Aravallis

The Aravalli Range is a mountain range in western India running approximately 692 km (430 mi) in a northeastern direction across the Indian states of Gujarat, Rajasthan, and Haryana, ending in Delhi. The range rises to an average elevation of 300–900 metres (980–2,950 ft) above sea level, with the highest point being Mount Abu at 1,722 metres (5,650 ft). The Aravallis are the oldest mountain range in India, dating back over 1.4 billion years.

Aravalli Range mountain range

The Aravallis are a vital ecological zone in India, providing habitat for a variety of flora and fauna. The range is also home to a number of important cultural and historical sites, including the forts of Jaigarh, Amer, and Kumbhalgarh.

The Aravallis play an important role in the climate of India. The range helps to block the Thar Desert from spreading further east, and it also helps to trap monsoon rains, which are essential for agriculture in the region.

The Aravallis are a popular tourist destination, offering a variety of activities such as trekking, camping, and visiting historical sites. Some of the most popular tourist destinations in the Aravallis include:

- Mount Abu: A hill station in Rajasthan known for its beautiful scenery and ancient temples.
- Udaipur: A city in Rajasthan known for its lakes, palaces, and forts.
- Jaipur: A city in Rajasthan known for its pink buildings and forts.
- Kumbhalgarh: A fort in Rajasthan known for its massive walls and massive ramparts.

- Ranthambore National Park: A national park in Rajasthan known for its tiger population.

The Aravallis are an important part of the Indian landscape and culture. The range provides a variety of ecological, cultural, and economic benefits to the region.

Proterozoic mobile belts

Proterozoic mobile belts are linear zones of intense deformation and magmatism that formed during the Proterozoic Eon (2.5 billion to 541 million years ago). They are typically found along the margins of Archean cratons, which are much older and more stable regions of continental crust.

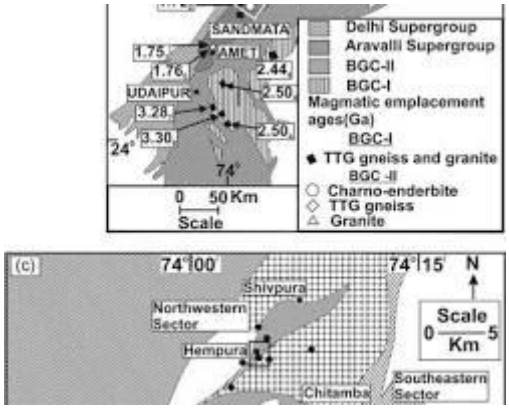
Proterozoic mobile belts are thought to have formed as a result of a variety of tectonic processes, including:

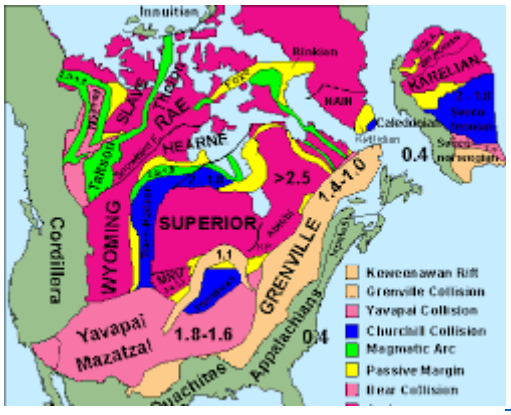
- Continental collisions: When two continents collide, the crust is compressed and thickened, leading to mountain building and deformation.
- Rifting: When a continent rifts apart, the crust is thinned and stretched, leading to volcanism and faulting.
- Subduction: When a denser oceanic plate slides beneath a less dense continental plate, the oceanic plate melts and produces magma. This magma can rise to the surface and erupt, forming volcanoes.

Proterozoic mobile belts are important because they contain a wealth of information about the early history of Earth. They can provide insights into the processes of mountain building, continental rifting, and subduction. Additionally, Proterozoic mobile belts are often home to valuable mineral resources, such as gold, copper, and iron ore.

Here are some examples of Proterozoic mobile belts from around the world, along with pictures:

- Aravalli-Delhi Mobile Belt (India): This mobile belt formed as a result of the collision of the Aravalli Craton with the Bundelkhand Craton. It contains a variety of rock types, including metasedimentary rocks, volcanic rocks, and granites.

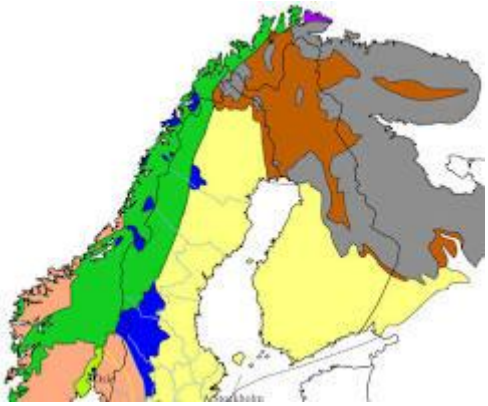


- Trans-Hudson Orogen (Canada): This orogen formed as a result of the collision of the North American Craton with the Greenland Craton. It contains a variety of rock types, including metasedimentary rocks, volcanic rocks, and plutons.
- 

Central African Copperbelt (Africa): This mobile belt formed as a result of rifting and subduction. It contains a variety of rock types, including metasedimentary rocks, volcanic rocks, and intrusive rocks. The copperbelt is home to some of the world's largest copper deposits.

