JOURNAL OF THE PALAEONTOLOGICAL SOCIETY OF INDIA
VOL. 26, 1981, pp. 32—37.

STRATIGRAPHY AND SEDIMENTATION IN THE PANGI VALLEY, HIMACHAL PRADESH

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ABSTRACT

This paper deals in brief the recent observations made in the Pangi valley of Chamba district, Himachal Pradesh. It aims at establishing a stratigraphical setup. The rocks have been grouped into Kilar Formation (Precambrian), Sachkhas and Sidh Dehra Formations (Lower to Middle Palaeozoic), Bagotu and Dunai Formations (Upper Palaeozoic) and Bindrabani Gahar Formation of Mesozoic age.

The thick interbedded sequence of metasiltstone, slate phyllite and greywacke which is characterised by graded bedding, minor cross bedding, convolute laminations and slump structures indicate the presence of flyschoidal sequence in the Pangi area, thereby suggesting the presence of possible geosyncline during Palaeozoic time in this part of the Himalaya.

The conglomeratic facies fo the Sidh Dehra and Bagotu Formations associated with various sedimentary structures and basic intrusions indicate turbidite aspect of the eugeosyncline possibly during Upper Devonian to Carboniferous(?) period.

INTRODUCTION

The background knowledge of the regional geology is confined to the traverses through the Pangi valley by Lyddekar (1878), Mcmahon (1881), Hutchinson (1885) and Raina *et al.*, (1977). This note incorporates the observations made during the expedition sponsored by the

