



MA-SEM II (CC- 8- India Unit -I)

India: Geological Structure

Dr. Supriya

Assistant Professor

Department of Geography

Patna University, Patna

Mob: 9006640841

Email: supriyavatsa52256@gmail.com

Webpage: <http://bhuvankosh.com/>

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➤ Learning Objectives:

- To understand the geology of India with reference to time and space.
- To acquaintance with lithological characteristics and distribution of rocks in India.

Learning Outcomes:

- Student able to explain complex geological formation of India.
- Able to establish relation between different geological formation of India with respect to Standard Geological Time Scale.
- Able to trace economic importance of different geological structural units.

- **Geological Structure:** Geological structure is most commonly (and best applied) to the arrangements and deposition of the rocks in the earth's crust, as result of (or absence of) earth movements; but also applied to the morphological features (morphology) of rocks; e.g. Gondwana structure.
- **Geological Time Scale:** Chronological dating of various geological formation (Geological strata) and life according to their time and place of origin, evolution and extinct. "Giovanni Arduina developed Geological Time Scale in 1760". Standard Geological Time Scale developed in International geological Congress held in 1881 , Italy.
- The **Indian Geological Time Scale**, advocated by T.S. Holland.
- **Geological History of India:** The Geological Structure & rock systems of India analysed with reference to their geographical locations and their geological history. The following physiographic divisions of India are used for referencing the geological formations:
1. Peninsular India; 2. Extra Peninsular India
- Major events in the geological history of India:
 - Peninsular India was a part of the old landmass since the formation of the Earth's Crust
 - The upheaval of Himalayas in the tertiary period.
 - Aggradational formation of the Indo-Gangetic plain during the Pleistocene period. It continues till today through sedimentation in the floodplains of the rivers and the lower part of the Gangetic plain.
- Based on this complex and varied geological history, the Geological Survey of India has classified rock systems of the country into 4 major divisions:
 - **The Archaean Rock System**
 - **The Purana Rock System**
 - **The Dravidian Rock System**
 - **The Aryan Rock System**

The Aryan Rock System

- Tertiary system
- Deccan trap
- Mesozoic system
- Gondwana System

The Dravidian Rock System

- Carboniferous System

The Purana Rock System

- Vindhyan System
- Cuddapah System

The Achaean Rock System

- Dharwar System
- Archean System

India: Geological Structure

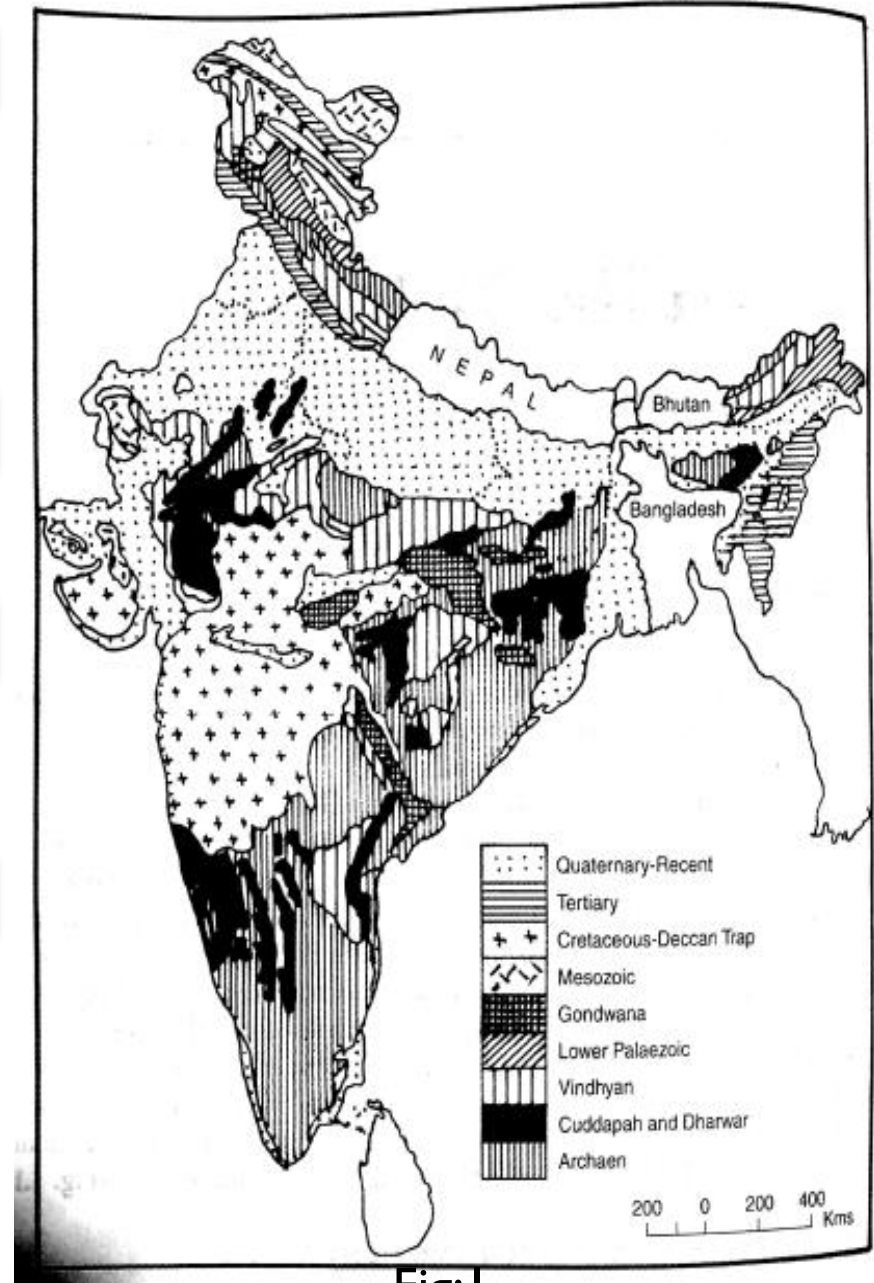
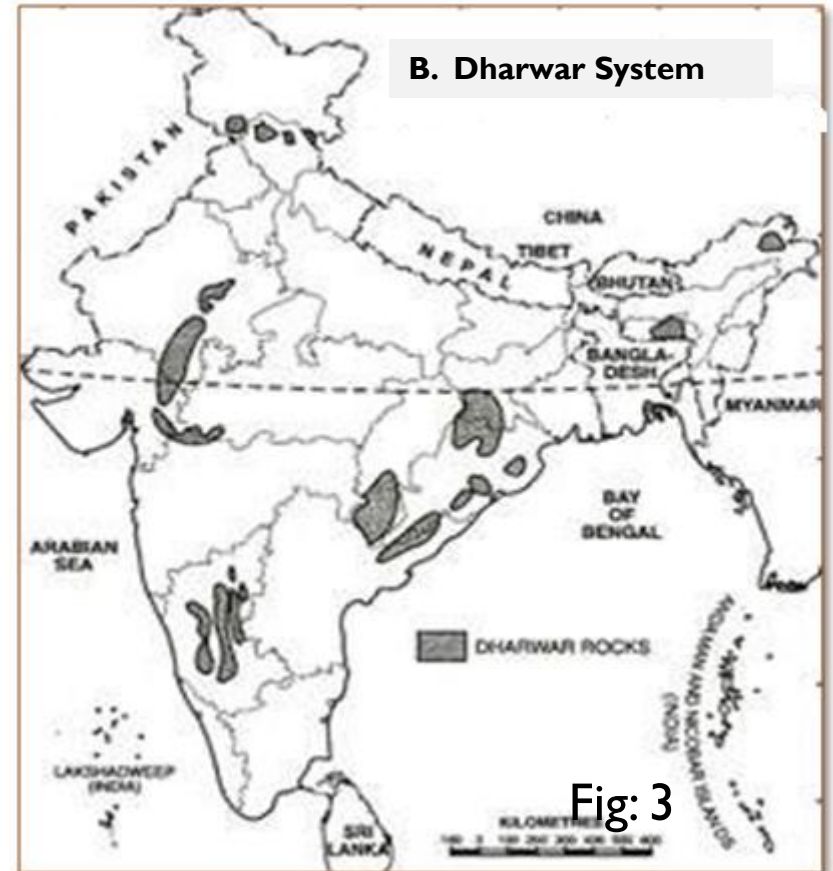
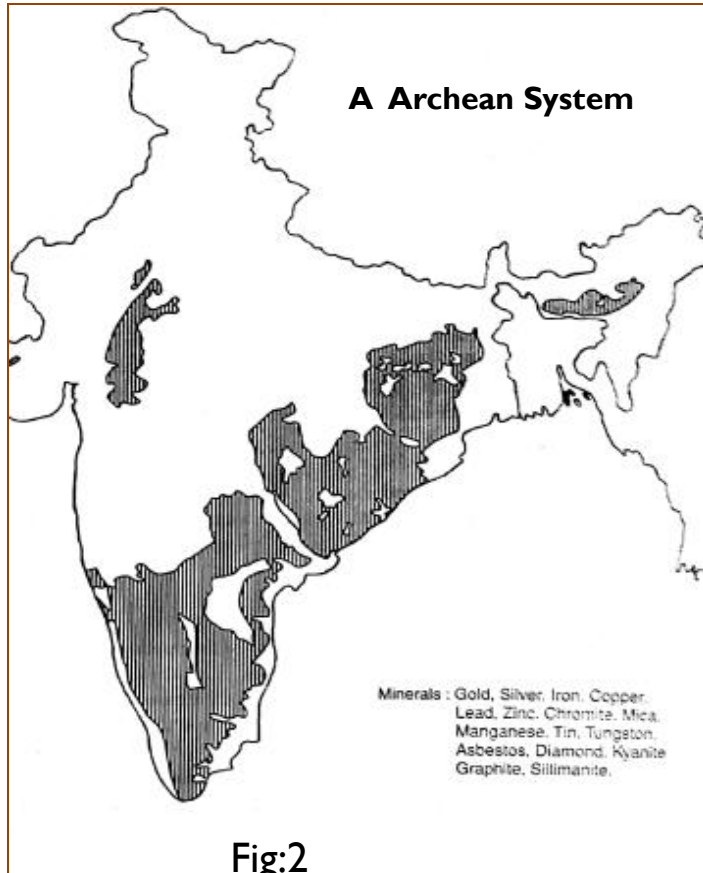