Baltic Shield (Europe): The Baltic Shield is a large cratonic region that contains a number of Proterozoic mobile belts. These mobile belts formed as a

result of a variety of tectonic processes, including continental collisions, rifting, and subduction.



Proterozoic mobile belts are fascinating and important geological features. They provide insights into the early history of Earth and are home to a variety of valuable mineral resources.

Stratigraphy of Cuddapah and Vindhyan Basins

Cuddapah Basin

The Cuddapah Basin is a crescent-shaped sedimentary basin located in the south-central part of Andhra Pradesh and Telangana, India. It is one of the largest Proterozoic basins in the world, covering an area of about 44,500 sq km. The basin is bounded by the Archaean gneisses to the west and north, and by the Eastern Ghats to the east.

The Cuddapah Supergroup, which fills the Cuddapah Basin, is a thick sequence of sedimentary rocks that were deposited over a period of about 1 billion years, from about 1.8 to 0.8 billion years ago. The Supergroup is divided into three groups:

- Papaghni Group: The basal Papaghni Group consists of a thick sequence of quartzites, shales, and conglomerates. It is interpreted to represent a shallow marine transgressive sequence.
- Chitravati Group: The Chitravati Group consists of a sequence of limestones, shales, and dolomites. It is interpreted to represent a deeper marine environment.

- Nallamalai Group: The Nallamalai Group consists of a sequence of quartzites, shales, and minor limestones. It is interpreted to represent a shallow marine to continental environment.

The Cuddapah Supergroup is unconformably overlain by the Kurnool Group, which is a sequence of Upper Proterozoic to Cambrian sedimentary rocks.

	Group	Formation	Thickness (in m)	Age
	Kurnool Group	Nandyal Shale	56-100	Neoproterozoic
		Koilkuntala Limestone	15-50	
		Paniam Quartzite	10-35	
		Auk Shale	10-35	
		Narji Limestone	100-200	
		Banganapalle Quartzite	10-57	
	-Unconformity-			
ergroup	Nallamalai Group	Srisailam Quartzite	620(+)	Meso-proterozoic (~1500 Ma)
		Cumbum Formation	2000(+)	
		Bairenkonda (Nagari) Quartzite	1500	
	-Unconformity-			

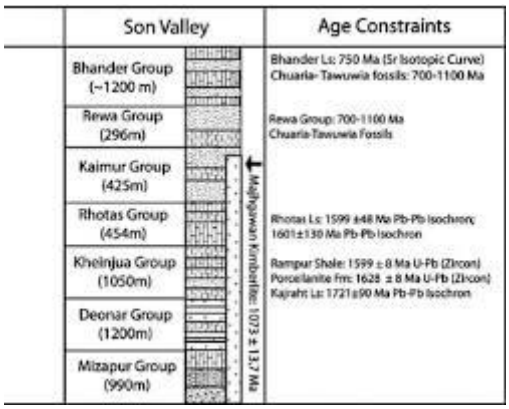
Vindhyan Basin

The Vindhyan Basin is a large sedimentary basin located in central India. It is bounded by the Aravalli Range to the west, the Bundelkhand Granite to the north, and the Satpura Range to the south.

The Vindhyan Supergroup, which fills the Vindhyan Basin, is a thick sequence of sedimentary rocks that were deposited over a period of about 500 million years, from about 1.5 to 0.9 billion years ago. The Supergroup is divided into two groups:

- Lower Vindhyan Group: The Lower Vindhyan Group consists of a sequence of sandstones, shales, and limestones. It is interpreted to represent a shallow marine environment.
- Upper Vindhyan Group: The Upper Vindhyan Group consists of a sequence of quartzites, sandstones, and shales. It is interpreted to represent a continental environment.

The Vindhyan Supergroup is unconformably overlain by the Gondwana Supergroup, which is a sequence of Late Paleozoic to Mesozoic sedimentary rocks.



Economic Importance

The Cuddapah and Vindhyan Basins are economically important for a variety of mineral resources, including:

- Cuddapah Basin: barytes, asbestos, steatite, diamonds, phosphorite, uranium, and building and ornamental stones.
- Vindhyan Basin: bauxite, iron ore, limestone, and building stones.

Conclusion

The Cuddapah and Vindhyan Basins are two of the most important Proterozoic sedimentary basins in India. They host a thick sequence of sedimentary rocks that contain a variety of important mineral resources.

