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GS Paper 1 || Volume - 2

Indian and World Geography

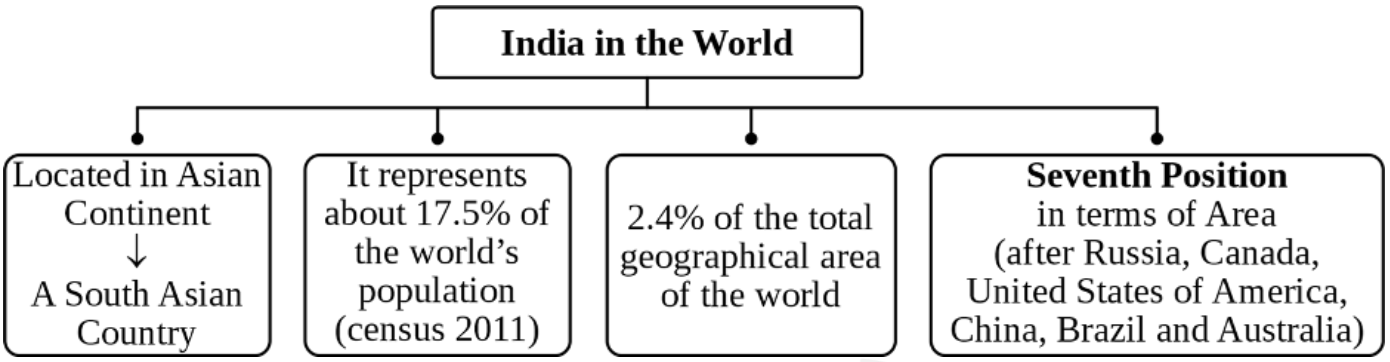
SIERRA INNOVATIONS

INDEX

1 CHAPTER

Geographical Setting of India

India is located in South Asia, stretching from the Himalayas in the north to the Indian Ocean in the south. Its diverse geographical features include mountains, plains, plateaus, deserts, and coastal areas, contributing to rich ecological and cultural variety.



India as a Geographical Unit

1. **Geographical Extent**
   - ✓ **Latitudinal Spread:** 8° 4′ N (southern tip) to 37° 6′ N (northern edge).
   - ✓ **Longitudinal Spread: 68° 7′ E** (western edge) **to 97° 25′ E** (eastern edge).
   - ✓ **North-South distance:** 3214 km
   - ✓ **East-west distance:** 2973 km
   - ✓ Comprises 28 states and 8 Union territories.
2. **Extreme Points of India**
   - ✓ **Northernmost Point:** Indira Col, located in the **Siachen Glacier** (J&K)
   - ✓ **Southernmost Point:**
     - Indira Point, **Great Nicobar Island** (Andaman Sea)
     - Kanyakumari, Southernmost point of **mainland India**
   - ✓ **Easternmost Point:** Kibithu, a remote town in **Arunachal Pradesh**
   - ✓ **Westernmost Point:** Ghuar Moti, situated in **Kutch district**, Gujarat
3. **Border Details**
   - ✓ **Total Land Border Length:** 15,106.7 km shared with neighbouring countries.
   - ✓ **Total Coastline Length:**
     - Approx. 7,516.6 km along the mainland, islands, and bays.
     - Revised coastline (including tidal inlets): 11,098 km.
     - Territorial Waters: Extend 12 nautical miles (22.2 km) from the coast.
   - ✓ **Total International Neighbours:** 7 (land); 9 (including maritime)
   - ✓ **Longest Border:** With Bangladesh
   - ✓ **Shortest Border:** With Afghanistan (via PoK)

Neighbouring Countries of India & Bordering States

Country	Border States
Bangladesh	West Bengal, Assam, Meghalaya, Tripura, Mizoram
China	J&K, Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh
Pakistan	Jammu & Kashmir, Punjab, Rajasthan, Gujarat, Ladakh
Nepal	Bihar, Uttarakhand, Uttar Pradesh, Sikkim, West Bengal
Myanmar	Arunachal Pradesh, Nagaland, Manipur, Mizoram
Bhutan	Sikkim, Arunachal Pradesh, Assam, West Bengal
Afghanistan	Ladakh (POK)

4. Key Parallels and Meridians

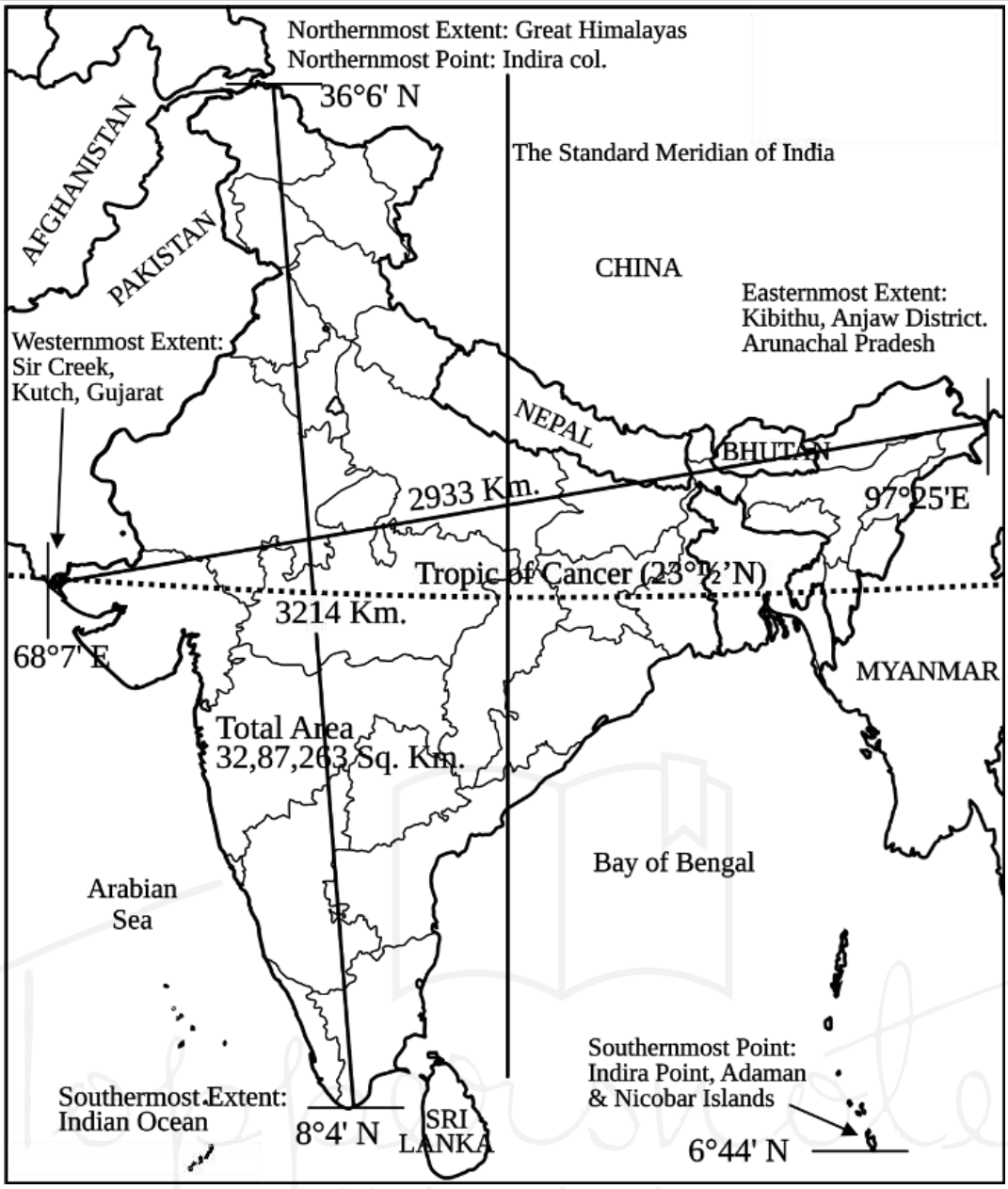
- ✓ **Tropic of Cancer:**
  - Divides India into 2 climatic zones
    - ☞ Tropical Zone: South of the tropic
    - ☞ Subtropical Zone: North of the Tropic
  - Passes through 8 states → Gujarat, Rajasthan, MP, Chhattisgarh, Jharkhand, West Bengal, Tripura & Mizoram
- ✓ **Standard Meridian:**
  - Defines Indian Standard Time.
  - It crosses UP, Chhattisgarh, Odisha, MP & Andhra Pradesh.
  - Despite India's wide east–west spread, the entire country follows a single time zone for administrative convenience and uniformity.

