

## Explanatory notes on the Geology of South Eastern Hazara, to accompany the revised Geological Map

By MIR ABDUL LATIF

Department of Geology, University of the Panjab, Lahore, West Pakistan  
With 1 plate, 1 map and 5 vertical sections

### Abstract

1. Location of the area
2. Introduction
3. History of Exploration
4. The basis of classification of rocks
5. Limits of accuracy of mapping
6. The stratigraphic succession
  - a) Hazara Group
  - b) Tanol Formation
  - c) Abbottabad Group
    1. Kakul Formation
    2. Sirban Formation
    3. Galdanian Formation
    4. Hazira Formation
  - d) Thandiani Group
    1. Maira Formation
    2. Sikhar Limestone

### Contents

- e) Hothla Group
  1. Spiti Shale
  2. Giupal Sandstone
  3. Chanali Limestone
- f) Galis Group
  1. Mari Limestone
  2. Kuzagali Shale
  3. Margala Hill Limestone
  4. Lora Formation
  5. Kuldana Formation
- g) Rawalpindi Group
  1. Murree Formation
- h) Havelian Group
7. Comparison of unit names used  
by different workers
- Bibliography

### Abstract

This is a brief account of the stratigraphy of over 1000 square miles of south eastern Hazara, West Pakistan, supported by a geological map on a scale of one inch to one mile. The mapping is based on the recognition of lithostratigraphic units, which are briefly described with modernisation of nomenclature. The rocks are divided into 7 groups and subdivided into 21 formations, some provisional. The strata range from Eo-Cambrian?/ Cambrian to Recent. Diagnostic fossil evidence where ever available is given. A correlation with the adjoining areas is attempted.

#### 1. Location of the area

The area under study is mainly composed of southeastern parts of the Hazara district, West Pakistan (see the map). Small portions of north-west of the Rawalpindi and southwest of the Muzaffarabad districts, just fringing the above area have also been included because of the extension of the same rock types. The area lies between longitude 73.00 and 73.30 east and latitude 33.43 and 34.20 north, and is covered by the Survey of Pakistan toposheets 43 F/4, 43 F/8, 43 G/1, 43 G/5, 43 F/7, and 43 G/2. The main part of the area is bounded on the north west and west by the Hazara trunk road through Haripur, Havelian, Abbottabad, Mansehra

and further beyond via Garhi Habibulah Khan to Muzaffarabad; and on the southeast and east by the Rawalpindi-Srinagar road, through Islamabad, Tret, Murree and Kohala to Muzaffarabad.

## 2. Introduction

The area under study ranges from just under 2,000 feet O. D. near Islamabad to 9,780 feet at Miranjani, near Nathiagali. More than half of the area lies above 4,000 feet O. D. The Galis lying between Murree and Abbottabad provide the highest regions in the area and serve as a water divide between the Indus and the Jhelum river systems. The relief is very high and is seen at its maximum when the mountains rise abruptly from 1,937 O. D. near Kohala to 9,780 feet O. D. near Miranjani, a horizontal distance of about five miles.

## 3. History of Exploration

The first publication of any significance on the geology of Hazara is ALBERT VERCHERE's paper read before the Asiatic Society in 1866. This gives a brief outline of the north eastern end of the Sirban mountain near Abbottabad. He recognised Carboniferous limestone resting upon volcanic rocks. The beds above these he referred in a general way to the "Jurassic Formation" and the highest strata to the Nummulitic Limestone.

WAAGEN and WYNNE in 1872, put an order for the first time to the structurally complex rocks of monotonous similarity. They also produced a map of the Sirban Mountain, on a scale of one inch to a mile covering an area of about 20 square miles. They suggested the presence of rocks from Triassic to Eocene based on fossil evidence and found similarities of some with those from the Cambrian of the Salt Range. This information coupled with a series of papers during the late seventies of the last century, is still considered the soundest basis of rock classification in the area.

MIDDLEMISS, 1896, pieced together all the available information, published or unpublished, from all over Hazara, to produce a map of Hazara on a scale of ½ inch to a mile, together with a detailed account of the geology.

The present study was initially suggested, in 1956, by N. R. MARTIN, then a UNESCO advisor and Head of the Geology Department, University of the Panjab, Lahore. A few road side reconnaissance trips were made by the author in his company during the summer months of 1956, followed by a few independent trips in 1957. Following the footsteps of ALBERT VERCHERE, the Sirban Mountain was selected as a starting point, and a beginning was made in July, 1959. The main purposes of the study were to (a) revise the stratigraphy, (b) bring the unit names in line with modern stratigraphic nomenclature and (c) produce a new geological map, on a scale of one inch to a mile.

Though some short publications to advance the knowledge of Geology of Hazara have recently appeared from Lahore, this is the first of its kind since 1896, in which (a) an attempt has been made to bring the rock units

in order, to suit the requirements of stratigraphic nomenclature (b) revise the ages of units based on faunal assemblages, (c) correlate the units with the adjoining areas and (d) produce a new map of the south eastern Hazara, on a scale of one inch to one mile. Publication of this map with short account of the stratigraphy marks the centenary of the first investigations started in the area by ALBERT VERCHERE, in 1866.

#### 4. The basis of classification of rocks

As most of the stratigraphic units in the area have not been formally defined by earlier workers, in accordance with the stratigraphic terminology, it is considered appropriate to do so in this study, wherever applicable. In recent years the nature and usage of stratigraphic units has been much discussed. The stratigraphic units newly erected and/or properly defined in this work follow the basis laid down by the Stratigraphic Committee of Pakistan in the Stratigraphic Code of Pakistan, 1967, which in turn follows the lines set by the Interational Subcommittee on Stratigraphic Terminology, 1961.

The present study is based on the field mapping by recognition of the lithostratigraphic units, supported by the faunal and environmental studies wherever possible. The subdivisions and definitions of such units are based on the definition as laid down in the Stratigraphic Code of Pakistan, 1967. The subdivisions applied in this work are the Group, the Formation and the Member. The formation is considered as the fundamental lithostratigraphic unit, the Group and Member are the aggregates and the subdivisions respectively and are defined as such. The names of various units which have been proposed are based on a geographic feature or locality of it's maximum development in the area. Wherever a convenient geographical name is not available at the type locality a name has been chosen from an adjacent locality where the unit may not be so well exposed. An attempt has been made to retain the existing unit names in spite of the fact that some may not be represented at the localities and/or the locality is situated outside the area of present investigations. An attempt has been made to select the type localities with an easy access, as far as possible. The various formations and members have been shown on the map by various patterns as near as possible to their lithologic content. In some cases the groups which could not be subdivided on the map have been shown in a single pattern. Every group, with minor adjustments, has been shown by a distinct colour suiting its stratigraphic position and follows the colour scheme as published in 1958 by N. V. De Bataafsche Petroleum Maatschappi, Hague, Holland.