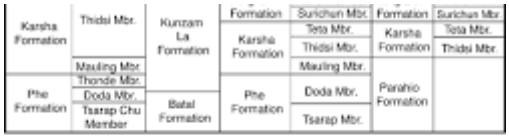
Stratigraphy of the Paleozoic of Spiti

The stratigraphy of the Paleozoic of Spiti and Kashmir is one of the most complete and well-studied in India. The rocks span the entire Paleozoic era, from the Cambrian to the Permian, and contain a rich fossil record that provides insights into the region's paleogeography and paleoclimate.

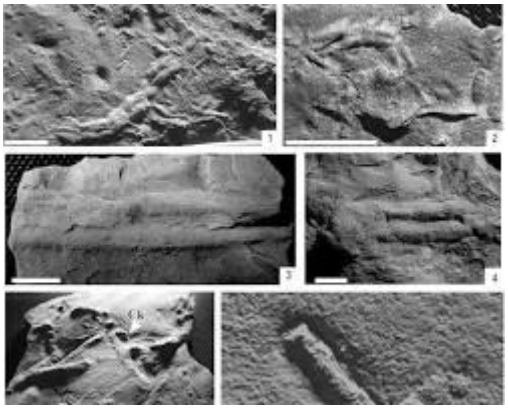
Stratigraphy of the Paleozoic of Spiti

The Paleozoic succession of Spiti is divided into the following groups:

- Haimanta Group (Cambrian): This group consists of a thick sequence of greenish grey shales, siltstones, slates, quartzites, and dolomites. It contains a diverse fossil assemblage of trilobites, brachiopods, and other marine invertebrates.

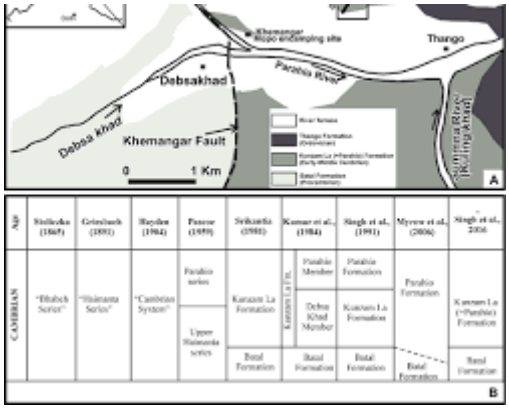


- Kunzam La Formation (Cambrian): This formation consists of a sequence of greywackes, sandstones, and shales with intercalated limestones. It contains fossils of trilobites, brachiopods, and cephalopods.



- Lipak Formation (Ordovician): This formation consists of a sequence of limestones, shales, and quartzites. It contains fossils of brachiopods, gastropods, bivalves, and cephalopods.

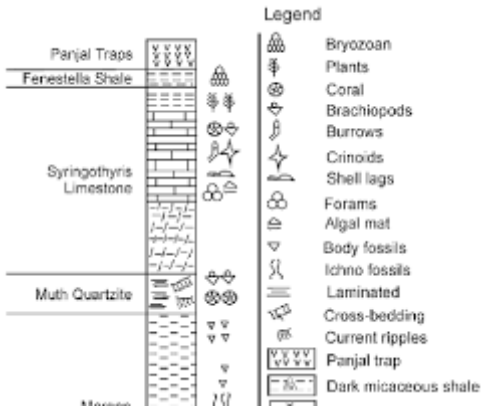
-  Parahio Formation (Silurian): This formation consists of a sequence of shales, siltstones, and quartzites with intercalated limestones. It contains fossils of brachiopods, gastropods, bivalves, and cephalopods.



- Muth Formation (Devonian): This formation consists of a sequence of limestones, shales, and quartzites. It contains fossils of brachiopods, gastropods, bivalves, cephalopods, and corals.

Fig. 2.5: View from the right side of the Pin River towards the NW to village Math.

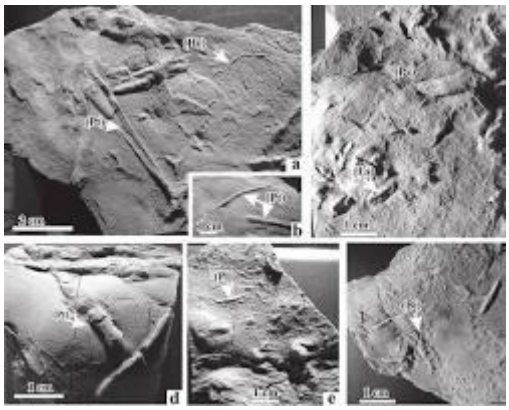
- Syringothyris Limestone (Devonian): This formation consists of a sequence of grey to dark blue limestones with bands of shales, quartzites, and traps. It contains fossils of brachiopods, bivalves, algae, corals, bryozoans, and conodonts.



- Gungri Formation (Carboniferous): This formation consists of a sequence of shales, siltstones, and sandstones with intercalated limestones. It

contains fossils of brachiopods, bivalves, gastropods, cephalopods, and corals.