The Greenwich Meridian, or 0° longitude:

- ➢ It does not pass through India. Instead, India follows its own Standard Meridian located at 82.5° East longitude, which passes near Mirzapur in Uttar Pradesh.
- ➢ This meridian is used to determine Indian Standard Time (IST), which is 5 hours and 30 minutes ahead of Greenwich Mean Time (GMT+5:30).
- ➢ Despite India's wide east-west geographical spread, the country maintains a single time zone for administrative convenience.
- ➢ This standardization helps ensure uniform time across all states and union territories.

Important International Boundary lines

Boundary Line	Between Countries
Radcliffe Line	India and Pakistan
MacMohan Line	India and China
Durand Line	Pakistan and Afghanistan
49th Parallel	USA and Canada
38th Parallel	North Korea and South Korea
Hindenburg Line	Germany and Poland
Maginot Line	France and Germany
Oder-Neisse Line	Germany and Poland



From snow-capped mountains to sun-kissed beaches, India's geography is as diverse as its people, defining both its natural beauty and its strategic importance in South Asia.

2 CHAPTER

Structure and Physiography of India

India's physical landscape is shaped by diverse geological structures and physiographic divisions formed over millions of years. This varied terrain influences climate, agriculture, biodiversity & human settlement patterns.

Earth Evolution & Indian Plate

1. **Age and Evolution of Earth**
   - ✓ Earth is approximately 4600 million years old.
   - ✓ Over time, it has undergone major changes due to:
     - **Endogenic forces:** These come from inside the Earth, like tectonic movements (plates shifting) and volcanic activity. They cause things like mountain building, earthquakes, and new landforms.
     - **Exogenic forces:** These come from outside, such as weathering (breaking down of rocks), erosion (movement of sediments by wind, water), and deposition.
   - ✓ These forces shaped various surface and subsurface features of the Earth.
2. **Movement of Indian Plate**
   - ✓ Originally located south of the equator, once part of a larger plate including Australia.
   - ✓ Broke away and moved northward, while the Eurasian Plate moved southeast.
   - ✓ The northward movement of the Indian Plate continues even today.
   - ✓ This ongoing movement has major consequences:
     - Formation & uplift of Himalayas.
     - Frequent earthquakes in the Himalayan region.
3. **Forces Shaping the Subcontinent**
   - ✓ Interaction of endogenic and exogenic forces with plate movements.
   - ✓ Led to the formation of major landforms and geological structures across India.
   - ✓ Drives ongoing geomorphological processes such as mountain-building, erosion, and sedimentation.

Geological Divisions of India

1. **The Peninsular Block:**
   - ✓ The Peninsular Block is the oldest and most stable part of India's geology.
   - ✓ **Extension**: Northern boundary runs from Kachchh (Gujarat) → Aravalli (Delhi) → Yamuna-Ganga plains → Rajmahal Hills → Ganga Delta.
   - ✓ It includes Karbi Anglong, Meghalaya Plateau (NE India) and Rajasthan Plateau (West).
   - ✓ A major geological feature, the Malda Fault in West Bengal, separates it from the Chotanagpur Plateau.

Formation & Features:

- ✓ Made of very old rocks such as gneisses and granites, which date back to the ancient supercontinent Gondwana, showing its great geological age.
- ✓ The block has undergone vertical movements and faulting, creating rift valleys like those of the Narmada, Tapi, and Mahanadi rivers. These valleys formed where blocks of land sank between faults.
- ✓ Contains relict/residual hills: Aravali, Nallamala, Javadi, Veliconda, Palkonda, Mahendragiri.
- ✓ River valleys are shallow with gentle gradients.
- ✓ Major east-flowing rivers form deltas (e.g., Mahanadi, Godavari, Krishna, Kaveri).

2. The Himalayas & Other Peninsular Mountains

- ✓ **Geological Nature:** The Himalayas are young, tectonically active, and flexible, unlike the rigid Peninsular Block. This means they are still rising and changing today due to plate collision.
- ✓ **Rock types:** Metamorphic (schist, gneiss), igneous, & sedimentary.
- ✓ Located at altitudes between 3000–8000 meters, the Himalayas include some of the highest peaks on Earth, illustrating the power of tectonic uplift.
- ✓ **Geomorphological Features:**
  - Shaped by endogenic (internal) and exogenic (external) forces.
  - Formation of faults, folds, thrust planes.
  - Dissected by youthful rivers, creating gorges, V-shaped valleys, rapids, and waterfalls.

3. Indo-Ganga-Brahmaputra Plain

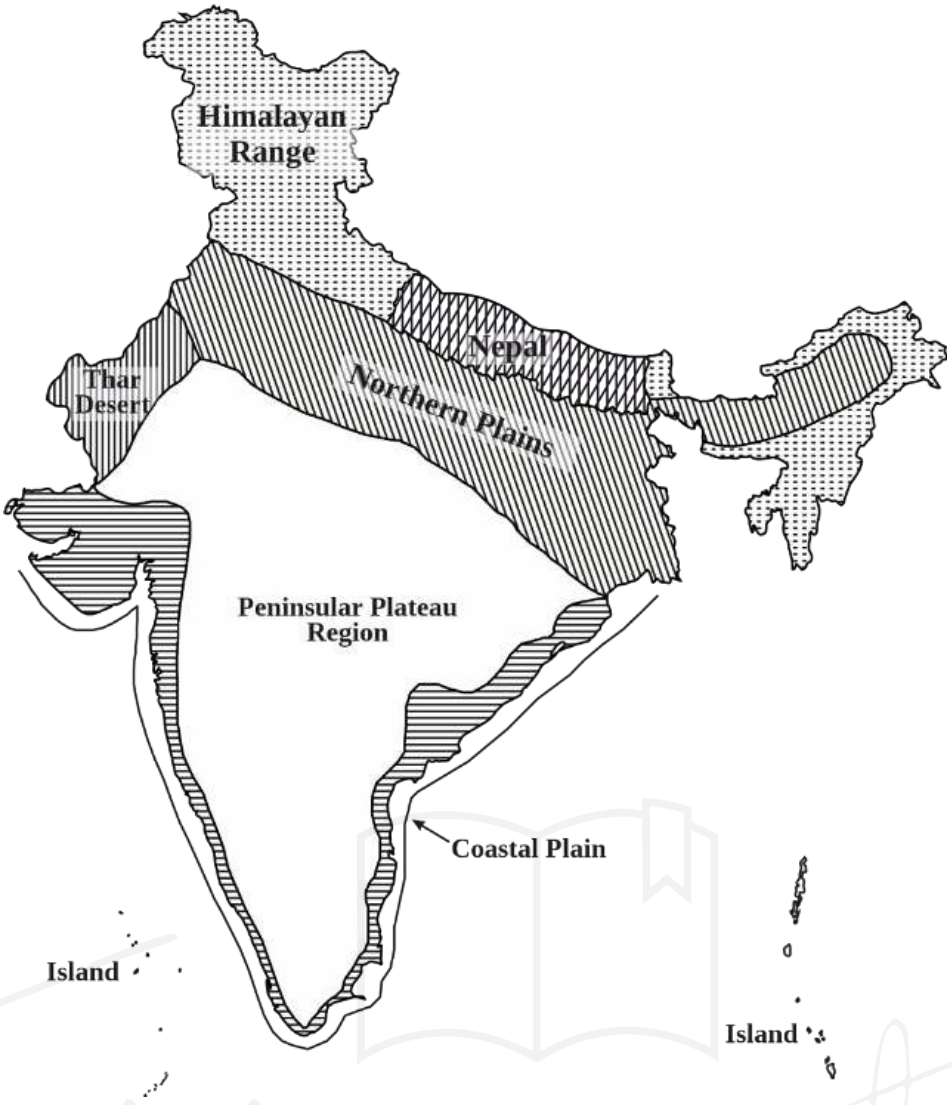
- ✓ **Formation & Evolution:** by alluvial deposits of Indus, Ganga, and Brahmaputra rivers → Initially a geo-synclinal depression, developed during the 3rd phase of Himalayan uplift (64 million years ago) → Gradually filled by sediments from Himalayan & Peninsular rivers.
- ✓ **Physiographic Significance:** Flat, fertile & densely populated. Reflects influence of both geological and geomorphological processes of the Indian subcontinent.