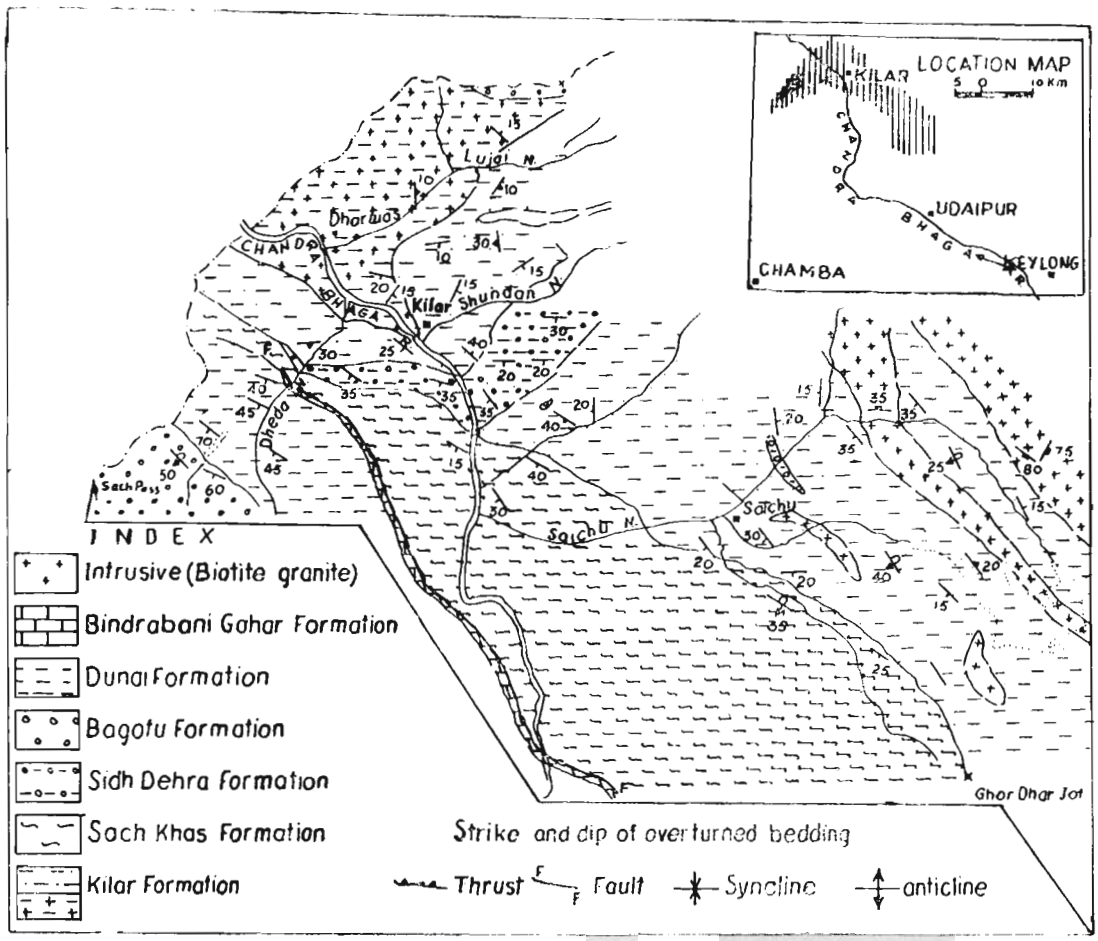

Fig. 1. Geological map of part of Pangi valley of Chamba district, Himachal Pradesh.

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Geological Survey of India in 1978 and 1979 in parts of Pangi valley of Chamba district, Himachal Pradesh.

The mapped area lies between northern slope of the "Pir Panjal Range" and southern slope of the "Great Himalaya Range" occupying either side of the Chandra Bhaga river from Ghordhar Jot on the south to Sansari nala on the south.

STRATIGRAPHY

The lithostratigraphic sequence established in Pangi area could be divided into Chamba and Pangi basins, as given under Table 1 and 2 respectively.

Table 1. Lithostratigraphic sequence belonging to Chamba basin.

Intrusives ..	Vein quartz and basic ..	Age not known.	
Bindrabani Gahar Formation.	Grey limestone interbedded with calc-phyllite.	Triassic	Over 15 m.
Dunai Formation.	Calcareous slate, phyllite, metasiltstone and greywacke ; Carbonaceous and pyritiferous slate and phyllite and associated with magnesite and limestone.	Permian	1500 m
Bagotu Formation.	Pebbles and boulders with phyllitic matrix.	Carboniferous.	1200 m

BAGOTU FORMATION

This formation consists of metasiltstone, phyllite and greywacke with subangular to subrounded pebbles and boulders. The framework of conglomerates being of quartzite, phyllite, slate and grey limestone. However, slates and phyllitic clasts are bladed and disposed in the form of shreds. Sorting of the fragments is poor. In Dheda nala section, this formation is characterised by load casts, flute casts and convolute laminations. Sedimentary cycles (Bouma, 1962) have also been met with at Bhota and Bagotu areas. This supports the connotation of 'flysch' for these sediments.

DUNAI FORMATION

Overlying the Bagotu Formation with gradational contact, occur carbonaceous and pyritiferous slate and phyllite, metasiltstone, greywacke and thin bands of limestone constituting the Dunai Formation. It occupies a considerable area in Dheda nala around Dunai Sarai. In its basal part immediately overlying the Bagotu Formation the rocks as compared to upper horizon, are more argillaceous, carbonaceous and pyritiferous and are associated with lenticular bodies of magnesite.

BINDRABANI GAHAR FORMATION

This formation of a carbonate sequence comprises limestone intercalated with calc-phyllite and quartzite and crops out at Bindrabani Gahar area as synclinal core within Dunai Formation. The grey limestone forming the main lithounit of this formation is generally platy. Its exposed thickness is over 15 m in Bindrabani Gahar area of Dheda nala and abuts against the Sach Khas Formation with a NW-SE trending fault. A parallel to subparallel arrangement of white thin veins of calcite have been developed within the limestone horizon.

Table 2. Lithostratigraphic sequence of the Pangi Basin

Intrusives ..	Biotite, tourmaline granite, beryl bearing pegmatite and basics.	Age not known.	
Sidh Dehra Formation.	Garnetiferous metasediments, with clasts and crushed conglomerates and dolomite bands.	Middle Palaeozoic.	Over 300 m
Sach Khas Formation.	Thick bedded quartzite interbedded with grey slates, metagreywacke and garnetiferous schist.	Lower Palaeozoic.	500 m
	Quartz-chlorite-mica schist member.		
Kilar Formation.	Garnetiferous mica schist member with bands of tremolite and marble.	Precambrian.	800 m
	Granite gneiss and schist member, with bands of kyanite.		Base not exposed.