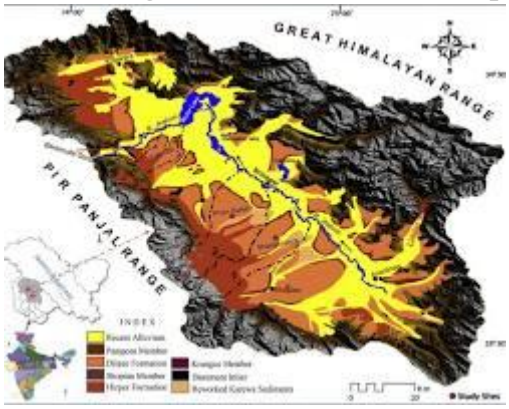
- Po Formation (Permian): This formation consists of a sequence of limestones, shales, and sandstones. It contains fossils of brachiopods, bivalves, gastropods, cephalopods, corals, and conodonts.



Stratigraphy of the Paleozoic of Kashmir

The Paleozoic succession of Kashmir is divided into the following groups:

Panjal Group (Cambrian-Permian): This group consists of a thick sequence of shales, siltstones, sandstones, and limestones. It contains a diverse fossil assemblage of trilobites, brachiopods, bivalves,



- Zewan Group (Permian): This group consists of a sequence of limestones, shales, and calcareous sandstones. It contains fossils of brachiopods, bivalves, bryozoans, corals, ammonoids, crinoids, and conodonts.

Paleogeography and Paleoclimate

The stratigraphy of the Paleozoic of Spiti and Kashmir suggests that the region was once a part of a vast Tethys Ocean that extended from the Atlantic Ocean to the Pacific Ocean. The region was also home to a variety of marine ecosystems, including shallow seas, reefs, and deep-sea basins.

The fossil record also provides insights into the paleoclimate of the region. For example, the occurrence of coral reefs in the Devonian and Permian periods suggests that the climate was warm and tropical during those times.

The stratigraphy of the Paleozoic of Spiti and Kashmir is one of the most complete and well-studied in India. The rocks span the entire Paleozoic era and contain a rich fossil record that provides insights into the region's paleogeography and paleoclimate.

- cephalopods, corals, and conodonts.

Stratigraphy of Mesozoic of Spiti and Kashmir

Introduction

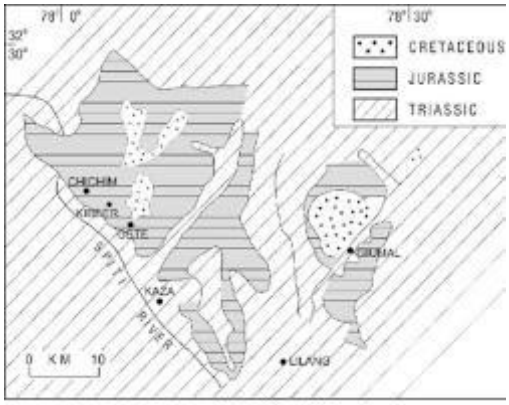
Spiti and Kashmir are two regions in the northwestern Himalayas of India that are known for their well-preserved and well-studied Mesozoic successions. These successions provide a valuable record of the geological history of the region and the evolution of life during the Mesozoic Era.

Stratigraphy

The Mesozoic successions of Spiti and Kashmir can be divided into three main eras: Triassic, Jurassic, and Cretaceous.

Triassic

The Triassic rocks of Spiti and Kashmir are dominated by marine limestones and shales. The most important formations include the Thakkhola Formation, the Lilang Group, and the Kuling Group. The Thakkhola Formation is a thick sequence of limestones and shales that contains a variety of Triassic fossils, including ammonites, bivalves, and brachiopods. The Lilang Group is a sequence of shales and siltstones that is known for its Triassic dinosaur fossils, such as plateosaurus and prosaurolophus. The Kuling Group is a sequence of limestones and shales that contains a variety of Triassic fossils, including ammonites, bivalves, and brachiopods.

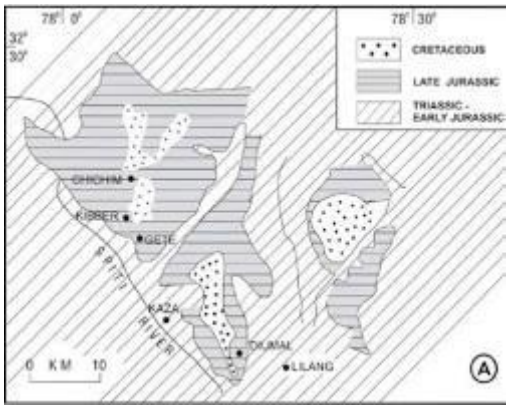


Jurassic

The Jurassic rocks of Spiti and Kashmir are also dominated by marine limestones and shales. The most important formations include the Spiti Shales, the Kioto Limestone, and the Tagling Limestone. The Spiti Shales are a thick sequence of shales and siltstones that contains a variety of Jurassic fossils, including ammonites, bivalves, and brachiopods. The Kioto Limestone is a sequence of limestones that is known for its Jurassic dinosaur fossils, such as sauropods and theropods. The Tagling Limestone is a sequence of limestones and shales that contains a variety of Jurassic fossils, including ammonites, bivalves, and brachiopods.