#### 5. Limits of accuracy of mapping

Though most of the area has been mapped thoroughly, it was not possible to maintain a uniform standard everywhere due to the limited means of communication, accommodation, dense vegetation, high relief, and above all the structural and sedimentational problems. The standard



The detailed mapping is from the regions of Tarnawai, Thandiani, Kakul, Abbottabad, Bagnotar, Sirban, Dubran, Nara, Mari, Lora, Islamabad, Murree and Muzzaffarabad. The mapping in the regions Miranjani, Mokshpuri, Kuzagali, Barian, Havelian, Margala and Rupper is partially detailed and partially of reconnaissance or photogeologic nature. The mapping from most of the Miranjani and Mokshpuri regions is purely of photogeologic nature. The Pleistocene and Recent alluvial deposits have mainly been marked by photogeology with some ground checking. The eastern and north eastern parts of the Bagnotar region towards the right bank of the river Jhelum are based purely on photogeology.

### 6. The stratigraphic succession

Group	Formation	Member	Age
Havelian			M. Pleistocene to Recent
		Unconformity	
Rawalpindi	Murree		Lower Miocene
		Unconformity	
Galis	Kuldana		L. & M. Eocene
	Lora		L. Eocene
	Margala Hill Limestone		L. Eocene
	Kuzagali Shale		U. Paleocene
	Mari Limestone		L. ?/M. to U. Paleocene
		Unconformity	
Hothla	Chanali Limestone		U. Cretaceous
	Giumal Sandstone		L. Cretaceous
	Spiti Shale		U. Jurassic
			U. Jurassic
		Unconformity	
Thandiani	Sikhar Limestone		Middle Jurassic to U. Jurassic
	Maira		Lower Jurassic
		Unconformity	
(Tarnawai?)	Hazira		Permian and/or Triassic?
	Galdanian		Carb. and/or Trias. (?)
		Unconformity	
Abbottabad	Sirban		Upper Devon. to Lower Carboniferous (?)
	Kakul	Mirpur Mahmdagali Sangargali Tanakki	Silurian to Devonian (?)
		Unconformity	
Hazara	Tanol		Cambrian and/or Ordovician to Silurian (?)
	Upper Langrial Limestone		Eo-Cambrian to Cambrian (?)
	Middle Miranjani Limestone		
	Lower		

## a) Hazara Group

Formerly known as the "Slate series", MIDDLEMISS, 1896, and recently identified as the "Hazara Slate formation", MOHAMMAD ALI, 1962, the rocks have provisionally been recognised as a group. The following provisional subdivisions are suggested.

5. Upper Formation
4. Langrial Limestone
3. Middle Formation
2. Miranjani Limestone
1. Lower Formation.

The above subdivisions are based on the occurrence of two limestone units of different geological horizons.

a) The Miranjani Limestone is a light grey algal limestone, on the weathered surfaces of which the stromatolites conspicuously stand up to form wavering uneven ridges.

b) The Langrial Limestone is a grey nodular limestone with dominant argillaceous matrix and weathering in grey to pale brown colours.

The Lower, Middle and Upper Formations all taken together are composed of low grade slates, argillites, silty shales, subgreywacke sandstones and siltstones, interbedded with gypsum and calcareous slaty shales. The subdivision is provisional subject to the detailed definitions of its constituent formations. Though a definite fossil evidence is lacking, the presence of some doubtful inarticulate brachiopod fossils similar to *Protobolella* CHAPMAN and Acrotretid, go to prove that the group may not be pre-Cambrian and could be Lower Palaeozoic. The rocks extend in the south west and north east to join the Attock and Slates respectively. In Kashmir, the Dogra Slates underlie a definite Cambrian sequence and as such a Cambrian age for the group, at least in part, may be possible.

The lithology, sedimentary structures and distribution of identical rocks suggest a shallow to deeper water facies approximately extending from south east to north west respectively. The presence of gypsum, further suggests a possible partial extension of the Cambrian "Saline Series" facies of Salt Range to Hazara.

## b) Tanol Formation

The Formation was first named as Tanol series by WYNNE in 1879 after its occurrence in the vicinity of Tanol. MOHAMMAD ALI, 1962, identified the unit as Tanol Formation.

The Formation is composed of well bedded to flaggy, light grey to yellowish and sometimes faintly reddish quartzites which are cross bedded and contain ripple marks. Siltstones and pebbly layers are common. The top of the Formation is marked by the presence of a badly sorted conglomerate containing pebbles derived from the quartzites as described above, embedded in a fine grained matrix. The conglomerate is followed by a

sequence of rocks similar to the Abbottabad Group and the conglomerate is probably homotaxial to the Tanakki Member of the Abbottabad Group.

The Formation may be Cambrian and/or Ordovician to Silurian (?) in age.

The Lower Tanawal in Kashmir lying below the Muth Quartzites and Jaunsars and Nagthat of Himalayas are considered as homotaxial.

### c) Abbottabad Group

MIDDLEMISS, 1896, introduced the term "Infra-Trias" to include rocks like conglomerate, shales, sandstones and limestones of a total thickness of up to 2,250 feet. MARKS and MOHAMMAD ALI, 1962, named the rocks as Abbottabad Formation. GARDEZI and GHAZANFAR, 1965, elevated the unit as Abbottabad Group with the addition of a new Hazira Formation overlying the rocks given above.

The group is named after Abbottabad, where it shows a maximum development. It overlies the Hazara group with a break in deposition represented by a basal conglomerate derived from the underlying rocks of Hazara Group. This is followed by a thick sequence of interbedded shales, sandstones, orthoquartzites, arenaceous dolomites, dolomites, volcanic materials, haematitic mudstones, quartz breccias, siltstones and silty shales. The group constitutes of four formations as given below:

Formation	Member
-----------	--------

- |              |  |
|--------------|--|
| 4. Hazira    |  |
| 3. Galdanian |  |
| 2. Sirban    |  |
| 1. Kakul     |  |

- |               |
|---------------|
| d) Mirpur     |
| c) Mahmdagali |
| b) Sangargali |
| a) Tanakki    |

#### 1. Kakul Formation

The formation is named after its occurrence near Kakul and is composed of angular to subangular conglomerate identified as Tanakki Member at the base derived from the underlying Hazara Group of rocks. The conglomerate is embedded in a silty and shaley matrix. The size of pebbles decreases higher up in the succession merging gradually into the overlying Sangargali Member, consisting of shales, sandstones and orthoquartzites of red and purplish colours. The overlying beds are composed of purple and red sandy dolomitic limestones and dolomites, named as Mahmdagali Member, followed by variegated shales and calcareous sandstones of Mirpur Member. The Formation is considered homotaxial to the Muth Quartzites and overlying shales of Kashmir; Pebbly shales, quartzites and Crinoidal limestone of the Swabi Chamla Group and the Siluro-

Devonian sequence in Nowshehra consisting of conglomerates, calcareous sandstone, purple quartzites and sandy dolomites.