What is Physiography?

- ➢ **Meaning:** Refers to the physical geography or surface features of a region, describing its landforms and terrain characteristics.
- ➢ **Formation:** Shaped by the underlying geological structure, geomorphic processes (like erosion, deposition, tectonics), and various developmental stages over time.
- ➢ **India's Physiography:**
  - ✓ Shows major variations across the country.
  - ✓ **North:** Rugged, young folded mountains of the Himalayas.
  - ✓ **South:** Stable, ancient plateaus of the Peninsular block.
  - ✓ **Between:** Extensive, flat alluvial plains of the Indo-Ganga-Brahmaputra region.

India's Major Physiographic Divisions:

1. **The Northern and North-Eastern Mountains**
2. **The Northern Plains**
3. **The Peninsular Plateau**
4. **The Indian Desert**
5. **The Coastal Plains**
6. **The Islands**



1. The Northern and North-Eastern Mountains

- ✓ Comprise the **Himalayas** and **North-Eastern Hills**.
- ✓ Himalayas:
  - Comprising parallel ranges: Trans-Himalaya, Greater Himalaya (Himadri), Middle Himalaya (Himachal), Shiwalik.
  - **Orientation:** NW–SE (main ranges), E–W (Sikkim), N–S (Nagaland, Mizoram).
  - Act as climatic, physical, drainage, and cultural barriers.
- ✓ **Subdivision-**

A. North–South Division of the Himalayas

- **Great Himalayas (Inner Himalayas)**
  - ☞ **Composition**: Central crystalline core of granite and gneiss topped by metamorphosed sedimentary layers.
  - ☞ **Characteristics**:
    i. Highest, most continuous belt (mean elevation ~6,100 m)
    ii. steep south face; asymmetrical fold structure
    iii. convex profile ending abruptly at Nanga Parbat (8,126 m) in the west and Namcha Barwa (7,782 m) in the east.
  - ☞ **Major Peaks**: Everest (8,848 m), Kanchenjunga (8,586 m), Lhotse, Makalu, Dhaulagiri, Nanda Devi, Trishul, etc.

- ☞ **Principal Passes**:
  i. Zoji La, Burzil Pass - Jammu & Kashmir
  ii. BaraLacha La, Shipki La - Himachal Pradesh
  iii. Niti Pass, LipuLekh - Uttarakhand
  iv. Nathu La, Jelep La - Sikkim.
- ☞ **Other Features**:
  i. Hosts world's largest non-polar glaciers (Siachen, Baltoro).
  ii. Deep valleys such as the Kashmir Valley.

▪ **Lesser Himalayas (Middle Himalayas)**
- ☞ **Composition**: Predominantly sedimentary & volcanic rocks (Pir Panjal range).
- ☞ **Characteristics**:
  i. Elevations between 3,500 m & 4,500 m
  ii. Rugged uplands interspersed with large valleys (Kashmir, Kullu, Kangra).
- ☞ **Key Peaks**: Nag Tibba, Mahabharat Lekh.
- ☞ **Key Passes**: Banihal, Pir Panjal, Golaghat.
- ☞ **Other Features**:
  i. Popular hill stations (Shimla, Mussoorie, Dharamshala)
  ii. Major river-gorges of the Jhelum, Beas & Chenab rivers.

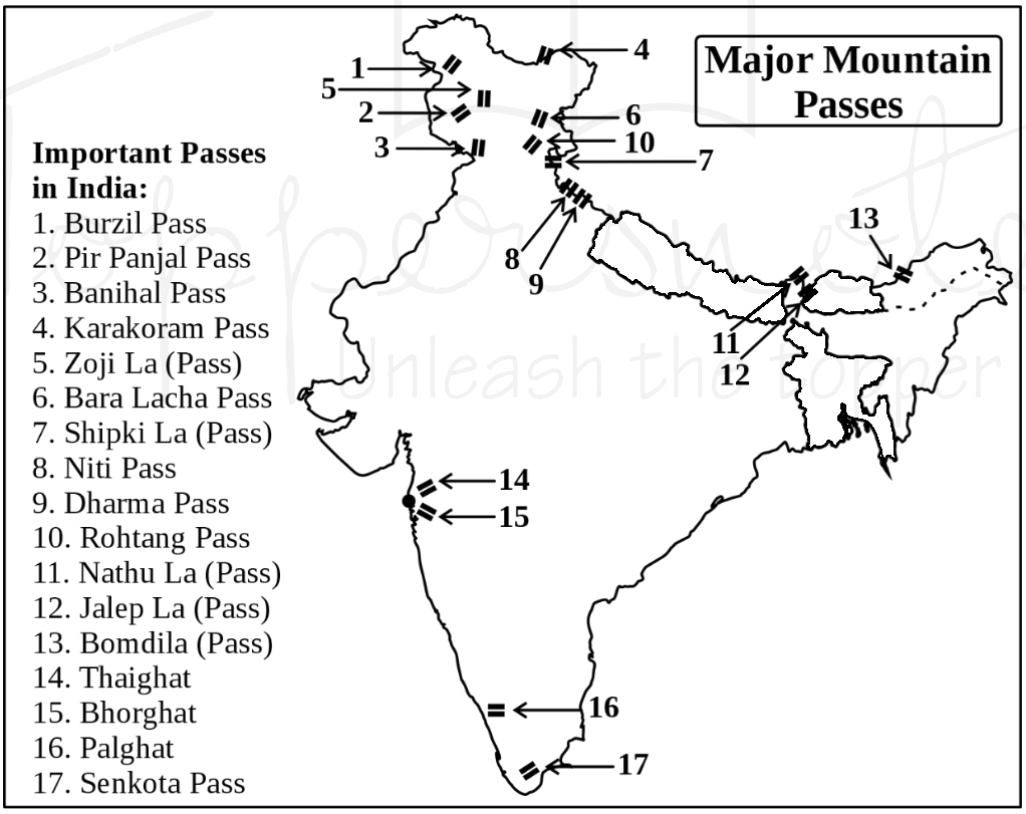
▪ **Shiwaliks (Outer Himalayas)**
- ☞ **Composition**: Mio-Pleistocene deposits, sands, gravels, conglomerates.
- ☞ **Characteristics**:
  i. Low relief (900–1,100 m)
  ii. Broad alluvial tracts known as duns (Dehradun, Kotli Dun) crossed by seasonal streams (chos).
- ☞ **Peaks & Passes**: No significant summits or passes.
- ☞ **Other Features**: Form youngest Himalayan foothills; dissected by scarps and anticlines.

B. East–West Division of the Himalayas

▪ **Kashmir / Northwestern Himalayas**
- ☞ Key Ranges: Karakoram, Ladakh, Zaskar, Pir Panjal.
- ☞ **Major Peaks**: K2 (8,611 m), Nanga Parbat, Gasherbrum, Rakaposhi.
- ☞ **Principal Passes**: Zoji La, Banihal, Khardung La, Photu La.
- ☞ **Other Features**:
  i. Kashmir Valley (Tectonic) with Dal and Wular lakes
  ii. Pangong Tso in Ladakh
  iii. Karewas (lacustrine benches) famous for saffron cultivation
  iv. Baltoro and Siachen glaciers north of Nubra Valley
  v. Changpa pastoralists of the Changthang plateau, rearing Pashmina goats & recognized as a Scheduled Tribe
  vi. Pilgrimage at Vaishno Devi and Hazratbal Shrine in Srinagar.