Cretaceous

The Cretaceous rocks of Spiti and Kashmir are dominated by marine sandstones and shales. The most important formations include the Chikkim Formation and the Giumal Sandstone. The Chikkim Formation is a sequence of sandstones and shales that contains a variety of Cretaceous fossils, including ammonites, bivalves, and brachiopods. The Giumal Sandstone is a sequence of sandstones that is known for its Cretaceous dinosaur fossils, such as titanosaurs and hadrosaurs.



Significance

The Mesozoic successions of Spiti and Kashmir are significant for a number of reasons. First, they provide a valuable record of the geological history of the region. The region was once covered by the Tethys Sea, and the Mesozoic rocks record the opening and closing of this seaway. Second, the Mesozoic successions of Spiti and Kashmir are known for their well-preserved fossils. These fossils provide important insights into the evolution of life during the Mesozoic Era The Mesozoic successions of Spiti and Kashmir are a valuable geological resource. They provide a record of the geological history of the region and the evolution of life during the Mesozoic Era. The successions are

also well-preserved and well-studied, making them an important destination for geologists and paleontologists from around the world.

The Gondwana Supergroup

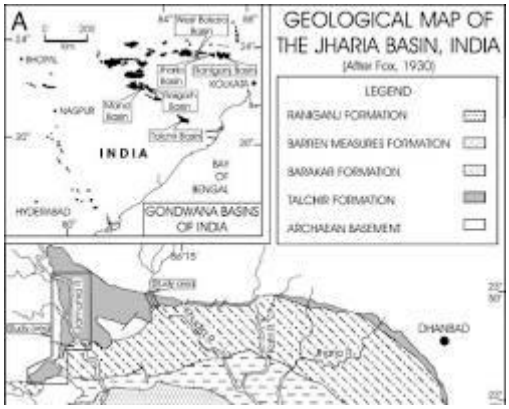
The Gondwana Supergroup is a sequence of sedimentary and volcanic rocks that were deposited in India and other parts of Gondwana, a former supercontinent, during the late Paleozoic and Mesozoic eras. It is one of the most important geological units in India, as it contains the country's vast coal resources.

The Gondwana Supergroup is classified into three groups: Lower Gondwana, Middle Gondwana, and Upper Gondwana.

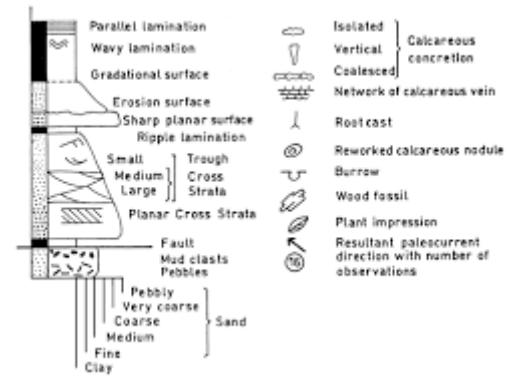
Lower Gondwana Group

The Lower Gondwana Group is of Permo-Carboniferous age and is characterized by glacial and periglacial deposits. It is composed of the following formations:

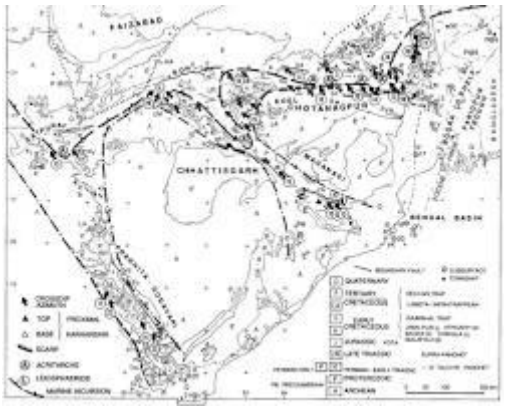
- Talchir Formation: This formation is composed of tillites, conglomerates, and sandstones. It represents the glacial period that occurred at the end of the Carboniferous era.



- Barakar Formation: This formation is composed of sandstones, shales, and coal seams. It represents the fluvio-deltaic environment that existed after the glacial period.



- Karharbari Formation: This formation is composed of shales, sandstones, and coal seams. It represents the transitional environment between the glacial and fluvio-deltaic environments.



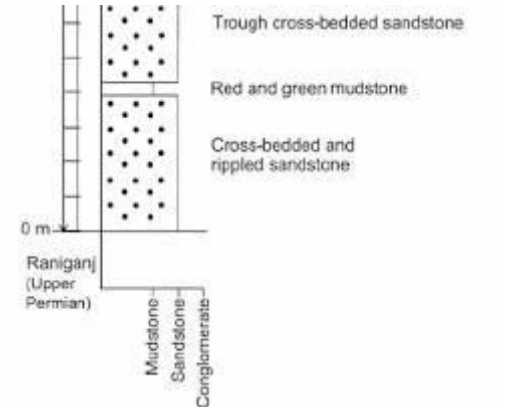
Middle Gondwana Group

The Middle Gondwana Group is of Permian age and is characterized by terrestrial deposits. It is composed of the following formations:

- Raniganj Formation: This formation is composed of sandstones, shales, and coal seams. It represents the fluvio-deltaic environment that existed in the Permian era.