Fig: I

I. THE ARCHAEOAN ROCK SYSTEM (EARLY PRE-CAMBRIAN/4 BY)

- ❑ The earliest phase of tectonic evolution was marked by the cooling and solidification of the upper crust of the earth surface in the Archaean era (prior to 2.5 billion years ; Precambrian Period) which is represented by the exposure of gneisses and granites especially on the Peninsula. These form the core of the Indian Craton (Block of Indian Subcontinent of Gondwanaland).
- ❑ The term 'Archaean' introduced by J.D. Dana in 1782, refers to the oldest rocks of the earth crust.
- ❑ The Archaean group of rocks consists of two systems-(a) Archaean System: Granites and Gneisses, & (b) Dharwar System: First Sedimentary Rocks



I. THE ARCHAEOAN SYSTEM (4-2.5 Billion year Ago)

- This is the oldest rock system of Indian subcontinent dating back to about 4 billion years . (Pre-Cambrian rocks)
- They serve as the basement complex or the foundation rocks for other rock systems which covers 2/3rd of Peninsular India.
- They are found in the Aravalli hills, Deccan plateau and the northeast of India. They also occur in roots of the mountain peaks all along the Greater Himalayas, trans-Himalayan ranges of Zaskar, Ladakh and Karakoram.
- They mostly contain gneisses (granite, gabbro etc.) and schists (crystalline rocks such as mica, chlorite, talc etc.)
- These rocks are formed when magma underneath the earth's surface solidified and hence they are devoid of any fossils (Azoic)
- Because of their volcanic origin, they are crystalline and consist of sheet-like layers (foliated).
- These rocks are abundant in metallic as well as non-metallic minerals such as iron, manganese, copper, bauxite, gold, lead, mica, graphite , hornblade etc.

The Archaean Rocks are three well defined types(see fig2)

a. The Bengal Gneiss:

- Named after first identified in Midnapur of West Bengal. It occur in Eastern Ghats , Orissa(known as Khondolites after Khond Tribes in Koraput & Bolangir district), Manbhum & Hazaribagh district of Jharkhand; Nellore district Andhra Pradesh; Salem district of Tamil Nadu;
- These are thin foliated deposits also occurs in Son valley , Meghalaya plateau and Mikir hillis.

b. The Bundelkhand Gneiss:

- Gneiss is coarse grained which look like granite . Its conspicuously criss-crossed structure charecterised by Quartz veins.
- Its occurs over Bundelkhand (U.P), Baghelkhand (M.P), Maharshttra, Rajasthan. Andhra Pradesh & Tamilnadu.

c. The Nilgiri Gneiss:

- Nilgiri Gneiss is plutonic rock intruding into other Archaean rocks. It is bluish-grey to dark colour rock with medium to coarse grained structure.
- Its recognised as Charnockite series which named in honour of James Charnock whose tomb was made up with this rock.
- Its found in South Arcot, Palani hills, Shevoray hills, Nilgiri hills

2. THE DHARWAR SYSTEM

[2.5 - 1.8 Billion Years]

- Formed between 2.5 billion to 1.8 billion year, these are the oldest metamorphic rocks of India.
They are formed due to the metamorphosis of the sediments formed out of the Archean rocks.
- Since they were first studied in the Dharwar region of Karnataka, they were named so. They are mainly found in the Aravallis, Chotanagpur plateau, Meghalaya and Tamil Nadu
- They are rich in metallic minerals such as iron, manganese, gold, copper, etc. They are considered to be the storehouses of metallic minerals and hence have a high economic significance.
- Dharwar rocks are divided into various series based on the region in which they are found and the type of metal contained in them. For instance, Champions series (Kolar - gold), Champaner series (Baroda - marble), Chilpi series (Balaghat - copper) etc.

Extra Peninsular India:

a. Rajasthan Series:

b. **Vaikertata Series:** Kumaun & Spiti; Slate, Schist, dolomite and Limestone;

c. **Dailing Series:** Sikkim & Shilong; Signs of igneous intrusion; Quartzite, Phyllite, Hornblende schist.