▪ **Himachal & Uttarakhand Himalayas**
- ☞ **Key Ranges**: Great Himalayas, Dhauladhar, Nag Tibba subranges & Shiwaliks.
- ☞ **Major Peaks**: Kamet, Nanda Devi, Kedarnath, Trishul, Bandarpunch.
- ☞ **Principal Passes**: Lipu Lekh, Niti Pass, BaraLacha La.
- ☞ **Other Features**:
  i. Valley of Flowers
  ii. Hill stations like Shimla, Ranikhet, Mussoorie
  iii. Sacred sites Badrinath and Kedarnath.

- **Nepal Himalayas**
  - **Key Ranges**: Mahabharat and Churia ranges.
  - **Major Peaks**: Everest, Annapurna, Dhaulagiri, Makalu.
  - **Passes**: No major trans-Himalayan passes.
  - **Other Features**:
    i. Highest continuous Himalayan section
    ii. Renowned tea gardens along the southern foothills.
- **Darjeeling & Sikkim Himalayas**
  - **Key Ranges**: Kanchenjunga, adjacent folds of the Mahabharat range.
  - **Major Peak**: Kanchenjunga (8,586 m).
  - **Principal Passes**: Jelep La, Nathu La.
  - **Other Features**:
    i. Famous tea plantations
    ii. Exceptional orchid diversity
    iii. Home to the Lepcha tribe.
- **Arunachal Himalayas**
  - **Key Ranges**: Patkai Bum, Naga Hills, Abor Hills.
  - **Major Peaks**: Namcha Barwa, Kangtu.
  - **Principal Pass**: Diphu Pass.
  - **Other Features**:
    i. Inhabited by Monpa, Abor and Mishmi tribes
    ii. Practice of jhum (shifting) cultivation.



C. Purvanchal himalayas

- The eastern extension of the Himalayas in Northeast India, curving southward beyond the Dihang Gorge, forming a series of hill ranges running mostly north–south.
- Composed of folded, uplifted sedimentary layers, with dense forests and complex relief.

Sub-Range	Composition & Structure	Characteristics & Uses	Highest Peak	Other Features
Patkai Bum	Highly dissected hills cloaked in dense rainforest	Forms international boundary between Arunachal Pradesh & Myanmar	—	Biodiversity hotspot
Naga Hills	Predominantly igneous and metamorphic rocks	Acts as watershed between India and Myanmar	Mount Saramati	Jhum cultivation by indigenous Naga tribes
Manipur Hills	Sedimentary layers with clay deposits	Southward continuation of the Naga range	—	—
Barail Range	Folded deposits separating it from Naga Hills	Characterized by narrow valleys and mid-elevations	Mount Tempu (Manipur)	—
Mizo (Lushai) Hills	Unconsolidated sediments of the molasse basin	Known locally as "Blue Mountain" region	Phawngpui (2,157 m)	Rich tribal cultures and continuous jhum farming

1. Prominent Himalayan Glaciers

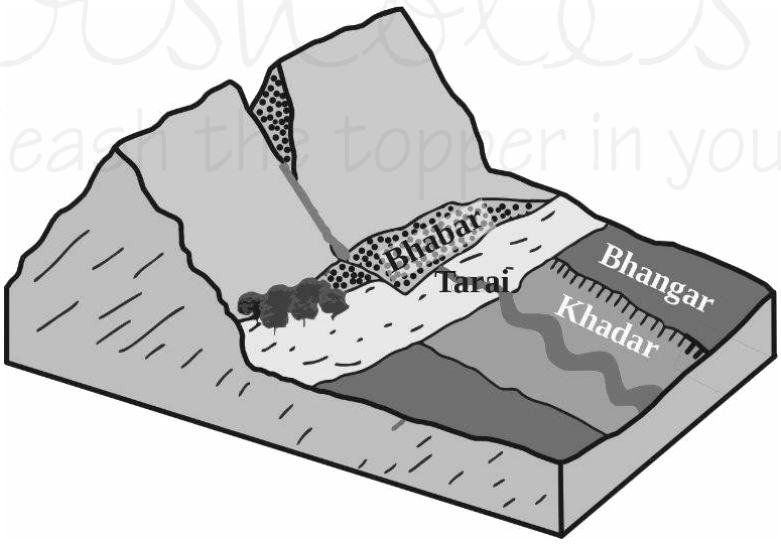
Glacier Name	Location	Important Features
Siachen	Karakoram ranges	Nubra Valley of Himalayas; 2nd longest glacier outside Polar region
Biafo	Karakoram	Flows into the Shigar River
Gangotri	Uttarakhand	Origin below Chaukhamba Peak; also known as 'Gomukh'
Hispar	Gilgit-Baltistan	World's longest glacial system
Zemu	Sikkim/Nepal	Largest glacier of Eastern Himalaya; feeds River Teesta
Sonapani	Lahaul & Spiti, HP	Longest glacier in the Pir Panjal range. A glacier stream is a tributary to the Chandra River, which later merges with the Bhaga River to form the Chenab.
Milam	Uttarakhand	Major source of River Gori Ganga (Saryu); biggest glacier in Kumaon Himalaya
Chong Kumdan	Karakoram, Ladakh	Feeds Shyok River due to potential blocking
Diamir	POK	Known as the 'King of Mountains'
Rupal	Kashmir	In Greater Himalayas; flows northeastward

2. Prominent Himalayan Passes

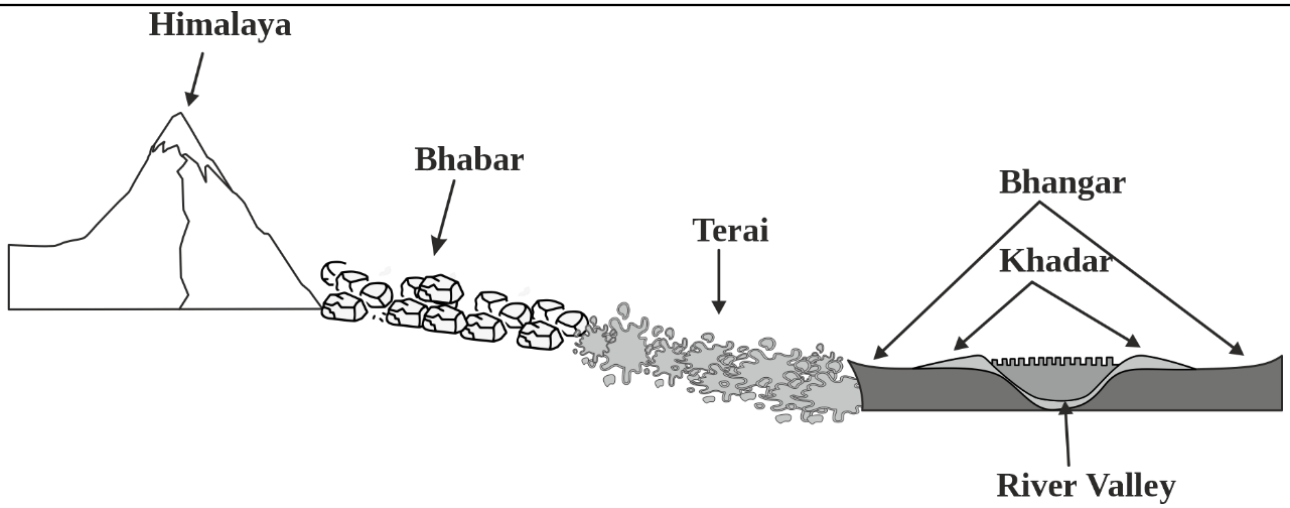
Pass Name	State / UT	Location / Border	Importance
Zoji La	Jammu & Kashmir, Ladakh	Greater Himalayas	Connects Srinagar–Leh; vital for defence
Banihal Pass	Jammu & Kashmir	Pir Panjal Range	Jawahar Tunnel passes under this; Srinagar–Jammu link
Khardung La	Ladakh	Ladakh Range	Road to Siachen; one of highest motorable roads
Chang La	Ladakh	Ladakh Range	Connects Leh to Pangong Lake