KILAR FORMATION

The rocks of this formation has been divided into three members, viz. granite gneiss and schist member, garnetiferous mica schist member and quartz chlorite-mica schist member.

GRANITE GNEISS AND SCHIST MEMBER

This member comprises mainly of granite and gneisses, which contain xenoliths of metasediments showing great variations from fine grained aplitic and migmatic granitoids to coarse grained porphyritic to augen gneiss. Kyanite has been developed within this formation at Gulogi Adwar area.

GARNETIFEROUS MICA SCHIST MEMBER

These schists are composed of quartz, muscovite, biotite and pink garnet with several lenticular bands of marble and calc-silicate rocks as observed at Batwas and Surkund areas. The calc-silicate rocks are generally associated with the marble bands and range in thickness from 0.5 m to a metre.

QUARTZ-CHLORITE-MICA SCHIST MEMBER

This member consists of medium to coarse grained bluish green schists interbedded with fine grained compact quartzite which forms the upper most part of the Kilar Formation. The metasedimentaries are intruded by quartz veins at the vicinity of the granite bodies and appear to be related with the emplacement of granite.

SACH KHAS FORMATION

This formation, representing a continuous sequence of alternating coarse to fine grained grey quartzite, grey to green slate, phyllite and greywacke, is well exposed around Sach Khas particularly along the defile of the Chandra Bhaga river between Ajog and Dheda nala. The slate interbedded with quartzite show well developed slaty cleavage and is often brittle and splintry in nature. In Dheda nala, the greyish green phyllite and metasiltstone are characterised by sheeny appearance. The slate at places is quartzose. The metasiltstone shows graded bedding and minor cross bedding.

SIDH DEHRA FORMATION

This formation is characterised by the presence of crush conglomeratic meta-sediments. It overlies the Sach Khas Formation with a gradational contact. The majority of the clasts being ow white and grey coloured quartzite followed by slate, phyllite, schist, marble and granitoid gneiss and vary in size from grit to 28 cm. along longer axis. They are subangular to subrounded and do not show any proper orientation except flattening along the foliation planes. These rocks exhibit slump structures and convolute laminations.

The nature of these conglomerates, characterised by clasts as well as crushed conglomerates with schistose matrix immediately overlying the Sach Khas Formation, bears kinship more towards Tanawals of Kashmir than the conglomerates of the Manjir Formation of Chamba area as discussed later.

GRANITE

The metasediments of Kilar Formation at Piri, Tinglot, Chatwani and Jambu nala areas are intruded by coarse grained granitic bodies. Except at Chetwani where it is tourmaline bearing, they are mostly biotite granite. In Tinglot area, it is emplaced discordantly for about 7 km within Kilar Formation. It also rests on the Sidh Dehra Formation across the thrust plane. This may be due to low angle overthrusting as the metasediments of the former have since been eroded away after thrusting leaving the more resistive granite, forming the conspicuous Hoshri Dhar ridge.

METAMORPHISM

The rocks of this area exhibit metamorphism from shale-slate stage in the younger rocks to mesograde kyanite stage in the oldest rocks of the Kilar Formation as is evident by the presence of metamorphic index minerals such as sericite, chlorite, garnet, staurolite and kyanite. The metasediments have also undergone some dyanamic alteration and deformation exhibited by the formation of compact slates and stretched pebbles. The granite have also been foliated and the felspars have commonly been altered to sericite. The impure limestones have been metamorphosed to calc-silicate rocks.

STRUCTURAL ELEMENTS

The metasedimentaries show typical flysch structures such as the graded bedding, load casts, flute casts and cross bedding, etc.

BEDDING

The bedding is represented by compositional, grain size layering and colour banding. The general strike varies from NW-SE to NNW-SSE with varying amount and direction of dips due to folding.

FOLIATION

The pelitic and semi pelitic rocks show schistosity characterised by preferred dimensional orientation exhibited by platy minerals such as mica, chlorite and flattened grains of quartz. The most prominent foliation plane (S_2) trend E-W to NW-SE around Kilar and Tunda Got areas and NW-SE to NNW-SSE in the western side of the Chandra Bhaga river and dipping either side due to folded sequence. The amount of dip decreases towards eastern side of the Chandra Bhaga river. The pebbles of Sidh Dehra and Bagotu Formations have been flattened along this plane with their shortest axis crossing S_2 plane.