Peninsular India:

a. Champion Series:

➤ Named after Champion reef in Kolar Gold Field of Mysore; occur in Kolar & Raichur district. Famous for Gold deposits

b. Champner Series:

- Outlier of Aravalli system spread in Vadodara;
- Rich in Quartzite, Conglomerates, Phyllites, Slates & Marbles (green variety).

c. Clospet Series:

- Occur in Balaghat & Chhindwara district of Madhya Pradesh;
- Rich in Copper Pyrite, quartzite and other magniferous rocks

d. Chilpi Series:

- Occur in Balaghat & Chhindwara district of Madhya Pradesh;
- Rich in grit, Phyllite, quartzite, green stones and magniferous rocks

e. Iron-ore Series:

- Occur in Singhbhum(Jharkhand), Bonai, Mayurbhanj and Keonjhar district (Orissa);
- Rich in Iron ore deposits which spread is over in 65 km long belt and approximate of 3000 million tons of Iron -ore Reserve

f. Khondolite series:

- Occur in Eastern Ghat of North Krishna River basin;
- Rich in Khondolite, Kodurites, Charconites and gneisses.

g. Rialo Series:

- Stretch over in Delhi (Majnu-ka-Tila) to Alwar (Rajasthan);
- Also Known as Delhi series;
- Rich in Marbles. Makrana & Bhagwanpur known for high quality marbles belong to this series.

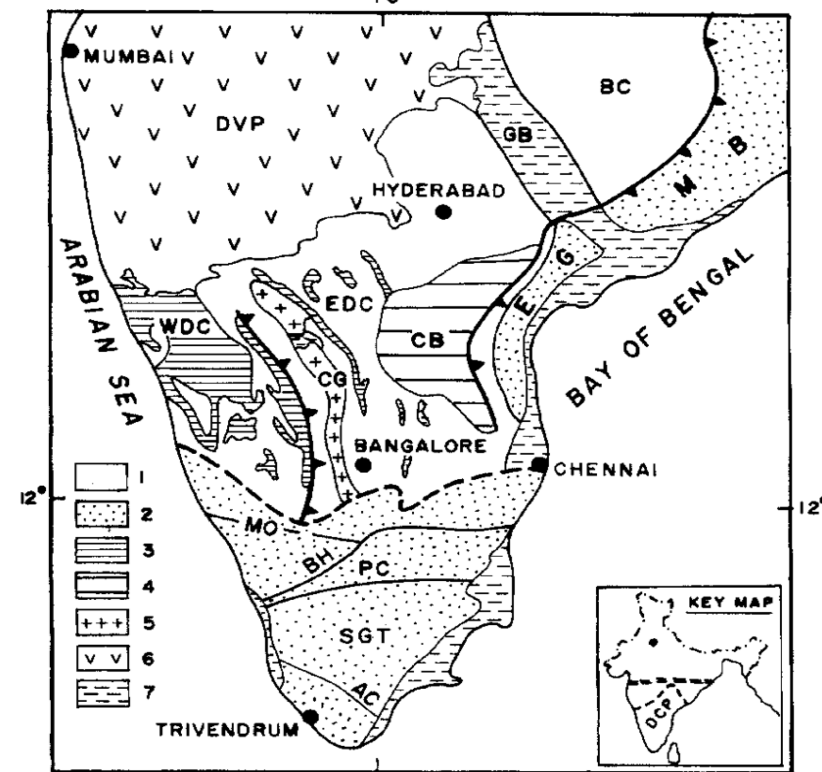


Fig:- 4: Dharwar rocks of Peninsular India

h. Sakoli Series:

- Occur in Jabalpur and Rewa districts(MP);
- Famous for Mica, also rich in dolomite, schist and Marble.

i. Sausar series:

- Occur in Nagpur, Bhandra district of Maharashtra and Chhindwara district of Madhya Pradesh;
- Rich in quartzite, mica-schist, marble and magniferous rocks.

II. PURANA ROCK SYSTEM (UPPER PRE CAMBRIAN- 1400-600 BY)

- The Cuddapah and Vindhyan rock systems are together known as the Purana rock system.
- They are formed by the erosion and deposition of Archean and Dharwar rocks, the process is believed to have taken place between 1400-600 million years ago.
- They are mostly sedimentary in nature.

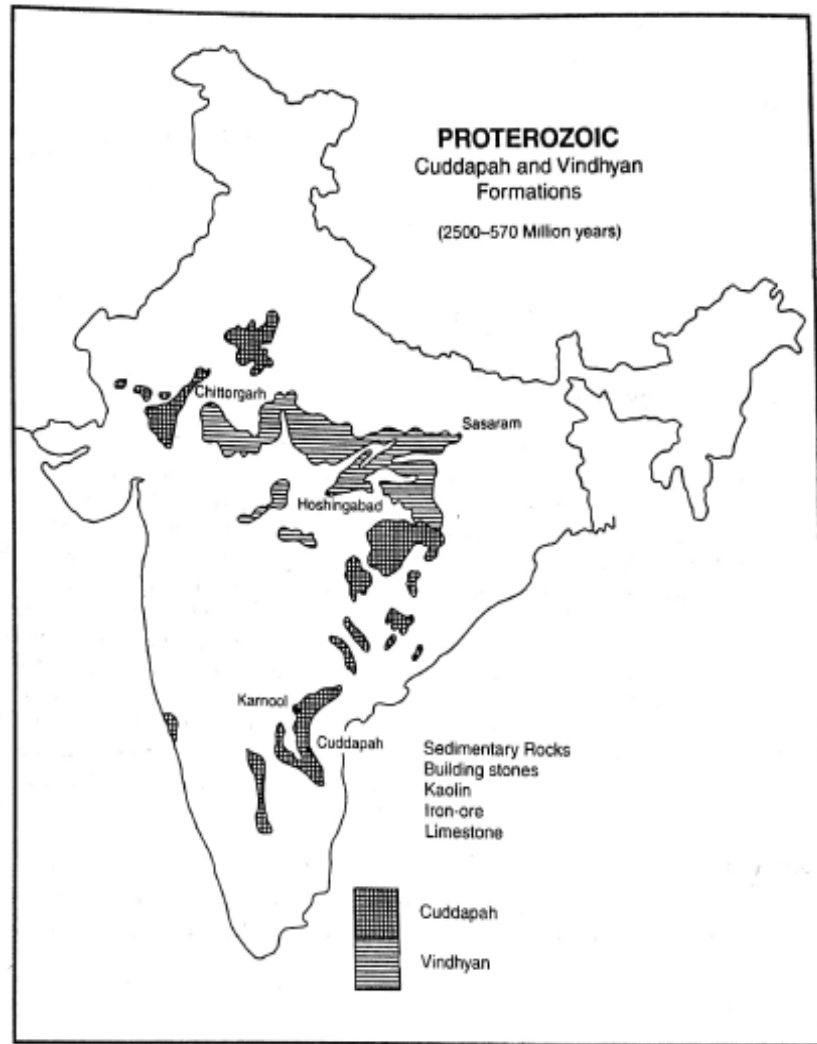


Fig 5- Distribution of Purana rocks

I. The Cuddapah Rock system

- Named after the Cuddapah district of Andhra Pradesh, due to large development of outcrops of cudappah rocks.
- It spread in crescent shape, approx 22000 sq km area of Andhra, Chhattisgarh, Maharashtra, Tamil Nadu, Delhi, Rajasthan, and lesser Himalayas.
- They were formed when sedimentary rocks like sandstone, limestone etc., and clay were deposited in synclinal folds (between two mountain ranges).
- They are rich in shale, slate, quartzite, iron ore (Inferior quality), manganese, asbestos, copper, nickel, cobalt, marble, jasper, building stones, and stones however they were of low quality.
- Cuddapah rocks are divided into various series based on the region in which they are found and the type of metal contained in them.