Fotu La	Ladakh	Zanskar Range	Highest point on Srinagar–Leh highway
Namika La	Ladakh	Zanskar Range	On Kargil–Leh route
Baralacha La	Himachal Pradesh	Zanskar Range	On Leh–Manali highway
Shipki La	Himachal Pradesh	India–Tibet Border (Kinnaur)	Historic trade route
Mana Pass	Uttarakhand	Chamoli District	Road to Kailash–Mansarovar; Indo-China route
Niti Pass	Uttarakhand	Chamoli District	Old trade route to Tibet
Lipulekh Pass	Uttarakhand	Pithoragarh District	Kailash–Mansarovar Yatra route; India–Nepal–Tibet tri-junction
Nathu La	Sikkim	Indo–China Border	Border trade post with China
Jelep La	Sikkim	Near Kalimpong	Trade route to Lhasa in historical times
Se La	Arunachal Pradesh	Tawang District	Connects Tawang to rest of state
Bum La	Arunachal Pradesh	Near Tawang	Indo–China sensitive military pass
Dipher Pass	Arunachal Pradesh	East Kameng	Eastern Himalayas, remote and strategic
Khunjerab Pass	(POK)	Gilgit–Baltistan (Pak-Occupied Kashmir)	On China–Pakistan border; on CPEC route
Lanak La	Ladakh (Disputed Border)	Aksai Chin region (Indo-China)	Disputed India–China border crossing
Lekhapani	Arunachal Pradesh	Eastern tip near Assam-Arunachal	Historic WW-II route via Stilwell Road; strategic for eastern sector

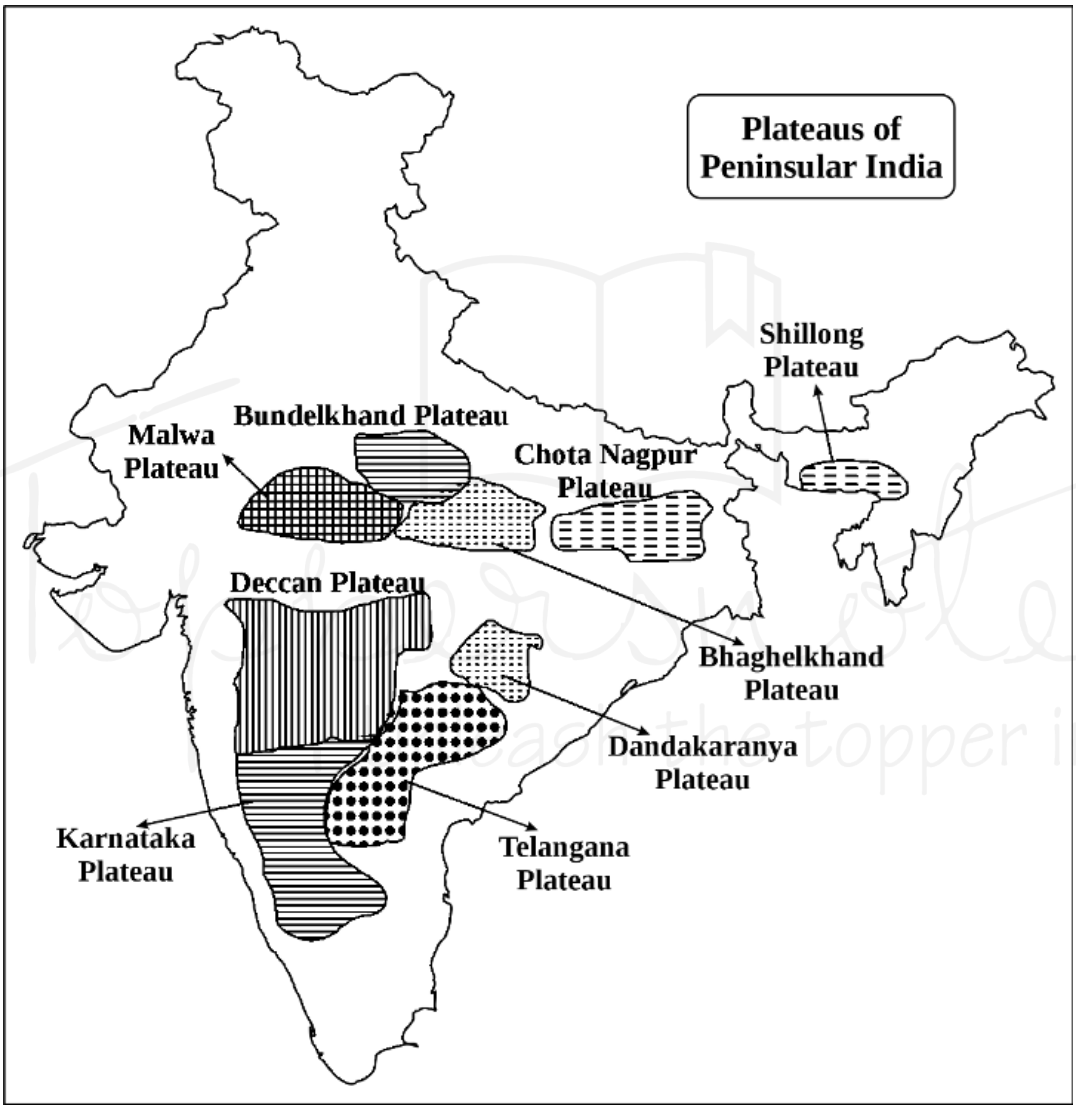
2. The Northern Plains



- ✓ Formed by alluvial deposition from Indus, Ganga & Brahmaputra.
- ✓ **Size:** About 3,200 km long and 150–300 km wide.
- ✓ **Significance:** One of the most fertile and densely populated regions of India.
- ✓ Divided into: (from north-south)
  - **Bhabar** (rocky, porous belt near base of Shiwaliks)
  - **Tarai** (marshy, re-emergent rivers- Dudhwa National park located)
  - **Alluvial Plains**:
    - ☞ **Khadar** – newer alluvium, floodplain deposits, fertile
    - ☞ **Bhangar** – older alluvium, calcareous in nature
- ✓ **Features:** Meanders, oxbow lakes, braided channels, sand bars.
- ✓ Brahmaputra Plain: prone to floods, home to riverine islands (Majuli).

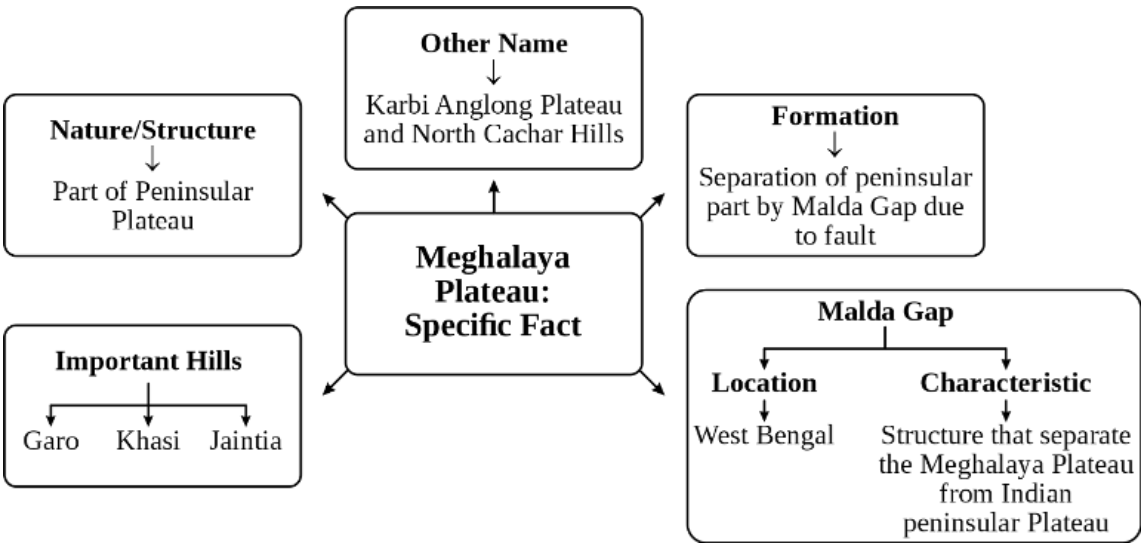


3. The Peninsular Plateau



- ✓ Oldest landmass, stable, formed from Gondwanaland.
- ✓ **Elevation:** Ranges between 150–900 m.
- ✓ **Slope:** Tilts eastward, with black soil in the northwest.
- ✓ The Plateau's outer extent includes Delhi Ridge (northwest), Rajmahal Hills (east), Gir Range (west), and Cardamom Hills (south). Eastern extension seen in the Shillong & Karbi-Anglong Plateau.
- ✓ **Physiographic Forms:** Includes block mountains, rift valleys, tors, bare rock exposures.

