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TECTONO-STRATIGRAPHIC IMPLICATIONS IN EXTENDING THE PANJAL THRUST, WEST OF THE HAZARA-KASHMIR SYNTAXIS

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ABSTRACT

The Panjal Thrust (PT) is one of the principal tectonic scars of the Lesser Himalayan domain in Kashmir. Its type section is located in the Panjal Range from where it extends northeastwards along the eastern flank of the Hazara-Kashmir syntaxis and terminates at its apex. In the Panjal Thrust the Precambrian Salkhalas thrust over the Permo-Triassic Panjal Group. This tectono-stratigraphic setup is retained by this thrust throughout its course in Kashmir.

During recent years, some geologists have extended this thrust west of the syntaxis through Galiat, Abbottabad, Gandghar Range and terminated it across the Indus in the Attock-Cherat Range. The tectono-stratigraphic and lithostratigraphic frames of these sections are not akin to the ones displayed in the Panjal Thrust sections in Kashmir. This controversial aspect of the Panjal Thrust has been studied to ascertain whether the western counterparts of the Panjal Thrust west of the Hazara-Kashmir syntaxis has any justification to be correlated with its tectono-stratigraphic net displayed in Kashmir.

INTRODUCTION

According to Wadia (1931) the Panjal Thrust demarcates two zones; the Tethyan and Himalayan. The Pir Panjal Range in Kashmir is the type section of the thrust, along which the Permo-Triassic sequence is thrustover by the metasediments of the Salkhala Series of Precambrian age. The Panjal Thrust was regarded as an analogue of the Main Central Thrust (MCT) in the NW Himalaya. The discovery of another deep level thrust called the Shontargali Thrust by Tahirkheli (1988, 1989) in Kashmir and Astor area, located on the southern margin of the Nanga Parbat massif, has overlapped the earlier contention.

The Panjal Thrust (PT) extends uninterrupted from the Panjal Range towards NNE through Poonch, Reshian and follows the eastern limb of the Hazara-Kashmir syntaxis and terminates at its apex in Kaghan valley. In all the sections examined in Kashmir, the tectono-stratigraphic frame of the PT appears alike and exposes very vivid surficial characteristic fractures which can be observed easily.

During recent years Calkins et al. (1975) followed by other geologists have extended the tectonic domain of the PT towards west of the syntaxis (Fig. 1), making it through Galiat; along Salhad stream in Abbottabad; on the eastern margin of the Gandgar Range; across the Indus River near Attock and terminating it on the northern margin of the Nizampur valley in the Attock-Cherat Range. The PT domain, west of the syntaxis, does not provide a clear picture about its stratigraphic setup and tectonic frame for correlation with the reference sections in Kashmir.

