

SEDIMENTOLOGY OF DHOK PATHAN FORMATION FROM THATHI AREA, NORTHEAST POTWAR DISTRICT RAWALPINDI

BY

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Abstract: *The Dhok Pathan Formation of Early to Middle Pliocene age exposed at Thathi area, northeast Potwar district. Rawalpindi was selected for sedimentological studies. The formation is composed of alternating beds of sandstone and clays in 1:1 ratio with minor intercalations of siltstone and intraformational conglomerates which are abundant in upper part. Lithofacies and petrographical studies revealed that sandstone is feldspathic litharenites and formation has provenance of the Kohistan Island Arc. The lithofacies studies suggests that formation is deposited in a fluvial environment in a wide depression in front of the rising Himalayas.*

INTRODUCTION

The Potwar Plateau is constituted by a less internally deformed fold and thrust belt having a width of approximately 150 km in N–S direction. It is bounded to the south by Salt Range Thrust and to the north by the Kalachitta–Margalla Hill Range. Indus River forms its western limit whereas the Jhelum River marks its eastern boundary (Kazmi and Jan 1997). There is a marked difference in the tectonic style of north western, south western and eastern Potwar. The northern part of Potwar Plateau, also referred to as the Northern Potwar Deformed Zone (NPDZ) lies between the Main Boundary Thrust and the Soan Syncline. It is more intensely deformed than the southern part, which is known Southern Potwar Deformed Zone (SPDZ) (Jaswal et.al. 1997). As part of foreland basin Potwar hosted mollase deposits named as “Siwaliks” of Meddlicot (1864) are the fluvial deposits formed in the foothills of the Himalaya mountain. 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).

The “Upper Manchar” of Blandford (1876), Dhok Pathan of Pilgrim (1913) and Dhok Pathan Formation of Cotter (1913) was adopted as such by the Stratigraphic Committee of Pakistan in 1967. The name is derived from the village of Dhok Pathan in the Attock district (lat. 33°07'N; long 72°14'E) is the type locality of formation. The formation is widely distributed through Indus Basin

and Quetta region of the Calcareous Zone of the Northern Axial Belt. The formation is 1330m thick at the Gaud River which is the principal reference section and 1500m at the Thathi (Fig.1) area which has been our area of study. Where it was mapped and measured first time (Fig.2).

A very rich vertebrate fauna has been recorded from the Dhok Pathan Formation of the Kohat-Potwar province, (Pascoe 1963). The formation is less fossiliferous in the lower Indus basin and Quetta region. Some of the important fossils are: *Indarctos salmontanus*, *Arctamphicyon lydekkeri*, *Ictitherium indicum*, *Mastodon browni*, *Dicoryphochoerus titanoides* and *Hydaspttherium megacephalum*. The fauna indicates Early to Middle Pliocene age. The formation has transitional contact with the underlying Nagri formation and conformable with the Soan formation in the study area.

LITHOLOGY

The formation is composed of monotonous cyclic alternations of sandstones & clays. Sandstone is grey, light grey, white, reddish brown, occasionally brownish grey, brown or buff thick bedded, calcareous, moderately cemented, soft and cross bedded. Clay is orange, brown, dull red or reddish brown; occasionally rusty orange, greenish yellow, yellowish grey, or chocolate coloured, calcareous and sandy. They are in 1:1 ratio.

Minor intercalations of yellowish brown siltstone are common. Conglomerates in the form of lenses & layers (channel beds) (Plate 1B) are the essential part of the upper part.