## 2. Sirban Formation

Formerly known as limestones belonging to "Infra-Trias series", MIDDLEMISS, 1896, and Upper Cherty Limestones of Upper Formation, belonging to "Infra-Trias" Group, MARKS and MOHAMMAD ALI, 1961, the unit is named after its occurrence in the Sirban hill near Abbottabad. The lower part of the formation is slightly sandy, followed by a thick sequence of dolomites of buff, light greenish grey, greyish white and rarely of red and pink colours. The upper parts of the formation occasionally contain cherty patches and bands. The rocks show a striking similarity to the bluish white crystalline limestone of Upper Devonian-Lower Carboniferous(?) of Nowshehra; brecciated white dolomite of Swabi Chamla Group, Devonian-Lower Carboniferous(?) of Swabi. The Muth Quartzites of Devonian age in Kashmir are followed by fossiliferous Syringothyris Limestone of Lower Carboniferous age and are considered homotaxial.

## 3. Galdanian Formation

Formerly known as the "Volcanic material" at the base of the Triassic series, MIDDLEMISS, 1896, the "Lower Formation" of Triassic System, MARKS and MOHAMMAD ALI, 1961, and Haematite Formation belonging to the Abbottabad Group, GARDEZI and GHAZANFAR, 1965, it is named after its occurrence near Galdanian. It is a distinct unit consisting of volcanic rocks, haematitic mudstones and sandstones, quartz breccias etc.; of red, purple and dark grey colours. The adjoining region of Kashmir, received the volcanic activity from Upper Carboniferous to Triassic. A correlation with the Panjal Volcanic Series of Kashmir sounds quite reasonable, and it is considered that the formation may be of Upper Carboniferous(?) and/or Permian(?) to Triassic(?).

## 4. Hazira Formation

During the course of current mapping of the area the rocks were noticed in the Hazira region. They were studied in detail and named by GARDEZI and GHAZANFAR, 1965.

The formation is composed of dirty grey and yellowish brown calcareous shaly siltstones containing earthy concretions. It is considered as of Permian?/Triassic? age.

Three distinct environmental subdivisions of the Abbottabad Group can be noticed, a) a basal conglomerate, siltstone sandstone; b) an ortho-quartzite, dolomite and c) a volcanic, oolitic haematite, siltstone. Though the name Abbottabad is retained for the time being, a fresh regrouping seems necessary. The upper two formations namely the Galdanian and Hazira Formations, it is suggested, may be grouped to be known as Tarnawai Group, in any later regrouping.



#### d) Thandiani Group

Formerly known as the 'Triassic series', MIDDLEMISS, 1896, is recognized as a group and is named after its occurrence in the vicinity of Thandiani, where it shows a maximum development. It follows the Abbottabad Group with a break in deposition and is found in contact with its various formations and sometimes even the Hazara Group. A microconglomerate at the base has been noticed and is composed of fragments of the rocks belonging to the Abbottabad Group. The group constitutes of the following formations.

#### 2. Sikhar Limestone

##### 1. Maira Formation

##### 1. Maira Formation

MIDDLEMISS, 1896, pointed to the occurrence of grey shales at the base of his 'Triassic series' in the Bagnotar region. He also recorded some fossils, though found them imperfect for identification. DAVIES and GARDEZI, 1965, identified the rocks as Maira Formation after their occurrence near Maira. The formation is composed of quartzite, orthoquartzite bands intercalated with shales marls and thin limestone bands. The quartzites are generally greyish white whereas shales, marls and thin limestone bands show a variety of colours apart from grey. The limestones show the occurrence of dolomitic patches of various shades. The patches are of irregular shape and size and in upper parts fuse together to form thin parallel bands of pale yellow colours. Fossils like *Bouleiceras* cf. *niticens* recorded from the marls show a Toarcian, Liassic age for the formation.

The formation may be compared with the Datta Formation of Kalachitta and northern Potwar, variegated shales of Salt Range and southern Potwar and upperparts of the Shinawari Formation of Kohat.

##### 2. Sikhar Limestone

Formerly known as "Upper limestones" of the "Triassic series", MIDDLEMISS, 1896, it is recognised as a formation and is named after its occurrence in the Sikhar mountain near Thandiani, where it shows a maximum development. The formation is composed mainly of limestones though some marley intercalations are also present, in the lower part. The limestones are grey in colour and are quite massive. They are oolitic, arenaceous and occasionally shelly and are shallow water deposits.

The highest beds show the presence of fossils like *Nerinea* Sp. of Oxfordian-Upper Cretaceous affinities. Since the basal part of the overlying formation also shows an Upper Oxfordian assemblage, it is considered that the top beds of this formation are pre Upper Oxfordian.

The formation can lithostratigraphically be correlated with Samana Suk Limestone of Kalachitta, northern Potwar and Kohat and Baroch Limestone of Salt Range and southern Potwar.

The overall range of the Thandiani Group is from Lower Toarcian to Middle Oxfordian.

## e) Hothla Group

The last detailed account of the area, MIDDLEMISS, 1896, shows the rocks like "Jurassic series", "Cretaceous" and "Grey limestones" as the basal part of the "Nummulitic series". All these rocks together have been identified as a group and named after Hothla, where they show a maximum development. The group overlies the Thandiani Group with a marked break in deposition. It is composed of the following formations.

3. Chanali Limestone

2. Giumal Sandstone

1. Spiti Shale

### 1. Spiti Shale

STOLICZKA, 1866, named the rocks as spiti shale after Spiti area in Himalayas. The name was applied for similar rocks in Hazara, by MIDDLEMISS 1896. The base of the formation shows a break in deposition and is marked by the presence of laterite. This is followed by dark grey arenaceous shales containing limonitic concretions and pyrite nodules. The shales are gradually replaced by sandstone bands higher up in the sequence and with a gradual change of material merge finally into the succeeding formation.

The basal beds contain fossils like *Perisphinctes frequens* of Upper Oxfordian and the later ones show the presence of *Hibolites subfusiformis* of Neocomian.

The formation may be compared with the Spiti Shale of Himalayas. Somewhat similar rocks occur in Kalachitta, Potwar, Salt Range and Kohat and are known as Chichali Formation.

### 2. Giumal Sandstone

Name given by STOLICZKA, 1866, after Giumal in Spiti Himalayas, was applied to rocks of identical nature in Hazara by MIDDLEMISS, 1896.

The formation consists of glauconitic and calcareous sandstones respectively in the ascending order of sequence. They are grey in colour, but generally weather in the shades of brown and yellow. The lower part is more argillaceous and the upper more calcareous. The rocks are generally massive and hard. A rich assemblage of fossils is present, among them are *Virgatosphinctes* Sp., *Aulacosphinctoides* Sp. of Tithonian and *Oxytropidoceras* Sp. and *Douvilleiceras* Sp. of Albian.