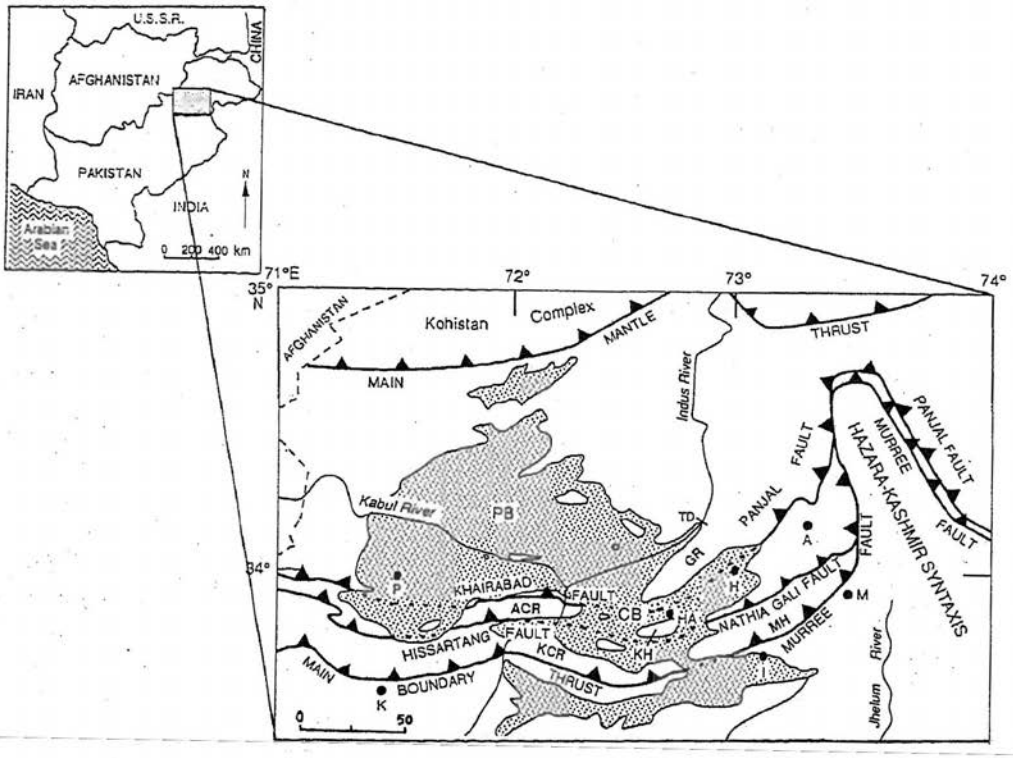

Fig. 1. Tectonic map of north Pakistan showing major structural boundaries.A = Abbottabad, ACR = Attock-Cherat Range, CB = Campbellpur Basin, GR = Gandghar Range, H = Haripur, HA = Hasan Abdal, I = Islamabad, K = Kohat, KCR = Kalachitta Range, KH = Kherimar Hills, M = Murree, MH = Margala Hills, P = Peshawar, PB = Peshawar Basin, TD = Tarbela Dam. (after Hylland et al., 1988).

In this paper it is intended to reappraise this problem of correlation of both these thrusts, i.e., the PT in Kashmir and its so called counterpart west of the syntaxis, to ascertain whether their tectono-stratigraphic and lithostratigraphic nets have any similarity to justify their being considered akin.

THE PANJAL GROUP

The Panjal Range in Kashmir is the type section of the Panjal Group of rocks which have been studied in the pre-Independence days by Lyddekar (1876) who named it the Panjal System, whereas Middlemiss (1890) called these rocks an assemblage of the Lower Panjal Agglomeratic Slates. Wadia (1931) first assigned these rocks the name Panjal Group which is still being retained in the geological literature.

Besides the type section of the Panjal Range, there are many reference sections located between Pir Panjal and the Kaghan valley. For this purpose, the authors selected only two sites, namely Nauseri (Fig. 2) and Khetar Tareri (Fig. 3) where the lithology and tectonic frame of these rocks are well represented. Two diagrammatic sections of these are produced to introduce their tectono-stratigraphic setup for correlation purpose.

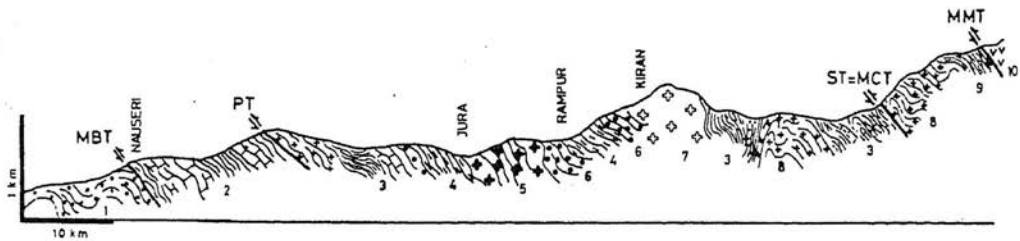

Fig. 2. Diagrammatic section along Neelam valley at Nauseri in Azad Kashmir. 1. Murree Formation, 2. Panjal Group, 3. Salkhala Series, 4. Dogra Slates, 5. Jura granite and granitic gniesses, 6. Quartzitic sandstone, 7. Kiran granite, 8. Nanga Parbat gneisses, 9. Rattu Formation (upper Salkhala), 10. Melange zone and Kamila Amphibolite (Kohistan sequence).

The Panjal Group consists of thick rock sequence with variegated lithology, ranging from agglomeratic slates- dolomitic limestone- marble- quartzitic sandstone to volcanic rocks, the latter known as Panjal Traps (Ashraf et al., 1989; Khan & Ashraf, 1989; Greco, 1989). The volcanic rocks contain basaltic to andesitic lava flows alongwith pyroclastic material, bulk of which are in the form of tuffs and ashes.

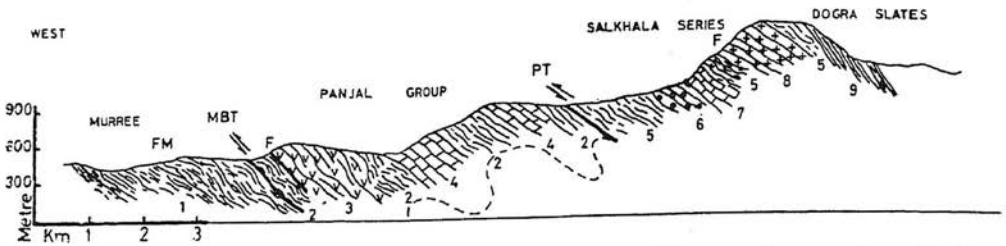

Fig. 3. Litho-tectonic zonation of Panjal Group in Khetar Treri section, eastern flank of Hazara-Kashmir Syntaxis in Kashmir. 1. Murre Formation, 2-4. Panjal Group (2. Agglomeratic slates & quartzitic sandstones, 3. Dolomitic limestone, 4. Volcanics), 5- 8. Salkhala Series (5. Schists including graphitic schists, 6. Medium crystalline limestone and marble, 7. Quartzites, 8. Granitic Gniesses), 9. Dogra Slates.