Peninsular India

Andhra Pradesh

- a. **Papaghani Series:** Papaghani river basin; Quartzite, shales, slates and lime stones.
- b. **Cheyair Series:** Cheyair river basin; Shales & quartzite
- c. **Nallamalai Series:** Nallamalia hills; quartzite & shales
- d. **Krishna Series:** Krishna basin; quartzite & shales

MP & Chattisgarh

- e. **Bijawar Series:** Bijawar district (MP) sandstone, quartzite & some volcanic rocks sill, dykes (parental rocks of diamonds).
- f. **Gwalior Series:** Gwalior district (MP); Shales, limestone, sandstones, quartzite overlain by shales, hornstone, jaspers and basic volcanic rocks
- g. **Rajpur Series:** Chhatisgarh; limestone, sandstones, quartzites.

KARNATKA

- h. **Kailagi series:** Bijapur district; ferrous rocks, quartzite, shale.
- i. **Pakhal series:** Godavari region; quartzite, shale & siliceous limestone
- j. **Penganga Series:** Penganga rivers Wardha district of Maharashtra; Limestone, Shales & Slates.
- k. **Ajabgarh series:** Alwar, Delhi & Gurgaon; quartzites and slates, granites with veins of pegmatites

Delhi System

- l. **Rialho series:** Stretch over Ladar (Gujrat) Delhi, and Arwal region ; rich in Marble.
- Ajabgarh, Rialho and arwal series known together as Delhi system.

Extra Peninsular India:

The Cudappah system rocks outcrops found in Kashmir, Simla and Nepal Himalayas; Slates (Pirpanjal, Rramban and Kistwar, Dogra) are predominant with graphite, talc, gypsum,

2. THE VINDHAYAN ROCK SYSTEM

Upper Vindhayan System

Lower Vindhayan System

2. The Vindhayan rock system (1300-600 million years)

- The system derives its name from the Vindhayan mountains,
- It extending from Rajasthan to Bihar in area of 1,00,000 Sq km form saucer shape.
- The system comprises of ancient sedimentary rocks (4000 m thick) superimposed on the Archaean base.
- Mostly Unfossiliferous rocks and large area of this belt is covered by the **Deccan trap**.
- It is **devoid of metalliferous minerals** but provides large quantities of durable stones, ornamental stones, limestone, pure glass making sand etc.
- The Vindhayan system have **diamond bearing** regions from which **Panna** and **Golconda diamonds** have been mined.
- Vindhayan rocks are classified into Various series:

Peninsular India

Semri Series: Son river valley of Bihar; Sandstone

Kurnool Series: Kurnool district, Gulbarga & Bijapur district; limestone,

Bhima Series: Bhima river basins of Gulbarga & Bijapur district;

Malani Series: Malani hills , Rajasthan; rhyolites and tuffs

Kaimur Series: Bundelkhand, Baghelkhand & Kaimur hills; sandstone & shales.

Rewa Series: Rewa district, MP; sandstone, shales, conglomerates- diamondiferous.

Bhandar Series: Madhya Pradesh; sandstone, shales, conglomerates- diamondiferous,

Extra Peninsular India

- The Dogra Slates of Kashmir, Chails and Simla slates of Simla hills, Attock Slates of Punjab, and Haimanta System of rocks in the Central Himalayas of Kumaon are all belonging to this system.

III. THE DRAVIDIAN ROCK SYSTEM

[600-300 million years ago]

- The **Paleozoic** rock formation is known as **Dravidian systems** in India; during the Paleozoic era i.e., 600-300 million years ago. It also known as the Carboniferous rocks System due to high quality Coal formation in the World.
- These rocks are mostly found in the extra-Peninsular regions of the Himalayas and the Gangetic plain and are very little in the Peninsular shield (Umaria in Rewa). Pir-Panjal, Handwara, Lida valley, Anantnag of Kashmir, Spiti, Kangra & Shimla region of Himanchal Pradesh Gharwal & Kumayun of Uttarakhand are the major region of Dravidian rocks.
- The Dravidian rocks mainly includes shales, sandstones, clays, quartzites, slates, salts, talc, dolomite, marble, etc.
- It is the period when Pangaea was broken and the Tethys Sea came into existence.
- It marks the beginning of life on the earth surfaces. The rocks of this is the period saw plenty of fossil evidences. These are seen in all geological formations from this period. They also indicated marine conditions in these Paleozoic rocks in India.
- Dravidian period was the beginning of coal formation ((high Quality Carboniferous coal) but these formation was not found abundantly in India.
- The Dravidian system of geological formations include the rocks of the following geological ages: The Cambrian System; The Ordovician Systems; The Silurian System; The Devonian System (fossils & corals) & The Carboniferous Systems.

1. The Cambrian System: It consists of the following formations: a) The Salt Range containing the Salt Marl and Saline Series of Punjab (Purple sandstone, greenish shale); b) The Spiti area containing the Haimanta System (Slates, quartzite, shales, dolomite etc.); c) The formations of Kashmir Valley (slates, foliated shales, limestone, soft quartzites etc.).

➤ These rocks are fossiliferous. Corals, Foraminifers, sponges, worms, gastropods, trilobites and brachiopods etc. They also indicated marine conditions in these Palaeozoic rocks in India. Salt marl, purple sandstone, shales, slates, dolomites and quartzites, are the notable rocks of this system.

2. The Ordovician system: It is exposed in the Northern Kumaon-Shimla regions containing mainly shales and pink quartzites, sandstone, conglomerates. The Ordovician rocks of in Kashmir is exposed in the Lidar valley (ferruginous shales and Limestones).

3. The Silurian System: The rocks stretch over in Spiti region (shales, limestone, dolomite). They contain Red Crinoidal limestone of Griesbach and Zaskar Range. The Silurian rocks of Kashmir are exposed in the Lidar valley.

4. The Devonian system of rocks are represented by the Muth Quartzites of Spiti, Kumaon and Kashmir. Limestones with brachiopods and corals that are exposed in these rocks.

5. The Lower & Middle Carboniferous system:

➤ The Carboniferous rocks (350 million years) comprise mainly of fossiliferous limestone, shale and quartzite.

➤ The rocks in India are distributed only in a few places in the Himalayan region in Kashmir (extended in Spiti to Kashmir). They are known as **Lipak series** (dark colour of limestone & shales) and **PO Series** (dark colour shales & quartzites); They together known as the Kanwar system.

➤ Coal formation also started in the lower Carboniferous.

➤ Mount Everest is composed of limestone in Upper Carboniferous period.