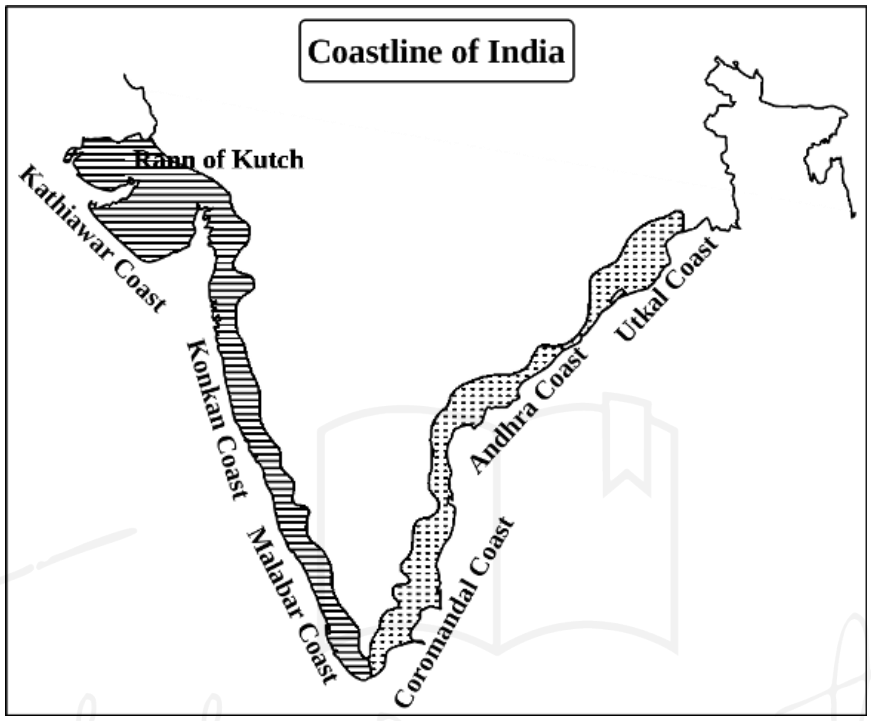
- ✓ **Divisions:**
  - **Deccan Plateau**
    - ☞ **Western Ghats**:
      - ❖ Known locally as the Sahyadri (Maharashtra), the Nilgiri Hills (Karnataka and Tamil Nadu), and the Anaimalai and Cardamom Hills (Kerala's Malabar Coast).
      - ❖ Average height ~1,500 m; becomes higher and more continuous toward the south.
      - ❖ Spread across **Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra, Gujarat**.
      - ❖ Eastern rain-shadow features mushroom rocks, dunes, oases, and ephemeral streams like the Luni ending in salt-rich playas for brine.
      - ❖ Source of major rivers: **Godavari, Krishna, Kaveri**.
      - ❖ Highest peaks: **Anamudi (2,695 m)**, **Doddabetta (2,637 m), Ooty (2,240 m)**, **Pushpagir (1,712 m)** in the Nilgiris.
      - ❖ Famous hill stations: **Ooty**, **Munnar, Kodaikanal**.
    - ☞ **Eastern Ghats:**
      - ❖ Broken, lower, heavily eroded hill chain running through **Odisha, Andhra Pradesh, Tamil Nadu, Karnataka, Telangana**.
      - ❖ Principal ranges (north to south): **Mahendragiri** (highest peak), **Nallamala Hills** (Srisailam temple), **Velikonda**, **Palkonda**, **Javadi**, **Shevaroy**, **Pachamalai**, **Sirumalai Hills**.
      - ❖ Geologically isolated outliers: Amarkantak Hills (Vindhya–Satpura junction), Biligirirangana Hills (Karnataka), Seshachalam Hills (Andhra Pradesh).
      - ❖ At the Nilgiris, Eastern and Western Ghats meet, forming a corridor with Sathyamangalam Tiger Reserve (Tamil Nadu).
  - **Central Highlands**
    - ☞ Bounded to the west by the Aravallis
    - ☞ Formed by disjunctive ranges of Vindhya, Satpura ranges.
    - ☞ Made of metamorphic rocks like marble, slate, gneiss, etc.
  - **North-Eastern Plateau**
    - ☞ Extension of Peninsular plateau Includes Chotanagpur, Shillong, Meghalaya (Garo, Khasi, Jaintia).
    - ☞ Separated by a fault from the main block between the rajmahal hills & the meghalayan gap.
    - ☞ **Features:** Rich in minerals, highly eroded (e.g., Mawsynram, Meghalaya,known for intense rainfall and rugged terrain).



4. The Indian Desert

- ✓ **Location:** Lies northwest of the Aravalli Range; also called the Thar Desert.
- ✓ **Landscape:** Arid zone with sand dunes and barchans (crescent-shaped dunes), known locally as Marusthali.
- ✓ **Rainfall:** Very low, less than 150 mm annually; features inland drainage (no major rivers reaching the sea).
- ✓ **Rivers:** Luni River flows seasonally in the southern desert.
- ✓ **Other Features:** Presence of lakes and brackish playas, which are important sources of salt. Khadeen agriculture practiced.

5. The Coastal Plains



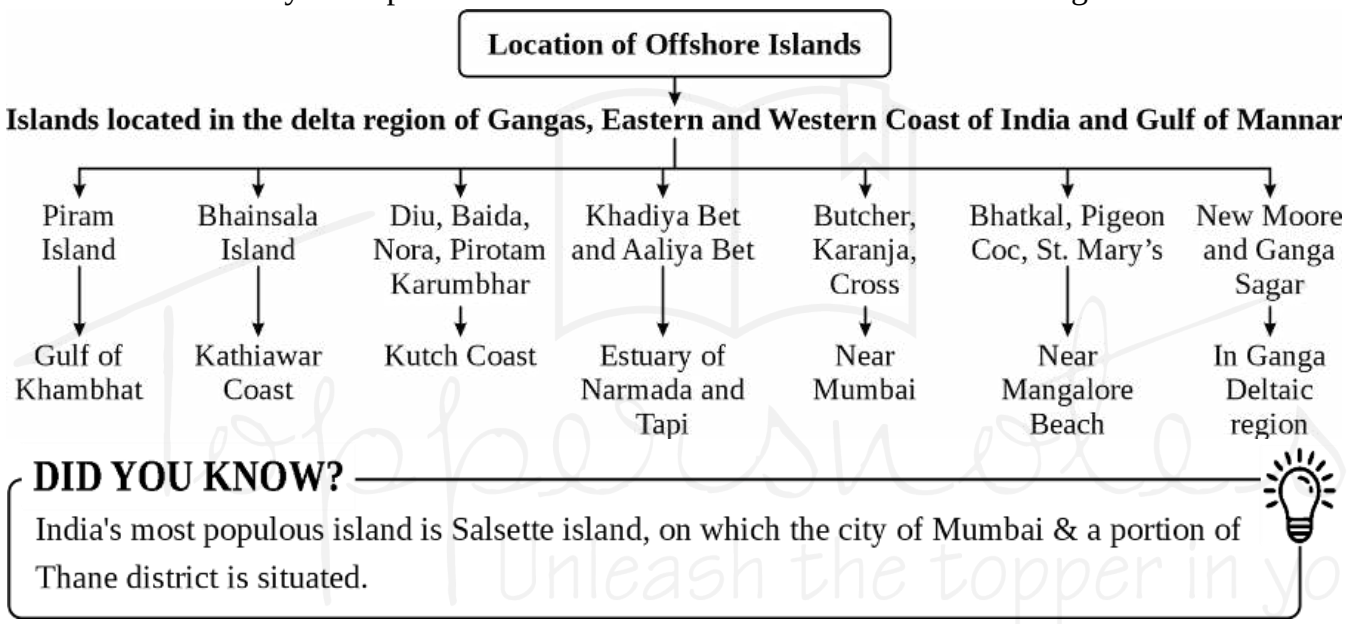
- ✓ **Western Coastal Plains:**
  - Submerged coast (city of Dwarka believed to be submerged); narrow & steep coastline.
  - **Ports:** Well-suited for natural harbours like Mumbai, Mangalore, Kochi.
  - **Divisions:** Kachchh-Kathiawar (Gujarat), Konkan (Maharashtra), Canara (Karnataka), Malabar (Kerala).
  - **Special Feature:** Kayals (backwaters) in Kerala's Malabar coast.
  - **Rivers:** Rivers here are short and swift because of the narrow coastal strip and steep slope. They flow quickly to the sea and do not form deltas, unlike the eastern side.
- ✓ **Eastern Coastal Plains:**
  - **Emergent coast**; broader, wide and flat, formed by marine regression.
  - Deltas well developed: Mahanadi, Godavari, Krishna, Kaveri. These deltas are fertile and densely populated.
  - **Ports:** Fewer ports due to the shallow continental shelf, making harbours less naturally deep.