The volcanics are massive to medium bedded and usually amygdoloidal, the cavities are filled with chlorite, epidote, chert, jasper and chalcedony. The larger part of pyroclasts constitute tuffs and ashes, representing the last phases of the lava flows. The ashes are mottled, compact and bedded, the latter gives a look of fissile shales. Pillows, mostly deformed and attaining squeezed oval shapes are quite common in the basaltic part of the lava flows.

In Kaghan valley, the Panjal volcanics show a relatively higher grade of metamorphism because of their involvement in the Hazara-Kashmir syntaxis. As a result, they mostly appear in the form of greenschist facies which in metamorphic level ranges from amphibolite to chlorite grade. Agglomerate is composed of predominant dark grey to black slates, conglomerate, quartz mica schist, chlorite schist and carbonaceous phyllite alongwith traps of volcanic lenticles.

In Kashmir, the Panjal Group is divided into two well marked horizons (Bhatt & Ziauddin, 1979), namely the Lower Agglomeratic Slate and the Upper Panjal Lava Flows. The Panjal Traps overlie the Middle Carboniferous slates and underlie the Upper Permian.

The Panjal Group in Kashmir is bounded by two steep thrusts: at the base, the Murree Formation is thrustover by the Panjal Group and on the top the older Salkhalas of Precambrian age thrustover the Panjal Group. The dolomitic limestone and dolomite of Triassic age which form bold outcrop in the Panjal Group are thick bedded to massive, medium crystalline and on weathered surfaces range in colour from light grey to yellowish grey. Where these rocks are in contact with the volcanics, they become vari-coloured and some of such beds could provide good dimensional stone for use as decorative purposes. Quartzite and quartzitic sandstone are usually thin bedded, medium textured and constitute a subordinate component of the rock assemblage of the Panjal Group. Among the igneous intrusions both acid and basic bodies in the form of sills and dykes are quite common.

THE PANJAL THRUST IN KASHMIR

In the Panjal Thrust, in Kashmir, two litho-stratigraphic units are involved, the Panjal Group of Permo-Triassic age thrustover by the Salhkala Series which form the base of the unfossiliferous Precambrian sequence of the inner zone of the Lesser Himalaya.

The Panjal Group forms the footwall and the Salkhalas constitute the hanging wall of the Panjal Thrust. The deformation pattern displayed in the thrust zone yields both ductile and brittle signatures; the latter being more common. Imbrications along the thrust plane is most conspicuous in all the reference sections.

The thrust is steep at places and shows sinuous feature along the strike. This could be the result of its involvement in the late Himalayan orogeny during post-thrust period.

PANJAL THRUST: ITS EXTENDED DOMAIN WEST OF THE HAZARA-KASHMIR SYNTAXIS

The litho- and tectono-stratigraphic nets of the extended domain of the Panjal Thrust, West of the Hazara-Kashmir syntaxis will be described in three isolated sections for comparison with the PT in Kashmir. These are i. Salhad stream in Abbottabad, ii. Gandghar Range located on the western fringe of the Haripur plain and iii. The Attock-Cherat-Range located in the eastern part of Peshawar plain. These sections have been considered to accommodate the western extension of the PT. The above mentioned sections constitute the outer zone of the Lesser Himalaya.

Salhad Stream Section

Abbottabad: This section is located on the southern edge of Abbottabad town along the Salhad stream. While leaving the town for Haripur, the road extends along the southern bank of this stream.

The rocks involved in the thrust are the Abbottabad Group belonging to the Cambrian and the Hazara Slates of Late Precambrian age. The thrust strikes east-west along the stream and dips northwards with moderate angle. The Abbottabad Group which forms the footwall is thrustover by the Hazara Slates developed in the hanging wall of the thrust. No other lithology is involved in this thrust.

Gandghar Range

This section is located west of Abbottabad between Haripur plain and the Indus River in an isolated massif named Gandghar Range. The rock types involved are the

Sirikot Slates considered equivalent to the Hazara Slates and the Lockhart limestone of Paleocene age in an isolated outcrop in the vicinity of Hassan Abdal. The thrust runs east-west along the Haro River along which the Late Precambrian Sirikot Slates thrustover the Paleocene Limestone. Thus the Lockhart Limestone is developed in the footwall and the older Sirikot Slates constitutes the hanging wall. It may be mentioned here that the Lockhart limestone unconformably overlies the Samana Suk Formation of Jurassic age. No other lithology is involved in the thrust.