The formation seems identical to the Giumal Sandstone of Spiti Himalayas. It may be compared with the Lumshiwal Sandstone of Kalachitta, Potwar, Salt Range and Kohat.

### 3. Chanali Limestone

MIDDLEMISS, 1896, identified the rocks as "Grey limestones" and described and mapped them as the basal part of this "Nummulitic series". The author, 1962, identified them as "Upper Cretaceous Limestone" on the

basis of planktonic microfossils as seen in thin sections. The limestones are recognised as a distinct formation and are named after Chanali, where they show a maximum development.

The formation is composed mainly of fine grained light grey limestones which weather in grey to pale cream colours. The limestones are generally thinly bedded though occasionally they occur as thickly bedded as well. The lower part of the sequence is marley, the middle thinly to thickly bedded and upper slightly arenaceous. There is a conspicuous variation in lithology from one section to the other.

The fauna is composed of microfossils, see the other publication on Hazara in this issue. The diagnostic fossils include *Globotruncana concavata* of Upper Coniacian to Upper Santonian, *Globotruncana elevata calcarata*, of Campanian, *Heterohelix reussi* and *Heterohelix globocarinata* of Middle Coniacian to Middle Campanian. On the basis of the occurrence of above fossils, the formation is considered to be of Upper Coniacian to Upper Campanian in age.

The formation may be correlated with Kawagarh Formation of Kalachitta, Darsmand Limestone of Kohat and Chikkim Series of Himalayas.

#### f) Galis Group

First identified by WYNNE, 1874, as "Nummulitic limestone series" along with "Kuldanas", were combined by MIDDLEMISS, 1896, as "Nummulitic series". They have been recognised here as a group and named after their frequent occurrence in the Galis region situated between Murree and Abbottabad. It overlies the Hothla Group with a marked break in deposition which is represented by the absence of the uppermost part of Cretaceous at least in the eastern regions and the presence of coal and laterite. The group is divided into the following formations.

5. Kuldana Formation
4. Lora Formation
3. Margala Hill Limestone
2. Kuzagali Shale
1. Mari Limestone

##### 1. Mari Limestone

MIDDLEMISS, 1896, identified variegated sandstone and coal followed by well bedded massive limestone, as the 2<sup>nd</sup> and 3<sup>rd</sup> units of his "Nummulitic series". Though it is quite possible to identify and map the two units separately, they have been taken together for the purposes of present work. The name of the formation is derived from its occurrence near Mari where it shows a maximum development.

The base of the formation overlies the Hothla Group with a marked break in deposition represented by the absence of the youngest Cretaceous rocks, presence of sandstone, coal, bituminous shales, laterite limonite and

oolitic haematite. This is followed by a sequence of dark grey bituminous limestones of nodular appearance.

The fauna is composed of microfossils like *Lockhartia conica*, *Lockhartia haimei*, *Actinosiphon punjabensis* and *Globigerina triloculinoides*, thereby showing a Lower/Middle to basal Upper Paleocene age for the formation.

The basal part of the formation may be correlated with the Dhak Pass Beds of Salt Range, Potwar, and Kalachitta and Hangu formation of Kohat. The main part of the formation is homotaxial to the Khairabad Limestone of Salt Range and Lockhart Limestone Kalachitta and Kohat.

## 2. Kuzagali Shale

The formation constitutes of the lower part "shales" of the 4<sup>th</sup> unit of the "Nummulitic series" introduced by MIDDLEMISS, 1896. The unit is recognised as a formation and is named after its maximum development near Kuzagali.

The formation is composed mainly of buff and Khaki coloured shales with insignificant limestone bands.

The fauna is mainly composed of microfossils and show a continuation of the underlying Mari Limestone assemblages. They include *Globorotalia elongata*, *Globigerina saldadoensis*, *Miscellanea miscella* and *Operculina salsa* showing an upper Paleocene age for the formation.

Similar rocks occur in Salt Range, Kalachitta, Potwar and Kohat known as Panoba Shale.

## 3. Margala Hill Limestone

MIDDLEMISS, 1896, mentioned the presence of "concretionary and nodular limestone" apart from other rocks in the 4<sup>th</sup> unit of his "Nummulitic series". This has been identified as a formation and named after its maximum development in the Margala Hills, north of Islamabad.

The formation consists of grey to dark grey, nodular to massive limestones generally forming cliffs. It is differentiated from the Mari Limestone by the absence of argillaceous materials, a conspicuously large size of the nodules and large sized Foraminiferida.

The fauna is mainly composed of microfossils and includes *Assilina laminosa*, *Nummulites atacicus* and *Fasciolites elliptica* showing an early Lower Eocene age for the formation.

The calcareous beds of "Nammal Limestone and Shales" in the adjoining areas are considered homotaxial.

## 4. Lora Formation

MIDDLEMISS, 1896, just gave a passing reference to the presence of "marls" in the 4<sup>th</sup> unit of his "Nummulitic series". It is regarded here as a formation and is named after its maximum development in the vicinity of Lora.

The formation is composed of Limestone & marls of light to pale grey colours weathering in light yellow and cream colours. The rocks are generally thinly bedded and show a distinct platy appearance.

The fossil assemblage shows the presence of *Assilina daviesi*, *Globigerina prolata* and *Globogerina yeguaensis*, showing a Lower Eocene age for the formation.

The formation may be correlated with the Sakesar Limestone and Bhadrar Beds of the Salt Range, Shekhan Limestone of Kohat and Passage Beds of Kalachitta and Potwar.

#### 5. Kuldana Formation

WYNNE, 1874, identified and named these rocks as Kuldana beds after their occurrence near Kuldana. MIDDLEMISS, 1896, called them Kuldana series. The rocks are recognised as a distinct formation.

The formation consists of variegated shales of crimson and purplish colours apart from Khaki, buff to pale grey shales and marls. The red shales are generally gypsiferous and/or arenaceous.

The fauna includes *Assilina granulosa*, *Assilina spinosa* and *Assilina exponens*, showing a range from the top of the Lower Eocene to the base of Middle Eocene.

Similar rocks are recognised in Kohat as Mamikhel Clay and Purple and variegated clays in Kalachitta and Potwar.

#### g) Rawalpindi Group

The group is recognised and named RASHID et al., 1965, after its occurrence in the Rawalpindi area and consists of a) Murree Formation and b) the Kamliyal Formation. In the area under study only the Murree Formation is recognised.

##### 1. Murree Formation

The rocks were first distinguished and mapped in the neighbourhood of Murree and named as Murree series by WYNNE, 1874. MIDDLEMISS included them in his "Murree beds". The formation consists of greyish green sandstones, weathering purplish, intercalated with purple coloured arenaceous shales. The basal beds contain reworked fossils.

The age of the formation as established by earlier workers is Lower Miocene.

The basal beds with reworked Foraminiferida and the overlying sandstones and shales have been recognised in Potwar, Kohat and Poonch in Kashmir and are known as Fatehjang zone and Murree sandstone & shale respectively.