Base Line	Territorial Sea	Exclusive Economic Zone
↓	↓	↓
The line defining the shoreward extent of the terrestrial sea	Territorial water extends seaward up to 12 nautical miles	Territorial water of a country extended up to 200 nautical miles from the base line

Coast → Sea

6. The Islands

- ✓ **Andaman & Nicobar Islands (Bay of Bengal):**
  - **Number:** Comprising 836 islands with 38 of them being permanently inhabited.
  - **Origin:** Volcanic, with Barren Island being South Asia's only confirmed active volcano. Barren Island Volcano erupted first in 1787, the last major eruption in 1991.
  - **Geological Link:** Extension of the Arakan Yoma range of Myanmar.
  - **Climate & Vegetation:** Equatorial climate with dense tropical forests.
  - **Highest Peak:** Saddle Peak in North Andaman.
  - **Significance:** Strategic location for maritime security and biodiversity hotspot with many unique species of plants and animals.
- ✓ **Lakshadweep Islands (Arabian Sea):**
  - **Number:** Consist of 36 coral islands, comprising 12 atolls, three reefs, five submerged banks and ten inhabited islands.
  - Minicoy is the largest island. Known for its distinctive culture and lighthouse.
  - Divided by 11° Channel (Amini in north, Cannanore in south).
  - **Features:** Formed entirely of coral deposits, showcasing unique marine ecosystems.
  - These ecosystems protect coastlines and are sensitive to climate change and sea-level rise.



DID YOU KNOW?

India's most populous island is Salsette island, on which the city of Mumbai & a portion of Thane district is situated.

Prominent Maritime Channels

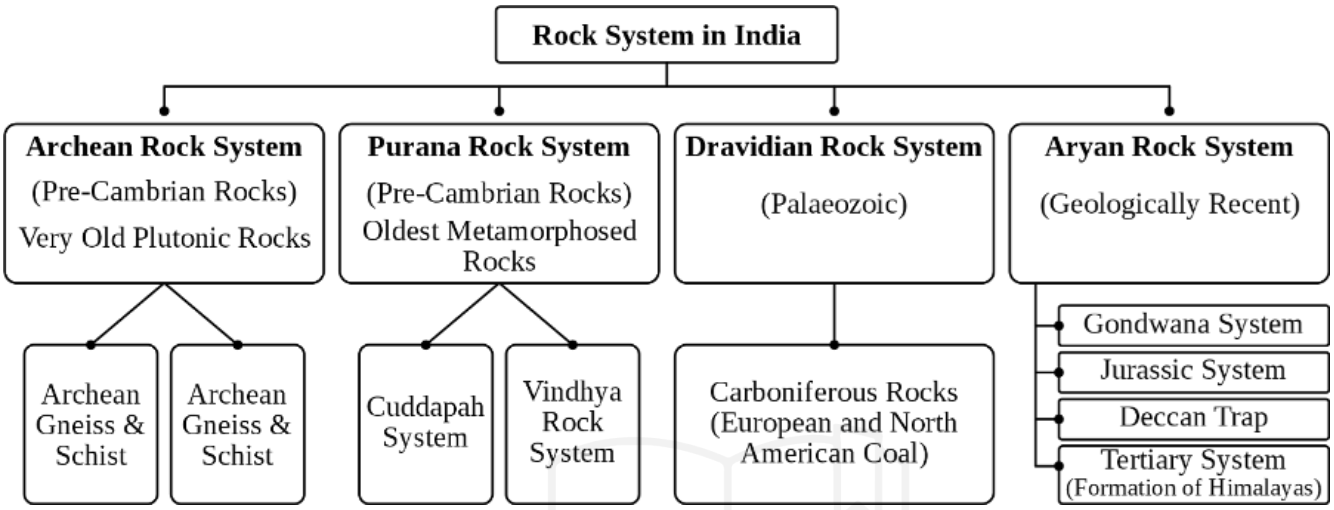
Channel	Division
8 degree channel	Minicoy and Maldives
9 degree channel	Minicoy Island and Lakshadweep Archipelago
10 Degree Channel	Andaman Islands and Nicobar Island
11 Degree Channel	Amindivi and Cannanore Island
Duncan Passage	South/Great Andaman and Little Andaman
St. George Channel	Little Nicobar and Great Nicobar
Grand Channel	Great Nicobar and Sumatra Island (Indonesia)
Coco strait	Middle of coco island (Myanmar) and Northern Andaman
Palk strait	Tamil Nadu (India) and Northern Sri Lanka

The structural and physiographic framework of India not only reflects its complex geological history but also plays a critical role in determining regional climates, river systems, and patterns of human settlement.

3 CHAPTER

Rock Systems Based on Geological History of India

India's geological history is marked by a series of rock formations spanning billions of years. These rock systems are classified based on their age, origin, and characteristics.



Rock Systems

1. **Archaean Rock System (4 to 1 Billion Years Old)**
   - ✓ **Formation:** Highly metamorphosed sedimentary rocks (gneisses and schists) formed from ancient sediments through intense heat and pressure.
   - ✓ **Distribution:** Central and southern Indian Peninsula, Odisha, Meghalaya, Madhya Pradesh, Chhattisgarh, Bundelkhand, Chotanagpur Plateau (Jharkhand).
   - ✓ **Characteristics:**
     - Composed mainly of Archaean Gneisses (granite to gabbro-like minerals) and Schists (crystalline rocks containing mica, talc, hornblende, chlorite).
     - Known as the Basement Complex- oldest rocks forming the foundation of all other rocks. Represents Earth's primordial crust formed by cooling and solidification of molten magma.
     - Originated from cooling and solidification of molten magma in the early Earth.
   - ✓ **Economic Importance:** Rich in minerals- iron ore, manganese, copper, lead, gold.
   - ✓ **Key Regions:**
     - **Dharwad-Bellary-Mysore (Karnataka):** Famous for iron and gold deposits.
     - **Odisha:** Rich in iron ore and manganese.
     - **Jharkhand:** Known for mica, copper, and iron ore.
     - **Madhya Pradesh & Chattisgarh:** Important for iron ore and other minerals.
     - **Aravallis:** Ancient mountains with mineral resources and evidence of early Earth processes.
2. **Purana Rock System (1.4 to 0.6 Billion Years Old)**
   - ✓ **Composition:**
     - A mix of sedimentary, volcanic, and metamorphic rocks.
     - Shows a **transitional stage** between ancient Archaean rocks and younger rock systems.
     - Records important geological events like deposition, volcanism, and metamorphism.

- ✓ **Locations:** Found in Peninsular Shield and parts of the Himalayas. Demonstrates widespread deposition in ancient geological basins.
- ✓ **Key Divisions:**
  - **Cuddapah System:**
    - ☞ Formed by deposition of clay, slates, sandstones, limestones in synclinal basins.
    - ☞ Found mainly in Cuddapah district (Andhra Pradesh), Chhattisgarh, Jharkhand, Odisha.
    - ☞ Contains ores like iron, manganese, copper, cobalt, nickel; rich limestone deposits.
  - **Vindhyan System:**
    - ☞ Named after Vindhyan Mountains in central India.
    - ☞ Forms a large, thick sedimentary sequence, about 4000 meters thick.
    - ☞ Comprises unfossiliferous sedimentary rocks over Archaean base.
    - ☞ Divided into Lower Vindhyan (1300–1100 m) and Upper Vindhyan (1000–600 m). These divisions reflect different phases of sediment deposition.
    - ☞ Found in Rajasthan, MP, Karnataka (Bhima valley), Chhattisgarh, Andhra Pradesh.
    - ☞ Famous for diamond-bearing regions: Panna (Madhya Pradesh) and Golconda (Telangana). Historically important for India's diamond trade.