IV. THE ARYAN ROCK SYSTEM

(250 million years ago to present)

- The beginning of Upper carboniferous period is known as the Aryan Group, has come to threshold of the last, longest and the most eventful era, extending from Upper Carboniferous to the Holocene period.
- The Aryan Group of Rock Formation classified in following Group:
 1. **Upper Paleozoic Era**---- **Upper Primary Epoch- Upper Carboniferous & Permian Period** formation
 2. **Mesozoic Era**---**Secondary Epoch - Triassic, Jurassic & Cretaceous period** Formation(Gondwana Rock system, Deccan trap, Jurassic system)
 3. **Cenozoic Era**---**Tertiary Epoch – Paleocene, Eocene, Oligocene Miocene & Pliocene Period**
 4. **Neozoic Era**--- **Quaternary Epoch- Pleistocene & Holocene/recent Period**

The salient features of the aryan formations are:

- ❑ Himalayan region was occupied by a vast geosynclines which was connected to the Tethys Sea (The Pacific Ocean in the east through China and the Atlantic Ocean in the west through Afghanistan, Iran, Asia Minor and the present Mediterranean sea). (see fig 6)
- ❑ The area of Kashmir Himalayas (From Pirpanjal to Hazara in the north-west and Ladakh in the north-east)witnessed violent volcanic activity.
- ❑ The upper continent of Gondwanaland developed fissures and its broken parts started drifting away from each other.The Indian subcontinent drifted towards north and north-east to collide with the Eurasian Plate (Asian landmass , see fig 6 & 7).
- ❑ There was large scale eruption of Lava in the Deccan Trap (see fig 8).
- ❑ The development and expansion of the Arabian sea and Bay of Bengal.
- ❑ The Tertiary mountain building gave birth of Himalayas. (see fig 9).
- ❑ The beginning of Ice-Age, belonging to the Pleistocene Period ,covering large parts of the earth under ice-sheets.
- ❑ Evolution and spread of man in different parts of the world.

The Gondwana System

- The Gondwana rock system is named after the Gond tribe (indigenous people mainly found in the Telangana and Andhra Pradesh regions).
- These are sedimentary deposits which were accumulated in the synclinal troughs on an older plateau surface. This system contains huge carbon deposits within them. This makes them the largest source of coal in India, containing up to 98 percent of our coal deposits. The process began during the Permian period (250 million years ago).
- Apart from coal, they are also a source of metallic minerals such as iron, manganese, antimony, uranium etc.
- The Gondwana rocks are mainly found in Ranigunj, Jharia regions of Jharkhand, Damodar valley, Pench valley in Chhattisgarh and Madhya Pradesh, Godavari valley in Telangana and the Rajmahal hills of West Bengal.
- They are divided into different series of rocks- Talcher, Damuda, Panchet, Mahadev, Rajmahal, Jabalpur and Umaia Series.

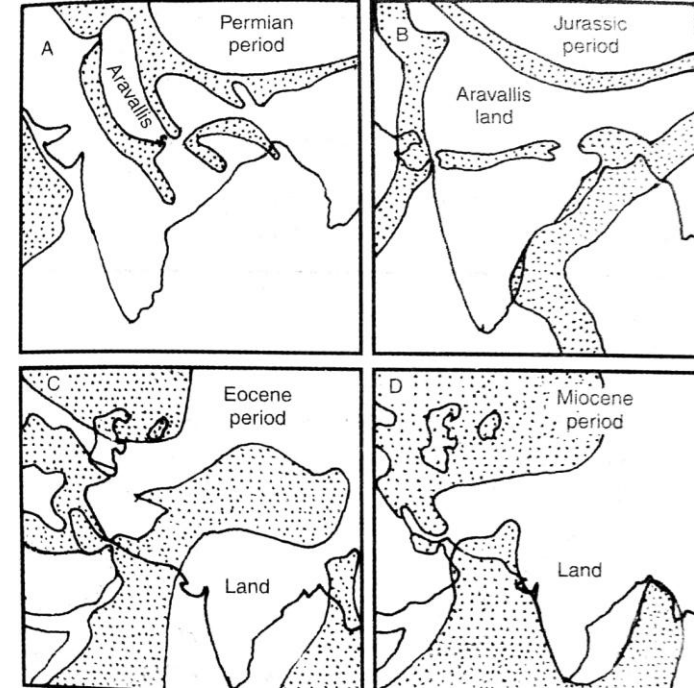


Fig 6. Change in Topography in Aryan Period

Extra Peninsular India:

The Gondwana System rocks are exposed in –

- Upper carboniferous rocks in Kashmir, Shimla, Hazara, Salt range; Rocks consist sandstone & lime stone.
- Lower Gondwana rocks (shale) are found in Kashmir., Gulabgarh pass, Zewar, Zowar, Kunamu Bren etc..

Coastal Gondwana: Few outcrops are occur in Coromandal coast major deposits are Cuttak (Orrisa), Rajmundri, Ongal (Andhra Pradesh), South Krishna (Tamilnadu); Rocks consists clay, grit, shales, sandstone, conglomerate.

I. THE GONDWANA ROCK SYSTEM

Lower Gondwana System

Peninsular India:

a. Talchir series : Oldest formation (Upper carboniferous to Permo carboniferous age) of Gondwana System, Stretches in Orissa outcrops found in Rajasthan & Salt Range, rocks containing coal seams, shales and sandstones; Boulders beds observed

b. Damuda series: Named after Domodar river outcrops found in Mahnadi and Godaveri river Valleys; Rocks containing seams coal, found as Barakar Coal field(grit, sandstone , shale) , Gridih, Jharia coal fields (Karharbari Stage), Raniganj coalfields (Ironore shales, Bengal)

c. Panchet series : Named from Panchet hills of south of Raniganj. Youngest formation of lower Gondwana System ; Rocks containig greenish sandston (felspar grains in sandstone which is evidence of cold climate), shale and devoid of coal.

d. Mahadeva series: Named after Mahadev hills, stretched in Mahadev and Panchmarhi Hills of the Satpura range; Rocks consist clay, sandstone & shales.

e. Rajmahal series: Named after the Rajmahal hills of stretches towards the northern part of the east coast of Peninsular India from the Godavari Valley to the Rajmahal hills;

f. Jabalpur series: widely spred in Satpura and Madhya Pradesh; Rocks consist of sandstone, clays, limestone and shales with few coal seams & lignte.

g. Umaia Series: rocks of upper gondwana found near Umaia village Gujrat; It consist Sandstone, Conglomerate