#### h) Havelian Group

The river channels in the area are occupied by a variety of materials, loose or indurated, medium grained silt and clays to large sized boulders and cobbles. These rocks have together been provisionally identified as a

group and named after their maximum development in the region of Havelian. The group may be subdivided into various formations, provisionally, composed of a) Gravels, b) Loess, c) Clays and Silts, d) Older alluvium and e) the Recent alluvium.

No fossil evidence is available. It is however suggested that the group may range from Middle Pleistocene to Recent.

The rocks may partly be correlated with the Lei Conglomerate and Loesic silt of northern Potwar as described by Gill, 1952.

VERCHERE 1866—67	WAAGEN & WYNNE 1872—79	MIDDLEMISS 1896	MARKS & MOHAMMAD ALI 1961—62	GARDEZI & GHAZANFAR 1965	LATIF 1969
					Havelian Group Rawalpindi Group
	Murree series	Murree beds			Murree Formation
Nummulitic Limestone	Kuldana beds	Kuldana series	Abbreviations: Fmn. = Formation, Mbr. = Member, Lst. = Limestone and Sst. = Sandstone.		Galis Group
	Nummulitic Formation	Nummulitic series Shales, Marls, Lst., Coal & Variegated Sst.			Kuldana Formation Lora Formation Margala Hill Lst. Kuzagali Shale Mari Limestone
	Thin bedded Limestone	Grey Limestone			Hothla Group Chanali Limestone
Jurassic	Giumal Sst? Spiti Shale	Giumal Sst. Spiti Shale			Giumal Sandstone Spiti Shale
Carboniferous Limestone	Triassic Series	Triassic Series Trias Lst.	Triassic System		Thandiani Group Sikhar Limestone
	Below the Trias		Upper Fmn.	Maira Fmn. Abbottabad Group	Maira Formation Abbottabad Group
Volcanic	3rd division	Volcanic etc. Infra-Trias Series	Lower Fmn.	Hazira Fmn. Haematite Fmn.	Hazira Fmn. } Tarnawai Galdanian Fmn. } Group?
	Upper Div.	Upper Lst.	Abbottabad Formation	Abbottabad Formation	
	Lower Div.	Lower Sst. & shale.	Upper Fmn.		Sirban Formation Kakul Formation
		Tanakki Congl.	Lower Formation		Mirpur Mbr. Mahmdagali Mbr. Sangargali Mbr. Tanakki Mbr.
	Tanol series	Tanol series	Tanol Fmn.		Tanol Formation
	Attock Slates	Slate Series	Hazara Slate Formation		Hazara Group Upper Formation Langrial Limestone Middle-Formation Miranjani Limestone Lower Formation

7. Comparison of unit names used by different workers

## Bibliography

- DAVIES, R. G., & A. RIAZ (1963): Fossils from Hazara Slate Formation at Baragali, Hazara West Pakistan. — *Geol. Bull. Panj. Univ.* 3, 29—30, Lahore.
- DAVIES, R. G., & A. H. GARDEZI (1965): The presence of *Bouleiceras* in Hazara and its geological implications. — *Geol. Bull. Panj. Univ.* 5, 23—30, Lahore.
- FUCHS, G. (1967): Zum Bau des Himalaya. — *Österr. Akad. Wiss. mathem.-naturwiss. Kl., Denkschrift*, 113, Wien, p. 1—211.
- GARDEZI, A. H., & M. GHAZANFAR (1965): A change of facies at the base of Jurassic in district Hazara. — *Geol. Bull. Panj. Univ.* 5, 53—56, Lahore.
- GILL, W. D. (1952): The stratigraphy of Siwalik Series in the northern Potwar, Panjab, Pakistan. — *Quart. Journ. Geol. Soc.* 107, Ser. 4, pp. 375—394, London.
- GILL, W. D. (1953): Facies and Fauna of the Bhadrar Beds of the Punjab Salt Range, Pakistan. — *Journ. Pal.* 27, 824—844, Tulsa.
- LATIF, M. A. (1962): An Upper Cretaceous limestone in the Hazara district. — *Geol. Bull. Panj. Univ.* 2, 57, Lahore.
- LATIF, M. A. (1964): Criteria used in the identification of various limestones in Hazara. — *Proc. Pak. Sci. Conf.*, Lahore.
- LATIF, M. A. (1968): Contribution to the Geology and micropalaeontology of Hazara, Pakistan. — *Sond. Verh. Geol. B.-A., Heft 3*, Wien.
- LATIF, M. A. (1969): Micropalaeontology of the Chanali Limestone, Upper Cretaceous, of Hazara, West Pakistan. — *Jb. Geol. B.-A., Sond.* 15, Wien.
- MARKS, P., & MOHAMMAD ALI (1961): The geology of the Abbottabad area, with special reference to Infra-Trias. — *Geol. Bull. Panj. Univ.* 1, 47—55, Lahore.
- MARKS, P., & MOHAMMAD ALI (1962): The Abbottabad Formation: a new name for Middle-miss' Infra-Trias. — *Geol. Bull. Panj. Univ.* 2, 56, Lahore.
- MIDDLEMISS, C. S. (1896): The Geology of Hazara and Black Mountains. — *Mem. G. S. I.* 26, 1—302, Calcutta.
- RASHID, MUZAFFAR, MASTER & MEISSNER (1965): Mineral deposits of the eastern Kohat region. — *Rec. G. S. P.* Vol. 13, pt. 2, 1—16, Karachi.
- Stratigraphic Nomenclature Committee of Pakistan (1967): Stratigraphic Code of Pakistan. — *Mem. G. S. P.* 4, pt. 1, Karachi.
- VERCHERE, A., & DEVERNEVIL (1866—67): Kashmir, the western Himalayas and Afghan Mountains. — *Journ. A. Beng.* 35 and 36, pt. 2.
- WAAGEN, W. (1872): Rough section showing the relations of rocks near Murree (Mari), Panjab. — *Rec. G. S. I.* 5, Calcutta.
- WAAGEN, W., & WYNNE, A. B. (1872): The Geology of Mount Sirban in upper Panjab. — *Mem. G. S. I.* 9, 331—350, Calcutta.
- WADIA, D. N. (1934): The Cambrian-Trias sequence of north western Kashmir (parts of Muzaffarabad and Baramula districts). — *Rec. G. S. I.* 68, 121—176, Calcutta.
- WYNNE, A. B. (1874): Notes on the Geology of the neighbourhood of Mari hills station in the Panjab. — *Rec. G. S. I.* 7, 64—74, Calcutta.
- Manuscript and map with sections first received and accepted for publication in May, 1968. Revised manuscript received in September, 1968.