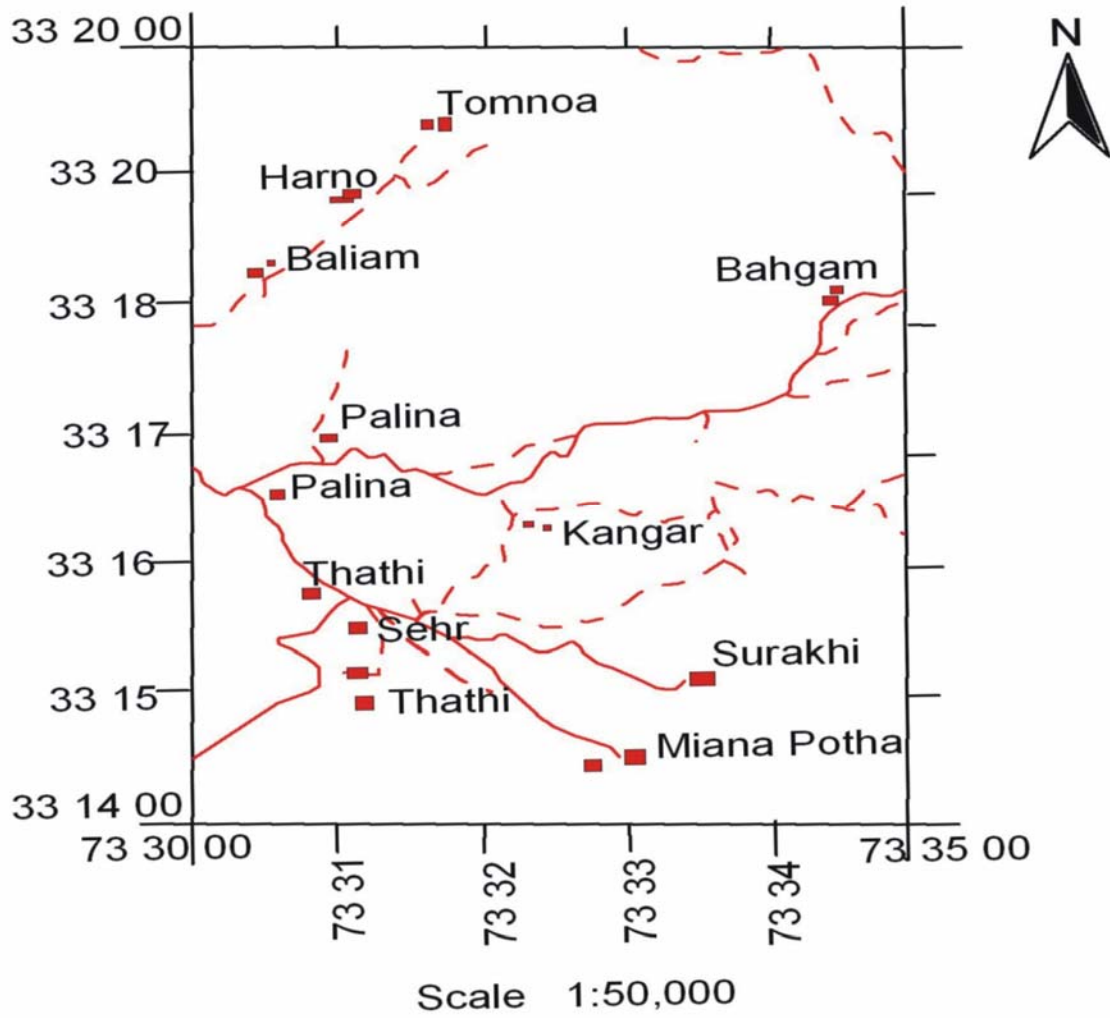


Fig.1 Location Map of Thathi Area

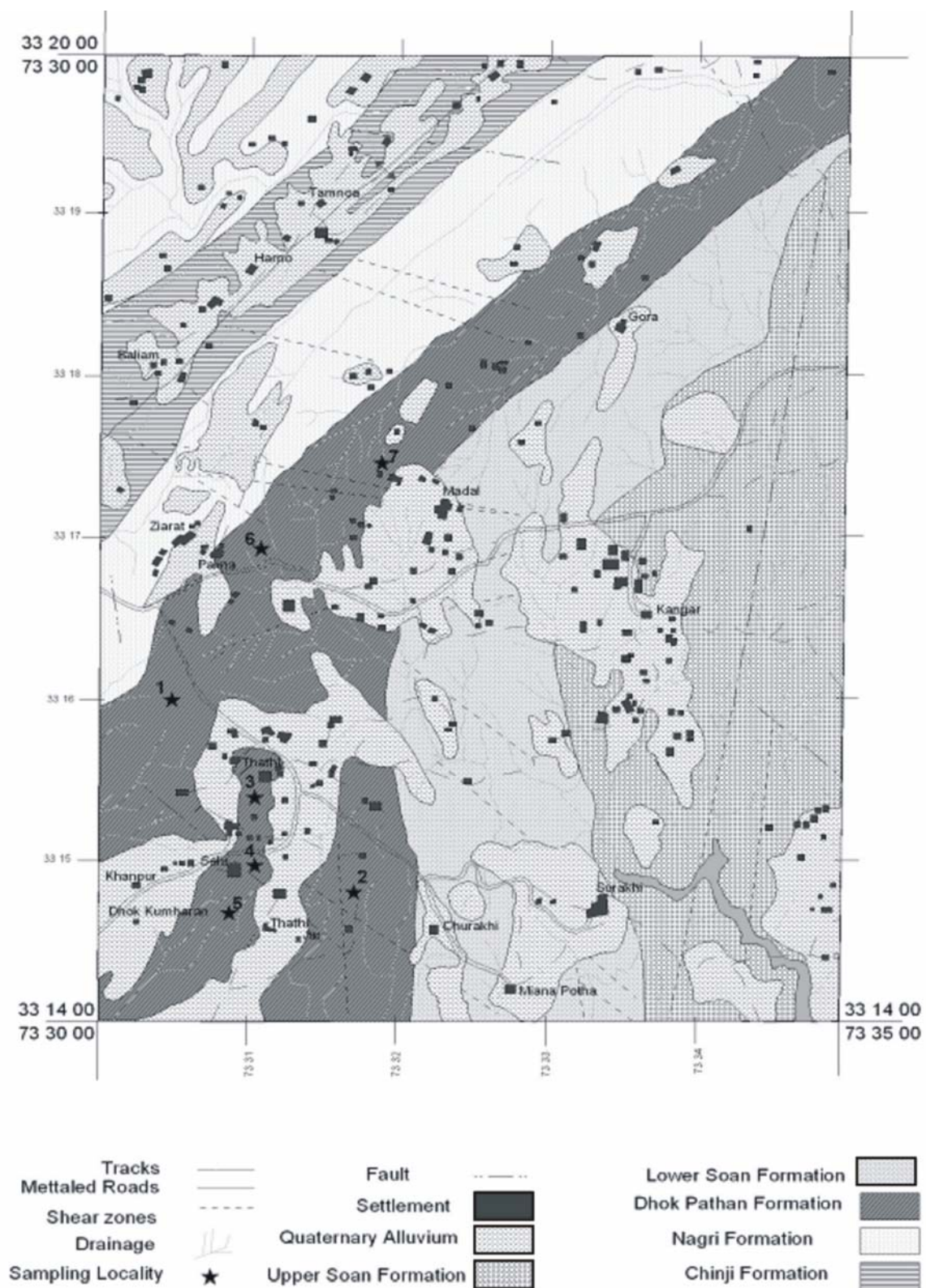


Fig. 2 Lithostructural map of area

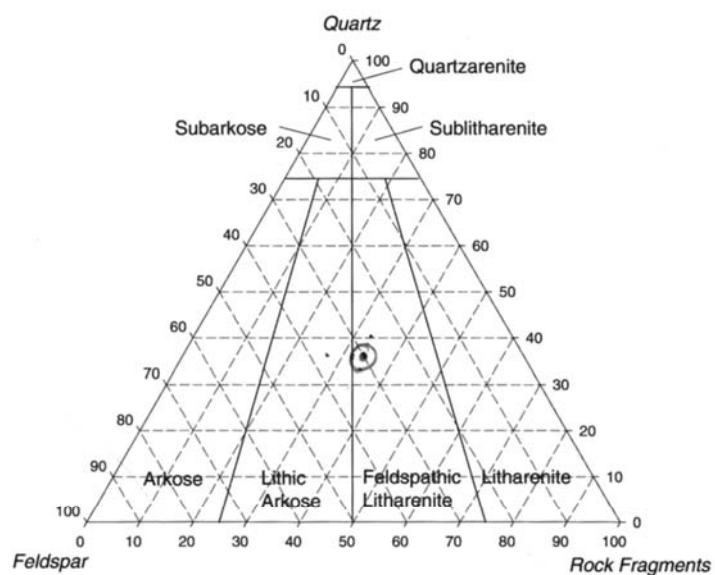


Fig. 3 Ternary diagram showing sandstone classification nomenclature

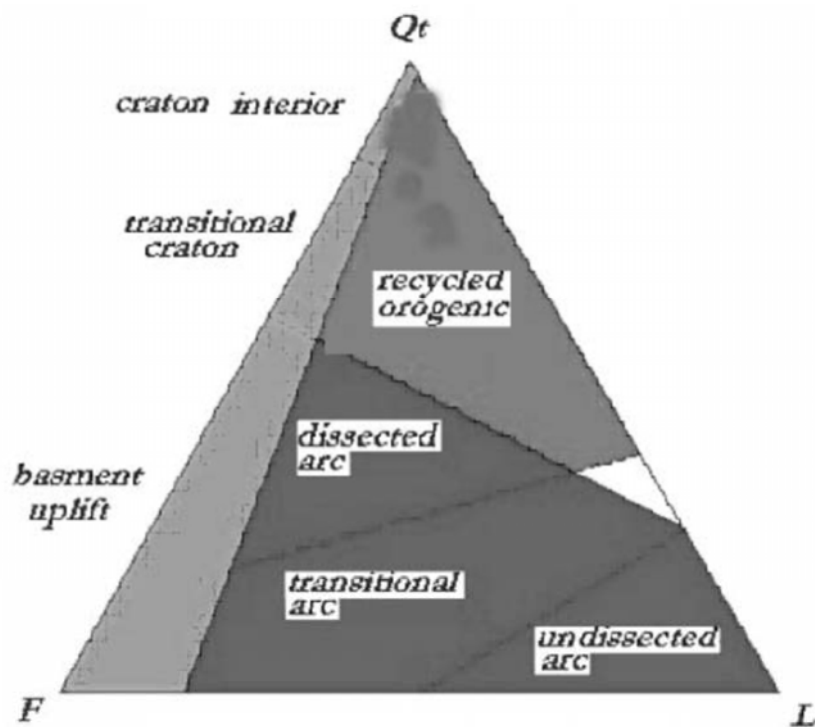


Fig. 4 Diagram showing provenance of Dhok Pathan F



A Conglomerates & Pebbles in channel bed of Dhok Pathan Formation



B Hematitic alteration in Dhok Pathan Formation

PETROGRAPHY

The sandstone of the Dhok Pathan Formation is medium to coarse grained, friable, poorly sorted and are immature both mineralogically. The average framework composition of the Dhok Pathan Formation is quartz varies from 32-39 percent, K-feldspar varies from 7-12 percent, plagioclase varies from 5-10 percent and rock fragments varies from 20-38 percent. Muscovite and biotite are also present and ranges from 1-3 percent. Chert ranges from traces to 2 percent.

The major alterations observed during thin section study are.

1. Hematite in the form of thin layers (Plate 1A).
2. Feldspar to sericite and kaolinite
3. Amphibole to chlorite

The QFL diagram after Folk(1976) shows that the sandstone is feldspathic litharenite (Fig. 3).

TEXTURE

The fabric is mostly feldspathic litharenites. The detrital constituent is medium to coarse grained but generally show mixture of grain sizes. Framework grains are mostly angular to subangular. Calcite act as cement with minor iron oxides.

CLAY MINERALOGY