FOLDS

The main Pangi valley covered by the Chandra Bhaga river represents the core of a major anticline between Sach Pass to the west and Khangsar to the east. Along the Dheda nala the western flank of this anticline forms an overturned syncline with axial plane dipping south-westerly. The Palaeo-Mesozoic rocks occur in the core of this syncline. The overturning may be due to the prominent Bindrabani thrust which has brought the older sequence along the Sidh Dehra Formation as a result of the upthrusting of the eastern block.

BINDRABANI GAHAR FAULT

This NW-SE trending fault, extending from Bindrabani Gahar in Dheda nala to further south to Kilka Dhar has cut off the extension of Palaeo-Mesozoic sequence. The fault zone is marked by crushing, shearing, crumpling and disharmonic attitude of the rocks. The Bindrabani

Gahar Formation (Triassic) forming the western block of the fault, is in contact with the eastern one of the Sach Khas Formation (Lr. Palaeozoic).

BINDRABANI THRUST

This low angle overthrust is noticed from Bindrabani, crossing Chandra Bhaga river at Rehti Got to beyond Hoshri Dhar ridge. Due to this thrust the mesograde metamorphites of the Kilar Formation rests over the low grade rocks of the Sidh Dehra Formation. The presence of granite over the latter formation also appears to be due to this thrusting.

SEDIMENTATION

The sediments in the Pangi valley are characterised by enormous thickness made up mostly of interbedded siltstone, metasiltstone, slate, phyllite and greywacke which could be grouped under wacke and greywacke group of rocks (Willium *et al.*, 1954). The presence of such thick sediments in the entire Chamba Himalaya could only be explained by assuming a sinking basin as the domain of sedimentation. The flysch-turbidite aspect is also exhibited by such sedimentary structures as graded bedding, cross bedding, flute casts, load casts and convolute laminations. In Dheda nala area the varied types of sedimentary cycles (Bouma 1962) corroborates its flyschoid nature of the sediments. The association of basic rocks with the sediments further connotes the geosynclinal origin of the sediments.

The aforesaid factors suggest, that the rocks of the Pangi area are a part of the flysch sequence that have been deposited in a geosyncline with unstable tectonic conditions. However, there might have been some periods of quiescence too during the Palazoeoic time which resulted in the deposition of argillaceous sediments which ultimately resulted in the formation of shale/slate. During Upper Devonian to Carboniferous time this area suffered a major movements. The depositional basin started subsiding rapidly and resulted in consequent upheaval of the surrounding areas. This resulted in slumping of the submarine zones and in the development of mud flows. The erovise currents generated under such condition brought clasts and deposited in the basin resulting thereby in the deposition of conglomerates found in this area.

During the deposition of Dunai Formation however, the intensity of turbulance relatively decreased but the unstable conditions of the basin prevailed throughout the period of deposition.

RELATIONSHIP WITH ADJOINING AREAS

The present study in the Pangi area reveals that the Bagotu, Dunai and Bindrabani Gahar Formations are part of Manjir, Salooni of Permian age (Datta &