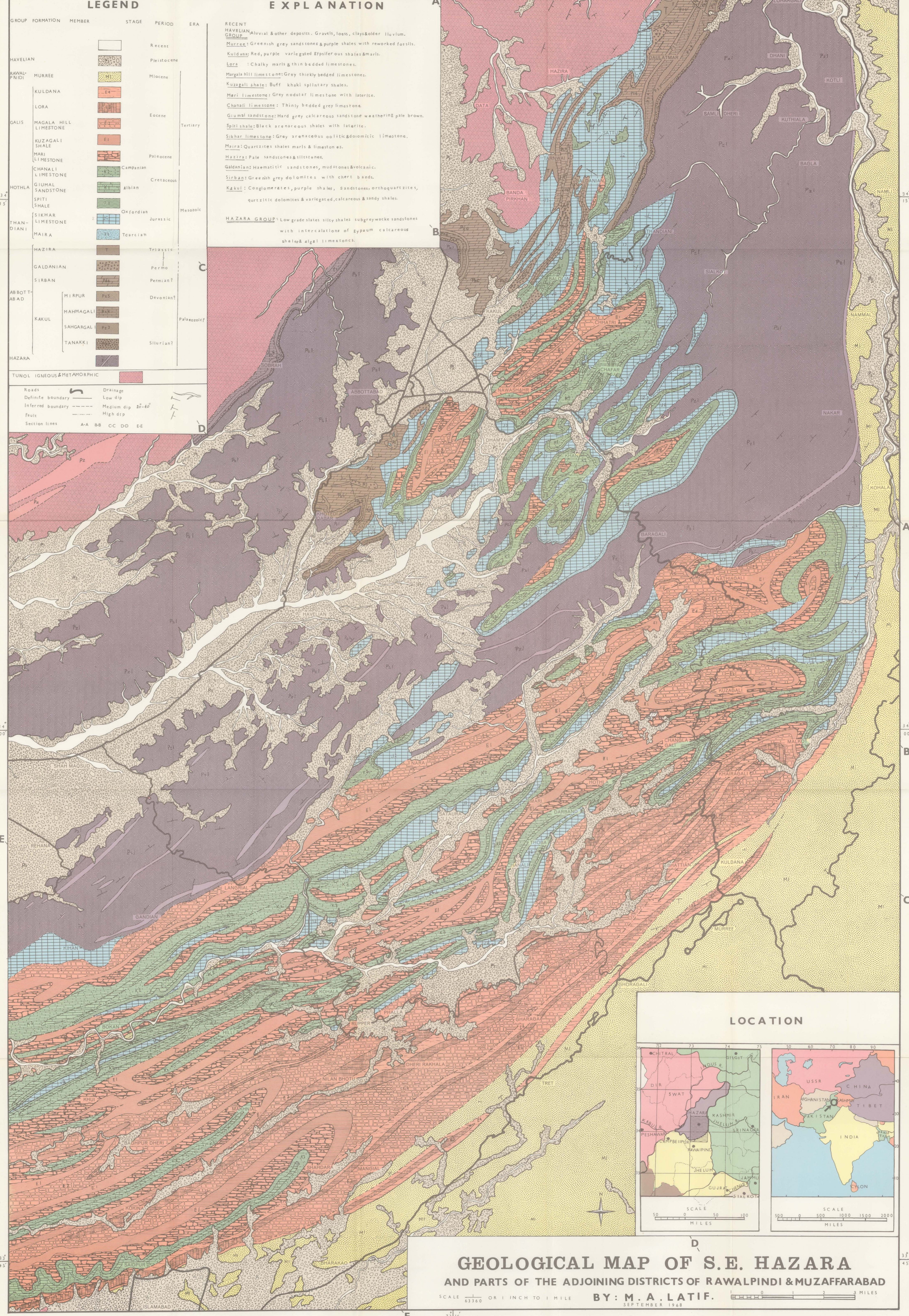
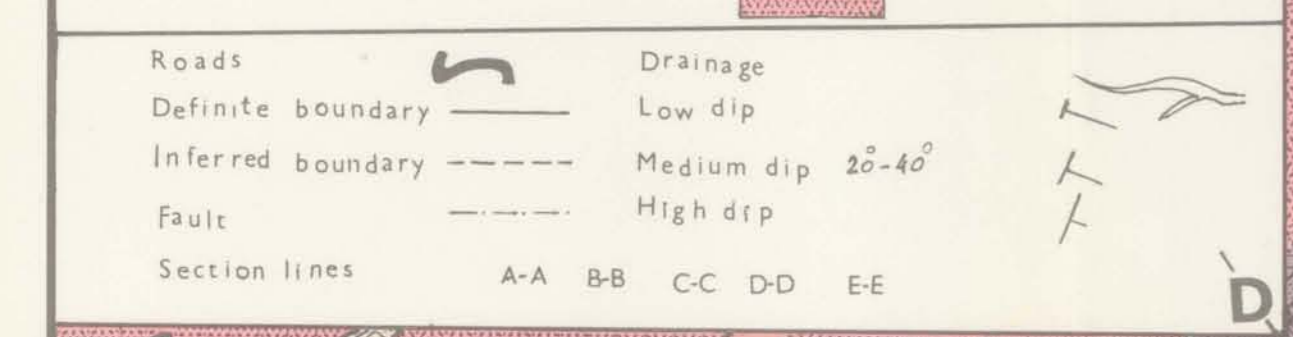
LEGEND