Attock-Cherat Range

This section is located southwest of the Gandghar Range across the Indus River. In this section there are two thrusts which are assumed to represent the extension of the Panjal Thrust. One is located underneath the Quaternary alluvium between the Kalachitta Range and the Attock-Cherat Range. In this thrust the sedimentary Mesozoic and late Cenozoic strata forming the footwall is thrustover by the metasediments of Paleozoic-Precambrian sequences developed in the hanging wall of the thrust. The rocks exposed in the hanging wall is named Dakhner Formation by Hussain et al. (1990) and placed in the Precambrian.

Another thrust which could be held representing the Panjal Thrust in this section is the Hissartang Thrust. In this thrust, according to Hussain et al. (1990), the Inzari Formation of Early Devonian age forming the footwall is thrust over by the Darwazai Formation of Cambrian age which is developed in the hanging wall. The ages assigned to these sequences still remain a debatable issue.

SUBSURFACE STRUCTURES

The subsurface structural data based on the seismo-tectonic investigation is also incorporated in this paper to further broaden the scope of locating the Panjal Thrust west of the Hazara-Kashmir Syntaxis. Seeber et al. (1980) and Armbruster et al. (1978) have scanned the Hazara arc region for locating the major subsurface tectonic scars from the Tarbela Dam seismic network. They have identified four major families of active faults which do not show any direct correlation with the surface structures but clearly indicate an obvious topographic expression. These faults are differentiated as; i. Tarbela Seismic Zone, ii. Hazara Lower Seismic Zone, iii. Indus-Kohistan Seismic Zone and iv. Decoupling along metasedimentary and sedimentary rocks.

Among these deep level fault zones, the last one emanates from the apex of the Hazara-Kashmir Syntaxis and extends westward across the Indus beneath the Tarbela Dam. This fault is still active and west of the Indus its subsurface extension coincides with the outcrops of Swabi-Buner (lower Swat) which expose Paleozoic-Mesozoic rocks

and fold belt and is relatively the main near surface feature of the Hazara arc and masks the other underlying basement faults.

CONCLUSIONS

Under the light of the field evidences gathered from the above mentioned sections the following conclusions can be drawn:

The lithostratigraphic net of the Panjal Thrust exposed in Kashmir does not correlate with the three sections discussed west of the Hazara-Kashmir Syntaxis. Specially the agglomeratic slates and volcanic suites which form the integral part of the Panjal Thrust in Kashmir are altogether missing in the latter sections.

The tectonostratigraphic frame of the sections exposed west of the Hazara-Kashmir syntaxis do not corroborate with the sections in Kashmir. For instance, in Kashmir the Panjal Group of Permo-Triassic age is thrustover by the Salkhala Series of Middle to Late Proterozoic age. But in the sections west of the syntaxis the following tectonostratigraphic setup is noted:

Abbottbad: The Hazara Slates of late Precambrian age thrustover by the Abbottabad Group of Cambrian age.

Gandghar Range: The Paleocene Lockhart Limestone is thrustover by the Sirikot Slates of the Precambrian age.

Attock-Cherat Range: The Eocene Patala Formation is thrustover by the Cambrian/Precambrian (?) rocks.

The ages of rocks involved in these thrusts are variable and range from Precambrian to Eocene. The tectonostratigraphic settings implicate the timing of thrusting whether it was post-Cambrian (Late Paleozoic?), post-Paleocene (?) or post-Eocene (?).

If one considers the post-Paleocene or post-Eocene timings of the formation of these thrusts, then three major tectonic episodes, the Main Mantle Thrust (=ISZ) during Eocene, Shontargali Thrust during Oligocene and the Main Boundary Thrust during post-Miocene are also to be figured for the thrusting imparted in the rocks exposed in these sections.

Most likely these tectonic signatures now being considered coeval with the Panjal Thrust are the result of the Shontargali and the Main Boundary accidents which prevailed in this region during this period. Thus there exists no convincing evidence which could authentically support the extension of the Panjal Thrust west of the syntaxis.

The Deep Level Detachment Thrust extending west of the syntaxis across the Indus has at least one evidence in support, that is a similar lithostratigraphic sequence in Swabi-Buner which is correlatable with the Panjal Group. These outcrops coincide with the subsurface extension of the thrust. Thus if at all the Panjal Thrust is to be extended west of the syntaxis, then the future investigation should be concentrated in this area to accommodate its extended tectonic domain.

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