3. Dravidian Rock System (Palaeozoic Era, 600–300 Million Years Old)

- ✓ **Locations:** Mostly in Himalayan and Ganga Plain regions. Rarely present in Peninsular India due to its geological stability during this era.
- ✓ **Importance:**
  - Contains over 90% of India's coal reserves (Gondwana Coal), which is younger and has lower carbon content than Carboniferous coal. Vital for India's thermal power and steel industries.
  - Rich in iron ore, copper, uranium, antimony; contains sandstones, slates, conglomerates used in construction.
- ✓ **Distribution:** Damodar valley, Mahanadi valley, Godavari troughs, Kashmir, Sikkim.
- ✓ **Geological Significance:**
  - Formed in synclinal troughs (down-folded basins), which collected thick layers of sediment.
  - Deposits are rich in terrestrial plant and animal fossils, especially since the Permian period.
  - Fossil evidence helps reconstruct ancient climates and ecosystems.
  - Named Gondwana after the Gond tribes of central India, where these rocks were first studied.

4. Triassic, Jurassic, and Cretaceous Systems

- ✓ **Triassic:**
  - Found mainly in the Himalayas (Kashmir to Kumaon).
  - Peninsular Shield lacks exposure due to geological stability.
  - Records marine and continental deposits in the northern mountain belts.
  - Helps understand India's position during Pangaea's breakup.
- ✓ **Jurassic:**
  - Marine transgressions led to deposits in Thar, Kutch, and east coast.
  - Includes coral limestone, sandstone, conglomerates.
  - These rocks indicate shallow warm seas rich in marine life.
- ✓ **Cretaceous (145–66 million years):**
  - Deposited in various environments- land, sea, estuaries, lakes across Peninsular & Himalayan regions.
  - Records India's drift as the Indian Plate began moving northward toward Asia.
  - Known for marine fossils, plant remains, and evidence of volcanic activity (e.g., Deccan Traps formed at the very end of this period).

5. **Deccan Traps (End of Cretaceous to Early Eocene)**
   - ✓ **Formation:** The Deccan Traps were formed by massive volcanic eruptions caused by hotspot volcanism. These eruptions led to extensive basaltic lava flows covering over 10 lakh sq km during the end of the Cretaceous period (around 66 million years ago) and continuing into the Early Eocene.
   - ✓ **Present Coverage:** About 5 lakh sq km in Kutch, Saurashtra, Maharashtra, Malwa plateau, northern Karnataka.
   - ✓ **Thickness:** The basaltic lava layers reach a thickness of up to 3000 meters in the western regions (near the Western Ghats) and gradually thin out towards the eastern parts.
   - ✓ **Significance:** The weathering of basalt has resulted in the formation of black cotton soil (also called regur soil), which is rich in minerals and highly fertile, supporting cotton cultivation and other crops.
   - ✓ **Trap Groups:**
     - Divided into Upper, Middle, and Lower Trap groups.
     - These divisions are often separated by intertrappean beds, which are sedimentary layers deposited between successive lava flows.
     - These layers sometimes contain fossils, providing important paleontological evidence.
6. **Tertiary System (60 to 7 Million Years Ago)**
   - ✓ Known as the "Era of Mammals", marking the rise and spread of modern mammalian groups.
   - ✓ Geologically significant as the period of Himalayan mountain-building.
   - ✓ Represents the time when the Indian Plate collided with the Eurasian Plate, leading to massive uplift and deformation.
   - ✓ **Eocene System:**
     - Marine, fluvial, deltaic sedimentary rocks (sandstone, shale, limestone).
     - Marks the early stages of Himalayan uplift when shallow seas covered parts of northern India.
     - Preserves fossils of marine organisms, showing past sea incursions.
   - ✓ **Oligocene & Lower Miocene:**
     - Sediments deposited in Himalayan foreland basin; coincided with Tibetan Plateau uplift.
     - Increased erosion supplied vast amounts of sediments to adjacent basins.
   - ✓ **Shiwalik System:**
     - Contains thick beds of sandstone, conglomerates, and clay.
     - Found extensively in the Shivalik Hills along the Himalayan foothills.
     - Rich in mammalian fossils, including early elephants, rhinoceroses, and other large mammals.
     - Provides evidence of terrestrial environments and evolution of mammals in South Asia.
7. **Pleistocene System (2.6 Million to 11,700 Years Ago)**
   - ✓ Represents the most recent geological chapter before the Holocene.
   - ✓ Characterized by multiple glacial and interglacial cycles globally.
   - ✓ **Characteristics:**
     - Sedimentary deposits laid down in various environments.
     - **Glacial formations** in the Himalayas: Evidence of glacial advance and retreat sculpting valleys and depositing moraines.
     - Alluvial plains in the Indo-Gangetic region: Massive river-borne sediments created fertile floodplains. Formed the basis of India’s agricultural heartland.
   - ✓ **Notable Deposits:** Loess soils in Punjab, Haryana; lacustrine deposits in Dal Lake, Chilika Lake.
   - ✓ **Geological Importance:**
     - Offers insight into climatic variations during the Ice Age.
     - Helps reconstruct paleoenvironmental changes in India.
     - Crucial for understanding human evolution and migration, as early humans adapted to these dynamic landscapes.

Rock System	Age Range	Key Features	Distribution	Economic Importance
Archaean	4 to 1 billion years	Metamorphosed gneisses, schists; oldest rocks	Peninsular India, Odisha, Jharkhand etc.	Iron, manganese, gold, copper
Purana	1.4 to 0.6 billion years	Sedimentary, volcanic, metamorphic rocks	Peninsular Shield, parts of Himalayas	Minerals, limestone, diamonds
Dravidian (Gondwana)	600 to 300 million years	Sedimentary; coal deposits	Himalayan foothills, valleys	90% coal reserves, iron ore
Triassic-Jurassic-Cretaceous	250 to 66 million years	Marine and terrestrial sedimentary deposits	Himalayas, Rajasthan, Kutch, East coast	Fossils, limestone, sandstone
Deccan Traps	66 million years	Basaltic lava flows, fertile black soils	Maharashtra, Kutch, Saurashtra	Agriculture (black soil)
Tertiary	60 to 7 million years	Sedimentary rocks; Himalayas uplift	Himalayas, Meghalaya plateau, Garo hills	Fossils, sediments
Pleistocene	2.6 million to 11,700 years	Glacial & sedimentary deposits	Himalayas, Indo-Gangetic plains	Loess soils, alluvial deposits

Mass Extinctions

Mass extinctions are sudden, large-scale events in Earth's history that lead to the widespread loss of species. They are usually caused by drastic environmental changes like asteroid impacts, volcanic eruptions, or climate shifts. These events have reshaped life on Earth multiple times, with five major mass extinctions recorded so far.

The Five Major Mass Extinctions

S.No	Name	Period (Million Years Ago)	Era / Period	Probable Causes	Estimated Species Lost	Majorly Affected Groups
1.	**Ordovician–Silurian**	445 MYA	Late Ordovician	Glaciation, sea-level fall, climate change	~85%	Marine species (trilobites, brachiopods)
2.	**Late Devonian**	375–360 MYA	Devonian	Ocean anoxia, asteroid impact, climate shift	~75%	Marine species (corals, jawless fish)
3.	**Permian–Triassic**	252 MYA	End of Paleozoic `	Volcanism (Siberian Traps), global warming, methane release	~96%	Marine invertebrates, insects, amphibians
4.	**Triassic–Jurassic**	201 MYA	Late Triassic	Volcanic activity, climate change, rising CO_2	~80%	Reptiles, amphibians, marine life