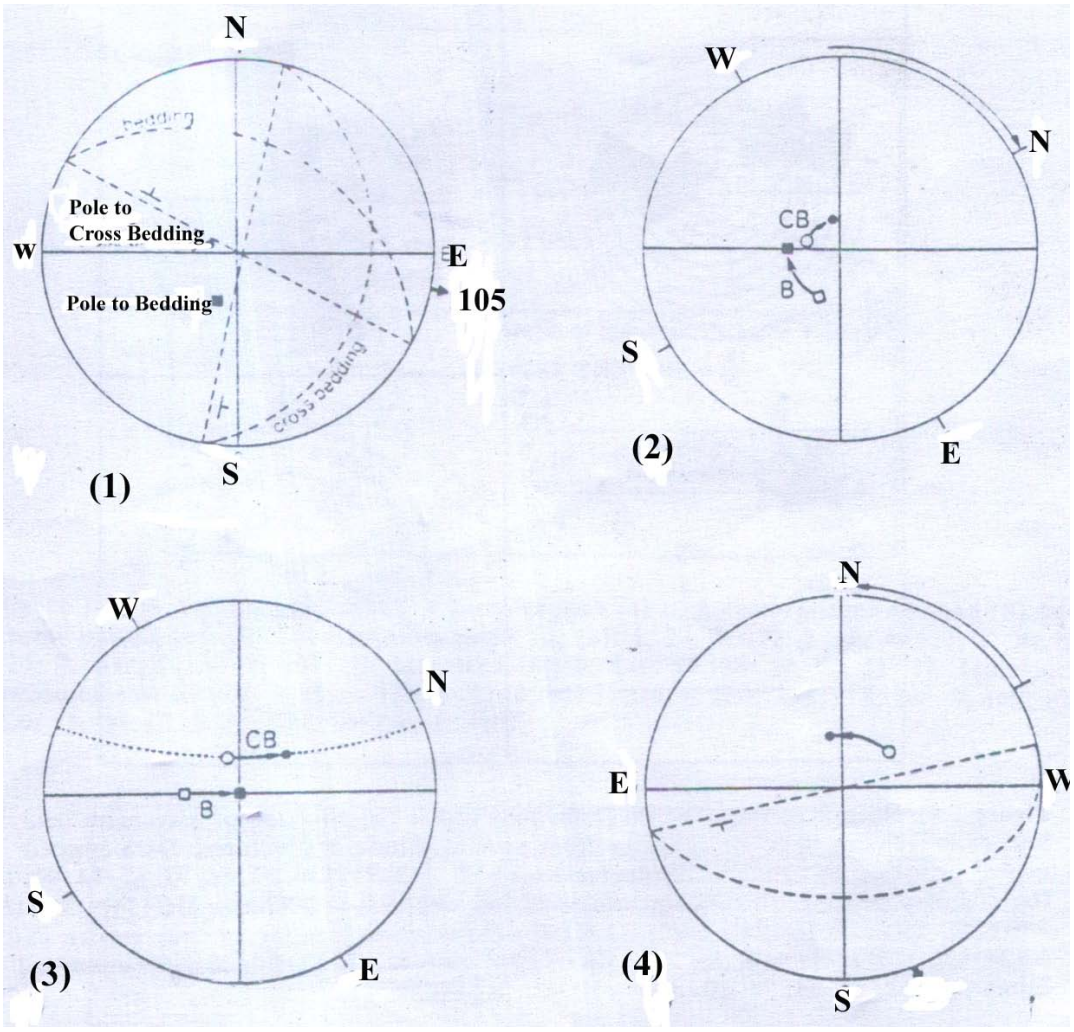


Fig. 4 Showing steps involved in the correction of data

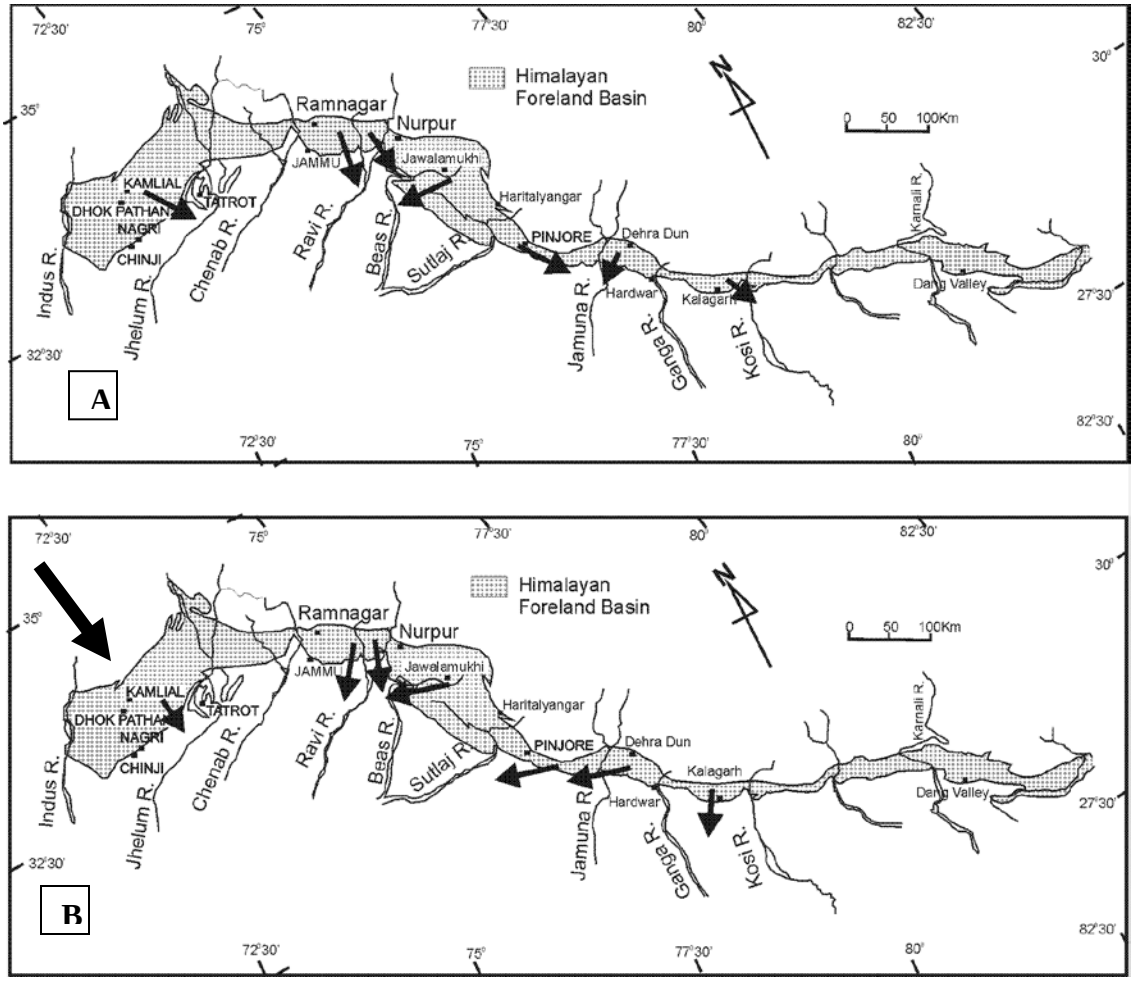


Fig. 5 Paleoflow orientation in the Himalayan Foreland Basin A- variability in paleoflow around 10 Ma B- Variability in paleoflow around 5Ma. Change in paleoflow around 5 Ma is related to the activity along MBT (after Rohtash Kumar, 2003).

raised high relief and climatic change caused the great influx of sediments from the Kohistan Island Arc deposited in the foreland basin (Potwar Plataeu) resulting in thick pile of Siwaliks. The paleoflow model of the Dhok Pathan formation is mentioned in the Fig. 3 & 5.

CONCLUSION

Paleocurrent data of the Dhok Pathan Formation was comprehensively studied from cross bedding exposures around the Thathi village in northeastern Potwar. Totally 50 sampling stations was corrected for tectonic tilt. Data was plotted on rose diagram for the paleoflow and source direction of the Dhok Pathan Formation. The analysis shows that the source was from northeast direction and paleoflow was in southeast direction.

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