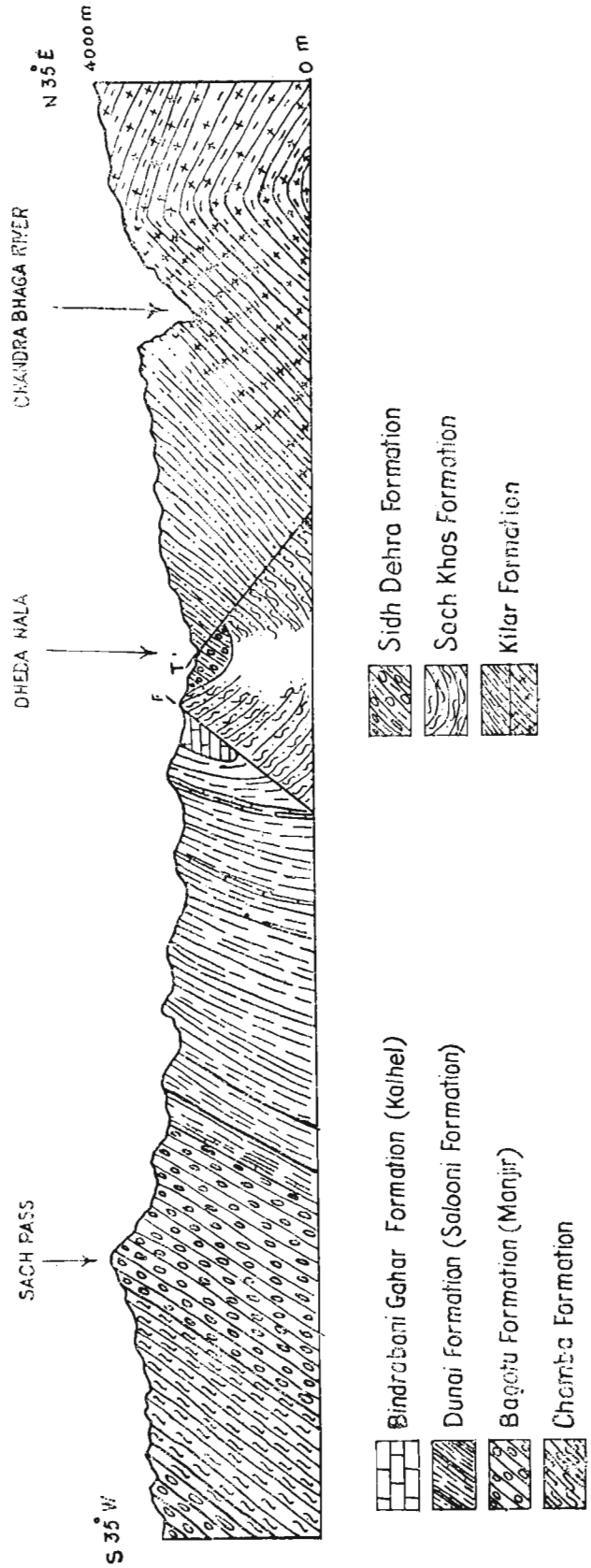

Fig. 2. Enlarged cross section from Sach Pass to Lujai nala S35°W-N35°E direction.

Bhattacharya 1971) and Kalhel Formatoins respectively of Chamba basin which have been overfolded due to Bindrabani thrust. This indicates that Chamba basin do extend in Pangi area along the eastern flank of the Pir Panjal Range from Bindrabani on the north to Kilka Dhar on the south. However, further north of it they differ in many points which constitute Pangi basin as discussed below :

(1) The metasediments of the Pangi area along Chandra Bhaga river show much higher grade of metamorphism (Mesograde kyanite stage) than the entire Palaeozoic sequence of Chamba Basin (Low grade biotite-garnet stage).

(2) The conglomeratic facies of the Sidh Dehra Formation comprising clasts and crushed conglomerates are deformed as such, that in the advanced stages of deformation the pebbles near Rehti Got, Chachros, Hoshri Dhar and Chabi Got areas have been drawn out and flattened similar to one that of Tanawal conglomerates of Kashmir which is also represented by clasts and crushed conglomerates (Wadia 1966) and the pebbles of Tanawals have also been flattened into mere flakes (Pascoe, 1968). Similar features such as deformed pebbles giving rise to pebble lineations have also been reported from Langera conglome-