	Major lithology
	Sand, clay and limestone
atrappeans	Dolerite, mica peridotite dykes and sills
	Sandstone and shales
	Medium- to coarse-grained feldspathic sand
	Fine- to medium-grained sandstone, sandy c coal seams, siltstone, and carbonaceous sh
	Carbonaceous shales containing nodules of
	Massive sandstones and grits with shale bed
	Tillites to boulder conglomerate, yellowish
with	Granites, granitic gneiss, hornblend schist tr patches of amphibolite, pegmatite, and vei

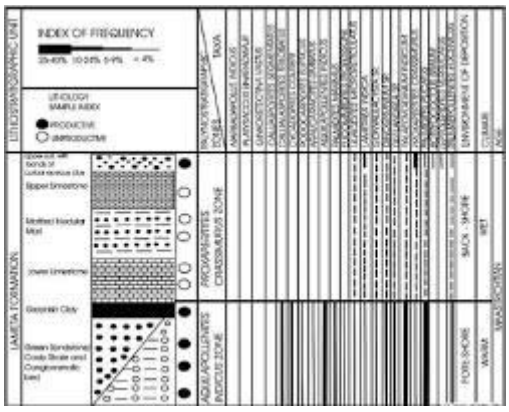
- Panchet Formation: This formation is composed of sandstones, shales, and conglomerates. It represents the fluvio-deltaic and alluvial plain environments that existed in the late Permian era.



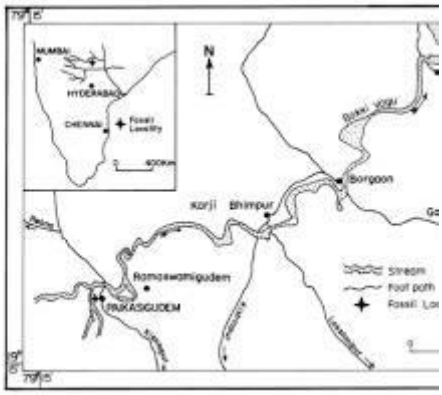
Upper Gondwana Group

The Upper Gondwana Group is of Triassic to Early Cretaceous age and is characterized by terrestrial and lacustrine deposits. It is composed of the following formations:

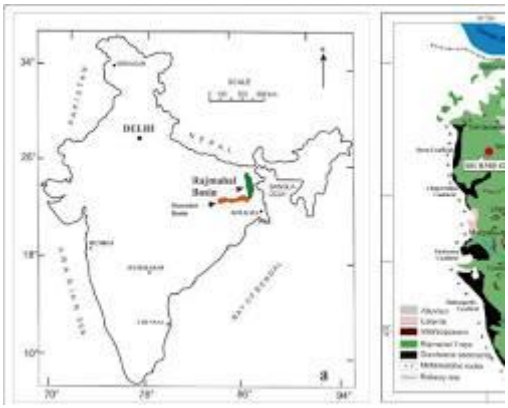
- Jabalpur Formation: This formation is composed of sandstones, shales, and conglomerates. It represents the fluvio-deltaic and alluvial plain environments that existed in the Triassic era.



- Kotra Formation: This formation is composed of limestones, shales, and sandstones. It represents the lacustrine environment that existed in the Triassic era.



- Rajmahal Formation: This formation is composed of lava flows, sandstones, and shales. It represents the volcanicand fluvio-deltaic environments that existed in the Jurassic era.



The Gondwana Supergroup is of great economic importance, as it contains India's vast coal resources. Coal is found in the Lower Gondwana Group, particularly in the Barakar Formation. The Gondwana Supergroup also contains other minerals, such as iron ore, bauxite, and copper ore.

The Gondwana Supergroup is also of great paleontological importance, as it contains fossils of plants and animals that lived during the late Paleozoic and Mesozoic eras. Some of the important fossils that have been found in the Gondwana Supergroup include:

- Plants: Glossopteris, Gangamopteris, Dicroidium, Lepidopteris, Ptylophylum
- Animals: Lystrosaurus, Kannemeyeria, Gondwanosaurus, Malawisaurus, Indosuchus

The Gondwana Supergroup is a fascinating and important geological unit that provides insights into the Earth's history and resources.

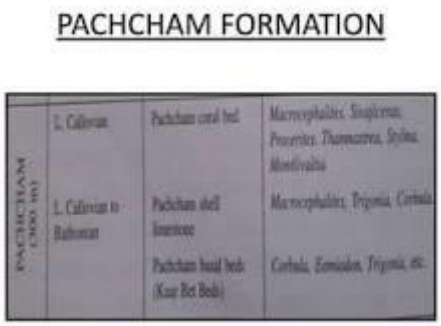
Jurassic succession of Kutch

The Jurassic succession of Kutch, India, is one of the most well-studied and well-exposed in the world. It represents a continuous record of marine sedimentation from the Middle Jurassic to the Lower Cretaceous, and contains a rich assemblage of fossils.