EXPLANATION

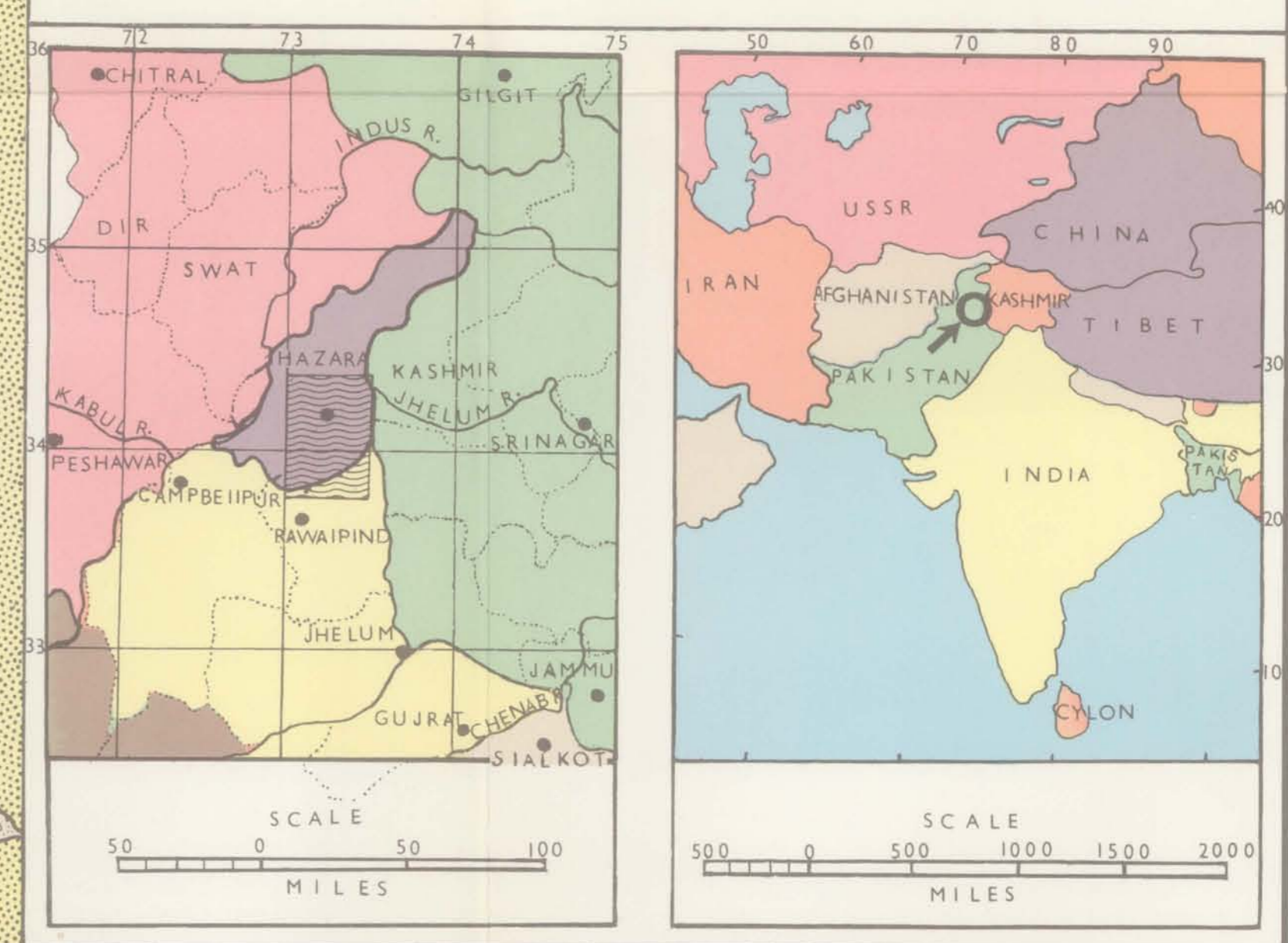
GROUP	FORMATION	MEMBER	STAGE	PERIOD	ERA
RECENT				Recent	
				Pleistocene	
HAVELIAN				Miocene	
				Eocene	
RAWALPINDI	MURREE			Tertiary	
	KULDANA				
GALIS	LORA			Paleocene	
	MAGALA HILL LIMESTONE				
HOTHLA	KUZAGALI SHALE			Cretaceous	
	SIKHAR LIMESTONE				
THANDIANI	MARI LIMESTONE			Mesozoic	
	CHANA LI LIMESTONE				
ABBOTTABAD	GIJMAL SANDSTONE			Jurassic	
	SPLITI SHALE				
KAKUL	SIKHAR LIMESTONE			Triassic	
	MAIRA				
HAZARA	HAZIRA			Permian?	
	GALDANIAN				
ABBOTTABAD	SIRBAN			Devonian?	
	MI RPUR				
KAKUL	MAHMAGALI			Palaeozoic	
	SAHGARGALI				
		TANAKKI		Silurian?	
		HAZARA			
TUNOL IGNEOUS & METAMORPHIC					

**RECENT**  
 Havelian Group: Aluvial & other deposits. Gravels, loess, clays & older alluvium.  
 Murree: Greenish grey sandstones & purple shales with reworked fossils.  
 Kuldana: Red, purple variegated & gypsiferous shales & marls.  
 Lora: Chalky marls & thin bedded limestones.  
 Margala Hill limestone: Grey thickly bedded limestones.  
 Kuzagali shale: Buff khaki splintary shales.  
 Mari limestone: Grey nodular limestone with laterite.  
 Chana li limestone: Thinly bedded grey limestone.  
 Gijmal sandstone: Hard grey calcareous sandstone weathering pale brown.  
 Spliti shale: Black arenaceous shales with laterite.  
 Sikhar limestone: Grey arenaceous oolitic & dolomitic limestone.  
 Maira: Quartzites shales marls & limestones.  
 Hazira: Pale sandstones & siltstones.  
 Galdanian: Haematisitic sandstones, mudstones & volcanic.  
 Sirban: Greenish grey dolomites with chert bands.  
 Kakul: Conglomerates, purple shales, sandstones, orthoquartzites, quartzitic dolomites & variegated, calcareous & sandy shales.

**HAZARA GROUP:** Low grade slates, silty shales, subgreywacke sandstones with intercalations of gypsum, calcareous shales & algal limestones.



LOCATION



**GEOLOGICAL MAP OF S.E. HAZARA AND PARTS OF THE ADJOINING DISTRICTS OF RAWALPINDI & MUZZAFFARABAD**  
 SCALE 1/63360 OR 1 INCH TO 1 MILE BY: M. A. LATIF. SEPTEMBER 1968