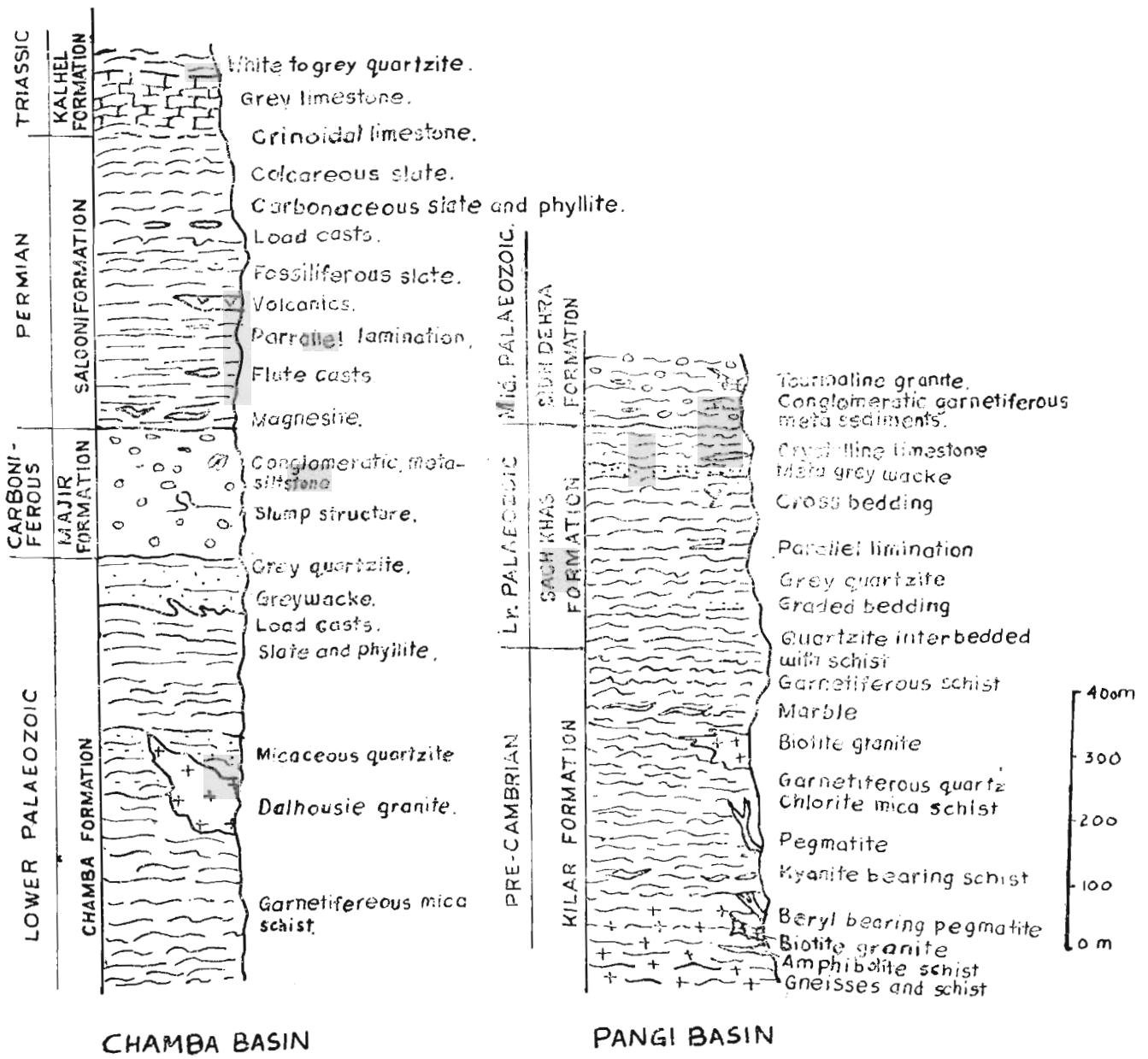

Fig. 3. A comparison of lithologs of Chamba and Pangi basins.

rates (Sharma *et al.*, 1975). The presence of granitoid gneiss clasts found within Sidh Dehra Formation about one km. north of Thane Adwar resemble the one found within Langera conglomerates (McMahon 1885) indicate the possibility of a depositional connection between the two adjoining basins. Mention may be made here, that no such clasts of granitoids, schist and marble have been recorded within the conglomerates of the Manjir Formation. The Sidh Dehra conglomerates are embedded in garnetiferous metasediments, where as the Manjir conglomeretic metasediments are devoid of any garnet.

The difference in lithology of Pangi and Chamba sediments and absence of organism in Pangi area (Fig. 3) indicates its deposition in sinking geosyncline with palaeogeographical conditions different from those prevailing in the Chamba basin, thus providing the speculation that the Pangi and Chamba basins were separate during the Palaeozoic time.

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