The Jurassic rocks of Kutch are divided into three main formations: the Chari Formation, the Bhuj Formation, and the Umia Formation.

Chari Formation

The Chari Formation is the oldest of the three formations, and is of Middle Jurassic age (Bajocian-Bathonian). It is composed of a sequence of marine shales, limestones, and sandstones. The Chari Formation is known for its rich ammonite fauna, which has been used to correlate the Jurassic succession of Kutch with other parts of the world.



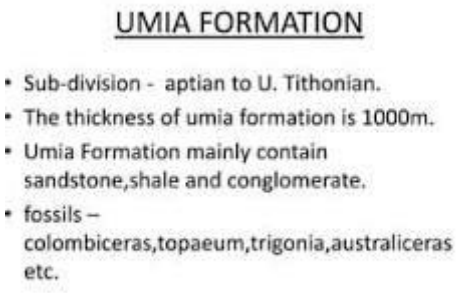
Bhuj Formation

The Bhuj Formation is of Late Jurassic age (Callovian-Kimmeridgian). It is composed of a sequence of marine limestones, shales, and sandstones. The Bhuj Formation is known for its dinosaur fossils, including the sauropods *Giraffatitan brancai* and *Barapasaurus africanus*.

Stage	Formation	Lithology
Valanginian–Albian	Bhuj (815 m)	Alternations of cross-bedded sandstone and shale containing abundant fossil content in places
Kimmeridgian–Tithonian	Jhuran (760 m)	Predominantly sandstone-shale alternations; Sandstone bed thicknesses increase upwards
Oxfordian	Jhumara (275 m)	Olive-gray, laminated shale alternating with oolitic limestone; Occasional sandstone interbeds
Callovian	Jhurio (290 m)	Shale interbedded with golden oolitic limestone
Bathonian		
Precambrian basement		

Umia Formation

The Umia Formation is the youngest of the three formations, and is of Berriasian-Valanginian age (Early Cretaceous). It is composed of a sequence of continental sandstones, shales, and limestones. The Umia Formation is known for its dinosaur fossils, including the theropods *Torvosaurus tanneri* and *Rajasaurus narmadensis*.



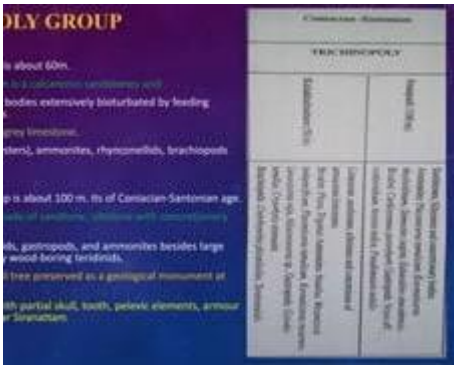
The Jurassic succession of Kutch is important for several reasons. First, it provides a continuous record of marine sedimentation from the Middle Jurassic to the Lower Cretaceous. Second, it contains a rich assemblage of fossils, including dinosaurs, ammonites, and other marine invertebrates. Third, it has been used to correlate the Jurassic succession of Kutch with other parts of the world.

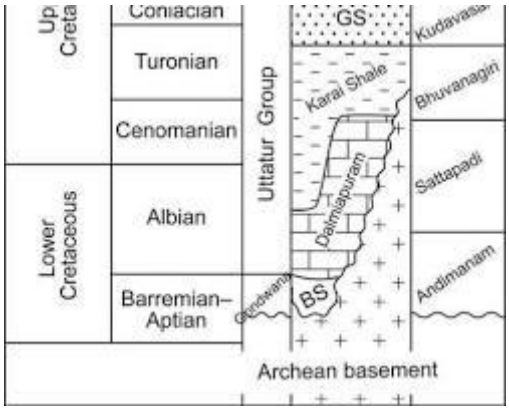
The Jurassic succession of Kutch is a popular tourist destination, and there are several museums in the area that display fossils from the Jurassic period.

Cretaceous of Trichinopoly

The Cretaceous of Trichinopoly (now Tiruchirapalli) is a geological formation in India that dates back to the Late Cretaceous period, about 70 million years ago. It is one of the most important fossil localities in India, and has yielded a wide variety of fossils, including dinosaurs, marine reptiles, terrestrial vertebrates, invertebrates, and plants.

The Cretaceous rocks of Trichinopoly are divided into two main groups: the Uttatur Group and the Trichinopoly Group. The Uttatur Group consists of sandstones and shales, and is thought to have been deposited in a coastal environment. The Trichinopoly Group consists of limestones and shales, and is thought to have been deposited in a marine environment.





Some of the most important dinosaur fossils that have been found in the Cretaceous of Trichinopoly include:

- Titanosaurus indicus: This was a large sauropod dinosaur, about 30 meters long. It was one of the first dinosaurs to be discovered in India.