Upper Gondwana System

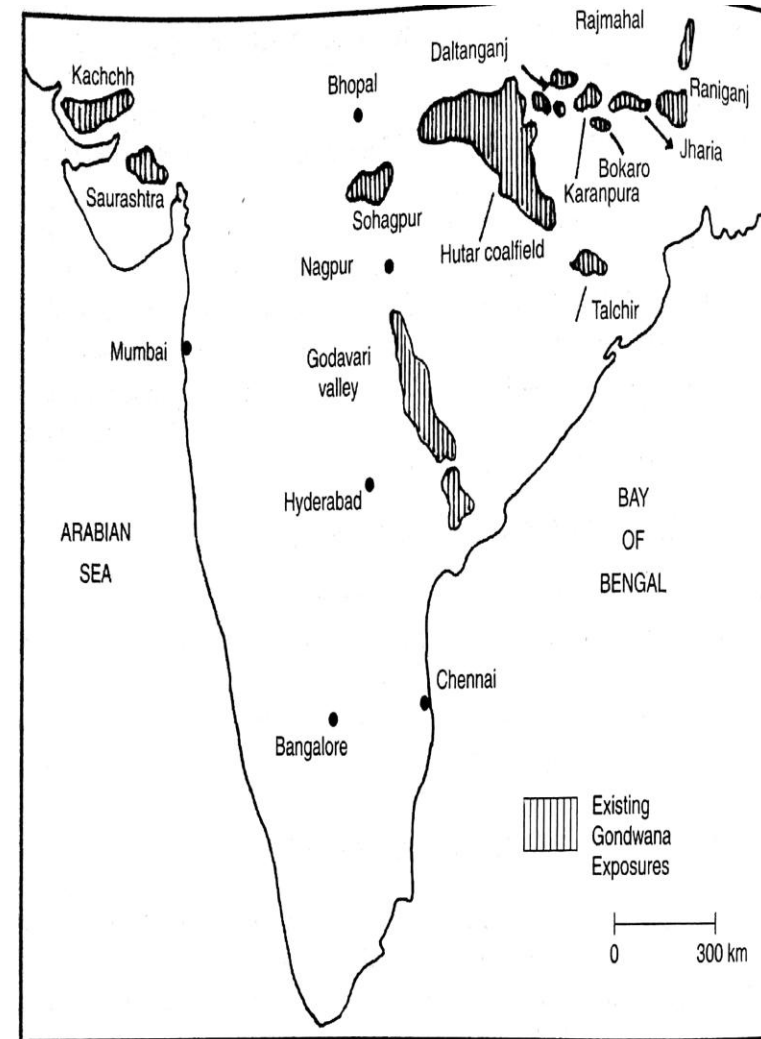


Fig 7- Distribution of Gondwana Rocks

The Mesozoic Group

- The Mesozoic geological formations belong to the period between 245 million years and 66 million years.
- It encompasses the formations of the Triassic, Jurassic and Cretaceous ages. The formations are:
 - a) The Triassic System
 - b) The Jurassic System
 - c) The Cretaceous System or The Deccan Traps.

The Triassic System is the earliest of all these systems in the Mesozoic era.

- This period has shown a very rich and varied fauna and flora.
- Numerous invertebrate fossils, including ceratites, ammonoids, brachiopods, Crinoids, echinoids and pelecypods have been observed in the rocks of this age. Amongst the vertebrates, fishes are quite abundant.

In India, they are exposed as

- a. The Lilang system in Spiti
- b. Northern Kumaon
- c. The Chocolate Series
- d. The Kalapani limestone
- e. The Kuti shales
- f. The Kioto limestone.

The Jurassic rock system

- This period witnessed marine transgressions on both west and east coasts. This led to shallow water deposits in Rajasthan and the Kutch region on the west and Guntur and Rajahmundry areas of Andhra Pradesh.
- Prominent deposits in this rock system include limestone, shale, sandstone etc.
- The Jurassic System is exposed as Spiti Shales, Laptal Series of Kumaon, Mount Everest Region, sub-Himalaya of Garhwal, Kutch and Rajasthan areas

2. THE MESOZOIC GROUP

Cretaceous rock system: The Jurassic and Cretaceous Systems are known for their marine transgression. Foraminifera play an important part in Cretaceous stratigraphy. The rocks contain limestones, sandstones and shales.

- They are exposed in Himalayan ranges, Central Tibet, Kashmir, Ahmednagar, Kutch, Narmada Valley, Tiruchinopoly, Ariyalur and Rajamahendri areas in north, west and south India.

Deccan Trap : Deccan Trap was formed when the Indian plate came over the Reunion hotspot in the Indian Ocean while travelling north towards the Eurasian plate, after breaking up from the Gondwana plate.

- The continuous outpouring of magma, from the fissures over the Indian plate led to the formation of a layered structure called the Deccan Traps. These are formed by the flow of magma over the solidified rock systems/cooled magma in layers.
- Basaltic lava covered an area of 5 lakh sq.km. encompassing the regions like Kutchch, Saurashtra, Maharashtra, Malwa plateau and north Karnataka.
- The thickness of the Deccan traps decreases from west to east, with around 3000m in the west to just 150m in the east, and around 800m in the south.

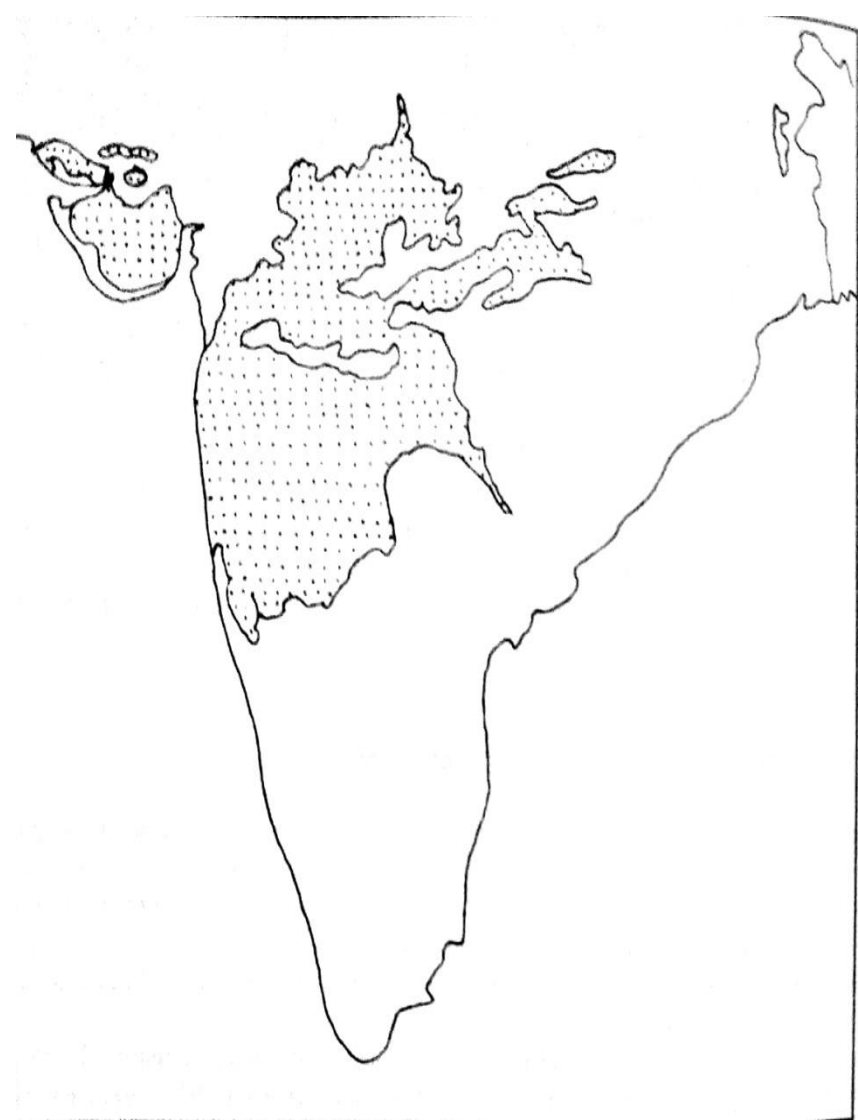


Fig 8- Distribution of Deccan Trap

- Due to the forces of weathering and erosion, this rock system gave birth to a new soil variety known as the Black Cotton soil or Regur.