NARBIR

RIHALA

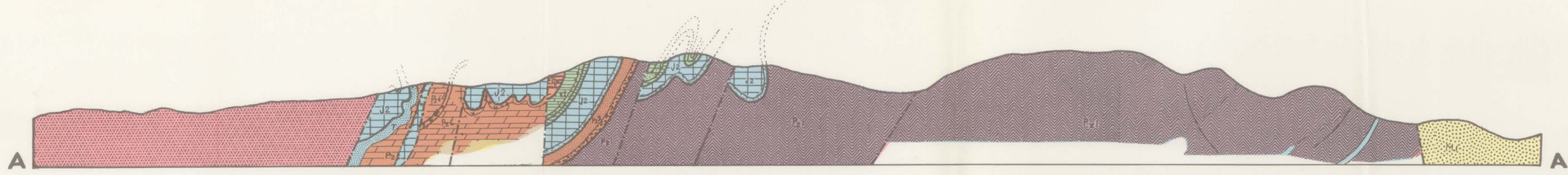
TARERI

THANDIANI

MIRANJANI

NAKAR

BAKOT



KAKUL

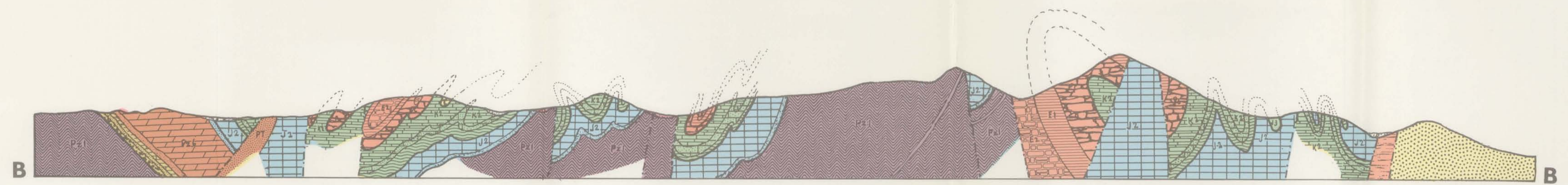
BANIAN

AZIZBANG

NAMLI

SUNDAR BAN

DEVAL



PASWAL

ABBOTTABAD

MARIDHOK

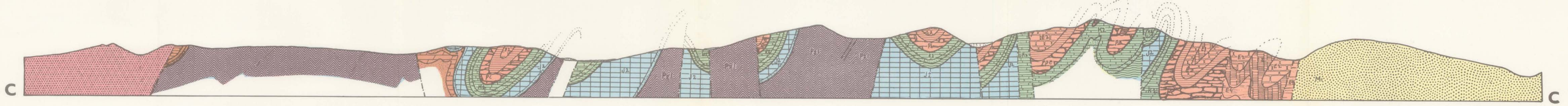
JAGIAN

NAGRUTLI

KUZAGALI

SURJAL

ALLOT



FATEH BANDI

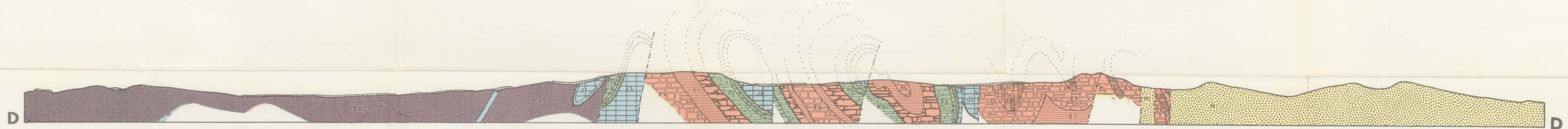
HAVELIAN

SATAURA

LORA

CHARRA PANI

ANGURI



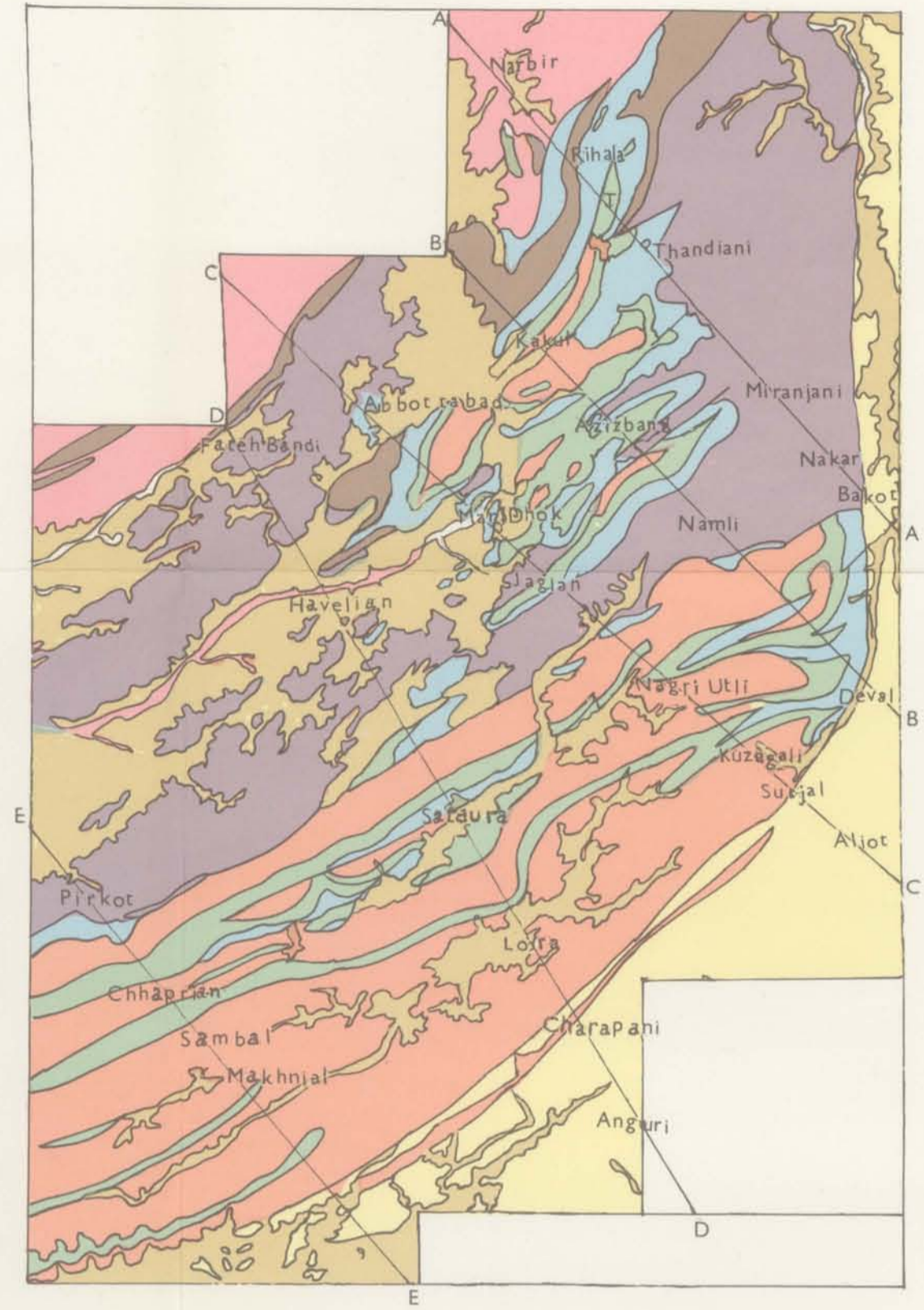
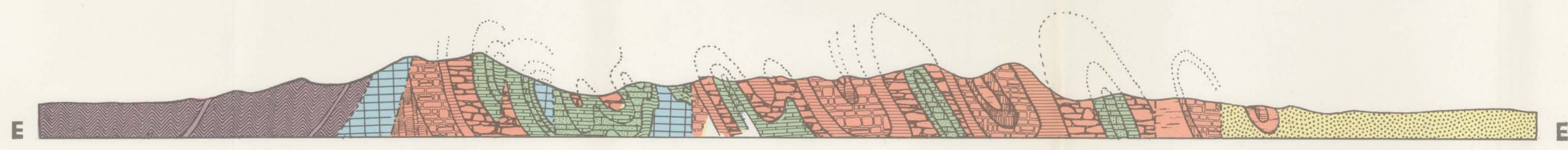
PIRKOT

CHHAPRIAN

SAMBAL

MAKHNIAL

SHAHDARA



**VERTICAL SECTIONS OF THE  
GEOLOGICAL MAP OF S. E. HAZARA  
ALONG LINES A-A, B-B, C-C, D-D & E-E.**

**BY: M.A. LATIF.**

SEPTEMBER 1968  
FOR LEGEND & EXPLANATION SEE THE  
GEOLOGICAL MAP OF S.E. HAZARA.