The bulk mineralogy of all the investigated samples is mainly composed of quartz as dominant phase, subsequently calcite, orthoclase, albite, montmorillonite, clinochlore (chlorite) and illite. The mineral composition throughout the shale is consistent, only one sample Das-10 shows the presence of gypsum, since the sample was dried at 70C°. The gypsum lost 1/2 molecule of H₂O and restructure as Bassanite.

Less than two micro friction indicates the presence of montmorillonite, Illite, Clinochlore (chlorite). On glycolation the peak shifting of Montmorillonite from 15Angstrom 17 Angstrom conform the presence of montmorillonite.

The fine grained nature of shales constituents and the absence of other mineral specially Feldspar suggests that material has come from the long distance and during the transportation only quartz and clay minerals were deposited at their final destination. It is also possible that this shale has been redeposited at the site of presence.

PROVENANCE

The quartz grains of the Dhok Pathan Formation are mostly angular to subangular, occasionally polycrystalline;

display normal to undulatory extinction suggests mainly metamorphic origin. The inclusion of zircon in some of the quartz crystals and presence of myrmekitic texture in some of feldspar grains suggest that source was plutonic. Some quartz grains show fracturing which possibly is related to the intense tectonic activity.

The QFL provenance discrimination diagram (Dickinson, 1985) shows that Dhok Pathan Formation has a dissected arc provenance (Fig. 4). The detrital material of the Dhok Pathan Formation was contributed by a dissected arc during Early to Middle Pliocene located to the north of the Potwar basin and paleodrainage was from northeast direction. Thus the source of Dhok Pathan Formation is mainly laid in Kohistan Island Arc with contribution from basement rocks exposed by the uplift at the back of MCT.

DEPOSITIONAL ENVIRONMENT

Sandstones represent deposits of levees, crevasse channels and splays, floodplain channels, and large sheet floods. Laminated mudstones represent floodplain and lacustrine deposits. Lakes were both perennial and short-lived, and likely less than 10m deep with maximum fetches on the order of a few tens of kilometers. Trace fossils and body fossils within all facies indicate the former existence of terrestrial vertebrates, molluscs (bivalves and gastropods), arthropods (including insects), worms, aquatic fauna (e.g. fish, turtles, and crocodiles), trees, bushes, grasses, and aquatic flora. Palaeoenvironmental reconstructions are consistent with previous palaeoclimatic interpretations of monsoonal conditions.

CONCLUSIONS

1. Dhok Pathan Formation is composed mainly of sandstone and shale in 1:1 ratio.
2. Intraformational conglomerates or channel beds are also present and abundant in upper part of formation.
3. Petrographical studies shows that cementing material of the formation is mainly calcite.
4. QFL diagram reveals that sandstone is feldspathic litharenite.
5. Petrographical analysis results that the provenance of the formation was from a dissected arc i.e. Kohistan Island Arc in the north of the Potwar basin.
6. The lithofacies studies suggests that formation is deposited in fluvial environment.

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