Cenozoic /Tertiary rock system

- These rocks belong to the Cenozoic era, formed around 60 million years ago. Characterised by two event- the final breaking up the old Gondwana land and the upliftment of Tethys geosynclines or Himalayas (See fig 8).
- It is also observed that the volcanism associated with the Deccan Traps has continued. (Oligocene & lower Miocene period). The rocks of this era have shown much valuable resources of petroleum and coal.
- The Tertiary Succession are fully spread over the Bengal and Ganges delta, East coast and Andaman Islands. They are also found in the Salt Range, Potwar Plateau, outer Himalayan regions of Jammu and Punjab, Assam, Sind and Baluchistan. Important rock systems include Karewas of Kashmir, Bhangra and Khadar of the Gangetic plains etc.
- The Tertiary's, in India, are called as Marine Tertiary's. The formations belonging to this age are:
 - a) **The Eocene System:** First upheaval of Himalayas take place (65 my); resultant **Greater Himalayas** in Oligocene period.
 - The Eocene System includes the rocks found in Sind and Baluchistan regions. It includes the following unique geologic series of formations: -
 - Ranikot Series, Laki Series, Kirthar Series, Kashmir ranges, Eocene Formations of Simla, Rajasthan, Kutch, Assam, Gujarat region, Eocene beds of Cauvery Basin and Bengal Basin.
 - b) **The Oligocene- Mid Miocene System :** This period mark with formation of **Lesser Himalayas** and **Great Boundary fault** during second upheaval of Himalayan ranges. A lot of coal and petroleum resources of India are found in most of these formations.
 - Oligocene and lower Miocene systems are exposed in-
 - The Cauvery Basin, Kutch and Rajasthan,
 - Sind and Baluchistan, Potwar Plateau,
 - Jammu, Simla Himalaya and Assam.

c) **The Lower Miocene to Post Pliocene Systems:** Third upheaval of Outer Himalayas took place in post Pliocene or Lower Pliocene Period (1.4 my) , resultant Shiwaliks.

- They geological formation of this period are :The Siwalik System in north western India;
- ❖ The Manchhar Series in Sindh ;
- ❖ The Tipam and Dihing Series in Assam;
- ❖ The Dwarka Beds in Kathiawar;
- ❖ The Khar series in Kutch;
- ❖ The Varkala Beds in Coastal Kerala;
- ❖ The Cuddalore Sandstones in Tamil Nadu
- ❖ The Rajamahendri Sandstones in Andhra Pradesh.
- Lignite, fire clays, ball clays, terra cotta clay, sandstones, shell-limestone, Kaolin and petroleum are the major economic natural resources of these formations.

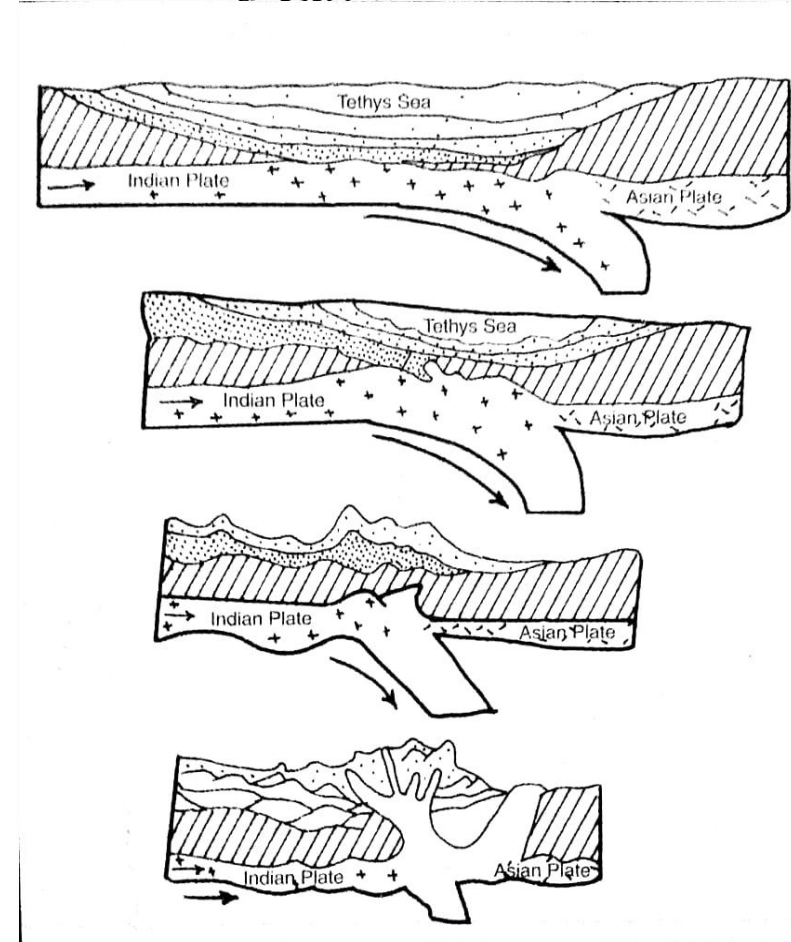
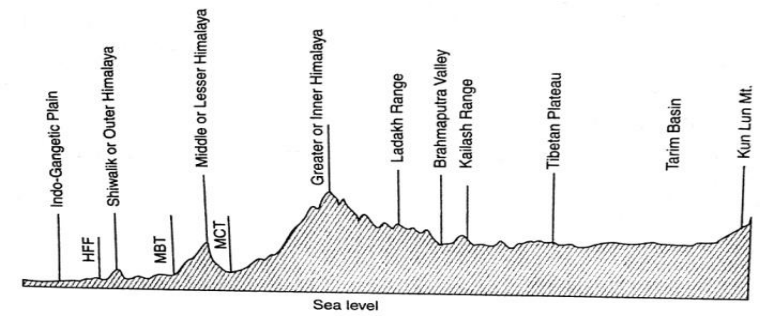


Fig 9- Stages of upheaval of Himalayas

4. NEOZOIC ROCK SYSTEM

Neozoic or Quaternary rock system

The Quaternary is named proposed for very recent deposits which contains fossils of species with living representatives.

The process began with Pleistocene period (1 million Yeara go) and remains to Holocene or Recent past

The alluvium which is found in the Indo-Gangetic plain are all belonging to this era. It also includes all the recent alluvial deposits of Indo-Gangetic plains in the northern parts of India.

The older alluvium is called Bhangar and is present in the ground above the flood level of the rivers.

Khaddar or newer alluvium is confined to the river channels and their flood plains. This region has some of the most fertile soil found in the country as new silt is continually laid down by the rivers every year.

These are largely found in the plains of north India (Satluj-Ganga-Brahmaputra plains) and also in the Karewas of Kashmir valley (Lucusterine and Moraine deposits)

Human culture and global diversity in faunal (Birds, Mammals) and floral assemblages happened during the Pleistocene period.

Five major episodes of glaciations (Gunj, Mindel, Riss, Wurm) happnes during the period

In addition to these, the geological signs of the **Holocene period** also exist in other part of the India. occurring long the Brahmaputra river banks. The Deltaic regions of major rivers including the Cauvery, Krishna, Mahanadi and the Ganges contain the alluvial deposits of this age.

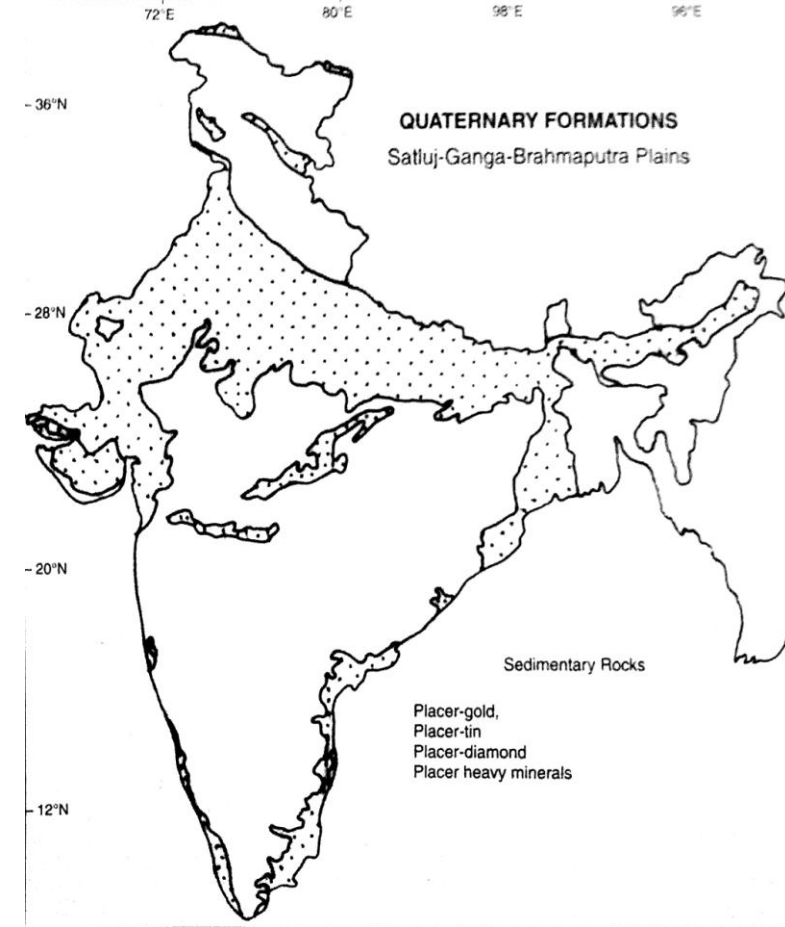


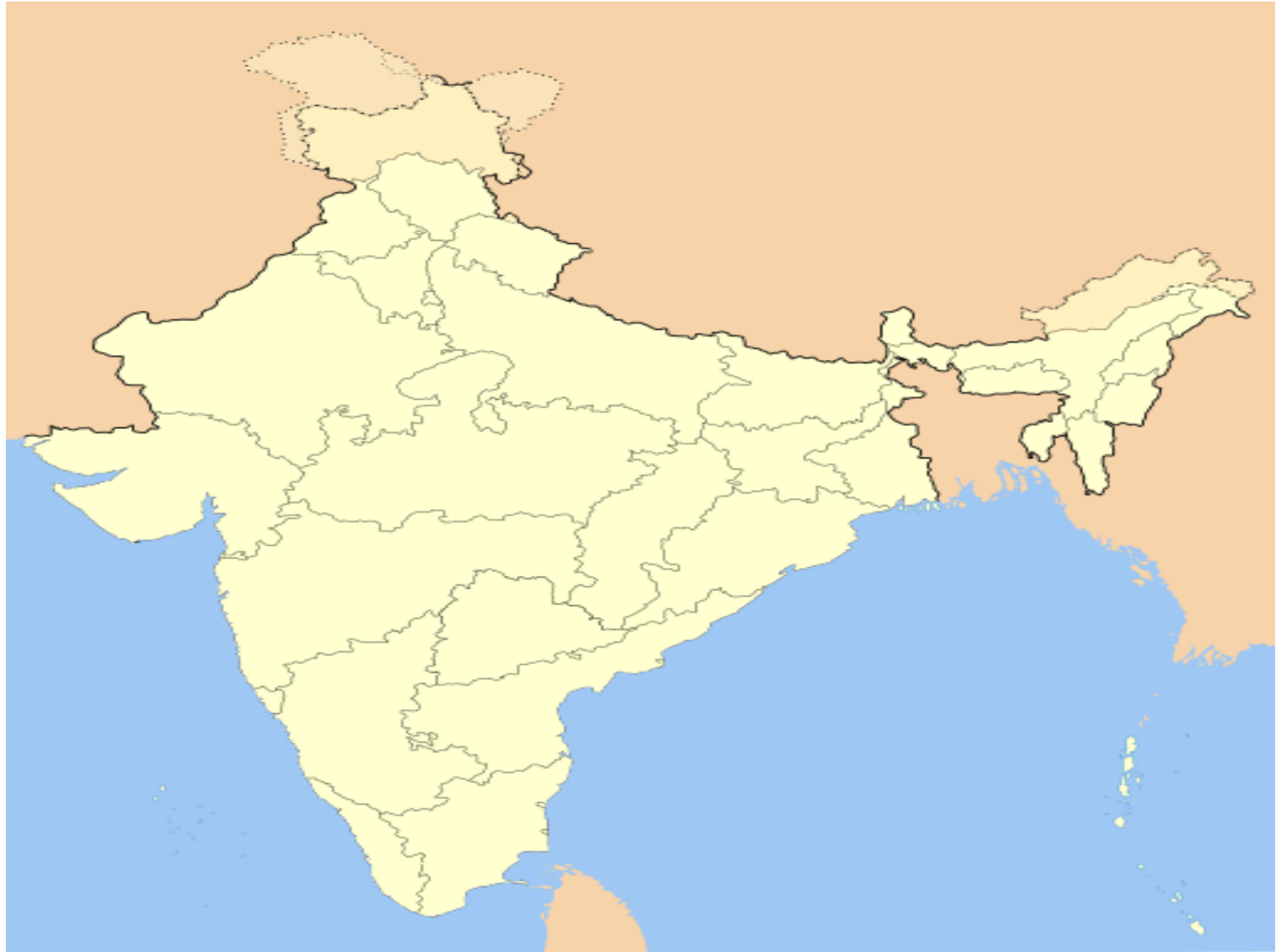
Fig 10- Distribution of Quaternary Rocks

➤ The post glacial environment has indicated the development of Mesolithic human culture, in India, approximately about 20,000 years Before Christ. The geology of India exhibits a very rich information about the continent and its evolution as well.

- The geology history of India saw unique and diverse character. Different regions of India contain rocks belonging to different geologic periods. The Indian Craton was once part of the supercontinent of Pangaea. After the breaking of Gondwanaland craton (225 my ago) and sliding towards Eurasian craton, Himalayan mountain region came into existence (65 my ago) . After succession of Outer Himalayas wide spread alluvial plain formation began in upper Pliocene & Pleistocene period as The Indo- Ganga- Brahmaputra plain region. Thus different parts of India contains rocks of almost every types of geological structures of different geologic periods.
- The stratigraphy of India can be divided into several divisions such as Archean System, Dharwar System, Cudappah system, Vindhyan system, Dravidian system and Aryan system (Gondwana, Jurassic, Deccan Trap, Tertiary and Quaternary rocks).
- India is marked by oldest rocks to the newest alluvial formations, found in the these geological stratum of India. The oldest rocks of the Archaean period are found in the peninsular India. Sedimentary rocks are found in the land formed by deposition of sediments from the Indo- Gangetic plains. Different sedimentary and metamorphism rocks also trace in the Great folded mountainous region.

1. **Describe the distribution and characteristics of the major Geological structural units of India. (long type)**
2. **“Nature has a way of writing his own history in her rocks and stone.” Explain the above statement in the context of geological structure of India. (long type)**
3. **“Present is the Key to the Past”.Who said this and examine the statement with relation to geological history of India. Or Discuss the Above statement with respect of one structural unit like Aryan Group. (long type)**
4. **Present a comparative study of Indian and Standard Geological time Scale.**
5. **Write short notes on the major structural changes during the different geological time:**
 - a. **The Dharwar Group**
 - b. **The Vindhyan Group**
 - c. **The Deccan Trap**
 - d. **The Gondwana Group**
 - e. **The Cenozoic Rock System**

Q. 6. Represent different structural units on the given map of India.



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