- Rajasaurus narmadai: This was a theropod dinosaur, about 9 meters long. It was a carnivore, and is thought to have been a top predator in its ecosystem.
- Isisaurus colberti: This was a small ceratosaur dinosaur, about 2 meters long. It is thought to have been a predator of small animals, such as lizards and mammals.

In addition to dinosaurs, the Cretaceous of Trichinopoly has also yielded a variety of other fossils, including:

- Marine reptiles: Mosasaurs, plesiosaurs, and ichthyosaurs have all been found in the Cretaceous rocks of Trichinopoly.
- Terrestrial vertebrates: Crocodiles, turtles, and lizards have also been found.
- Invertebrates: Ammonites, bivalves, and gastropods are all common fossils in the Cretaceous rocks of Trichinopoly.
- Plants: Ferns, cycads, and conifers are all common plant fossils in the Cretaceous rocks of Trichinopoly.

The Cretaceous of Trichinopoly is a valuable source of information about the life and environment of India during the Late Cretaceous period. The fossils that have been found there provide us with insights into the diversity of dinosaurs and other animals that lived in India at the time, as well as the climate and geography of the region.

Tertiary and Quaternary sequences of Assam

The Tertiary and Quaternary sequences of Assam represent a significant period of geological history, spanning from 65 million years ago to the present day. These sequences are composed of a variety of sedimentary rocks, including sandstones, shales, limestones, and coals, which were deposited in a variety of environments, including marine, fluvial, and lacustrine settings.

The Tertiary sequence in Assam is divided into two main units: the Lower Tertiary (Paleocene to Eocene) and the Upper Tertiary (Oligocene to Pliocene). The Lower Tertiary unit is dominated by marine sandstones and shales, while the Upper Tertiary unit is dominated by continental sandstones, shales, and coals.

The Quaternary sequence in Assam is also divided into two main units: the Pleistocene and the Holocene. The Pleistocene unit is dominated by fluvial sands and gravels, while the Holocene unit is dominated by alluvial deposits.

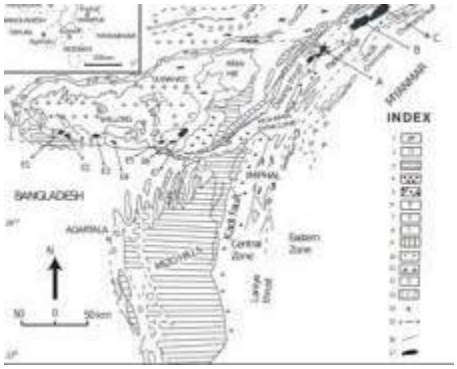
Tertiary Sequences of Assam

- Barail Group (Eocene): The Barail Group is a sequence of marine sandstones and shales that is exposed in the eastern part of the Assam Basin. It is known for its rich fossil content, including dinosaurs, turtles, and crocodiles.

				lignite sand
Unconformity				
Miocene sequence	Tipam	Girujan Clay	100-2300	Mottled clay with sandstone lenses
		Tipam (Upper Sandstone)	300-500	Essentially arenaceous sequence
		(Middle Sandstone)	100-200	Sand/Shale alteration sequence
		(Lower Sandstone)	100-200	Arenaceous
	Surmas[2]	Not subdivided		Sandstone with shale & grit bed
Unconformity Not subdivided				
Oligocene	Barail		500-1200	(Upper Part: Mudstone/ shale with sandstone beds and coal bands (Argillaceous sequence)
		Kopili	280-500	(Lower Part: Sandstone with shale bands (Arenaceous sequence) splintery shales

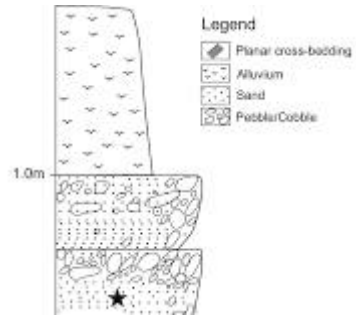
Kopili Formation (Oligocene-Miocene): The Kopili Formation is a sequence of continental sandstones, shales, and coals that is exposed in the central part of the Assam Basin. It is a major source of coal for the region.

- Disang Group (Pliocene): The Disang Group is a sequence of continental sandstones, shales, and conglomerates that is exposed in the western part of the Assam Basin. It is known for its red-colored rocks and its rich fossil content, including mammals, reptiles, and amphibians.



Quaternary Sequences of Assam

- Dihing Formation (Pleistocene): The Dihing Formation is a sequence of fluvial sands and gravels that is exposed in the northern part of the Assam Basin. It is a major source of sand and gravel for the region.



- Alluvium (Holocene): The alluvium is a sequence of unconsolidated sediments that is deposited by rivers and streams. It covers most of the Assam Valley and is a major source of fertile soil for agriculture.

Economic Importance of Tertiary and Quaternary Sequences of Assam

The Tertiary and Quaternary sequences of Assam are of significant economic importance. The coal deposits of the Kopili Formation are a major source of energy for the region. The oil and gas fields of the Upper Assam Basin are also

important sources of energy. The fertile soils of the Assam Valley are used to cultivate a variety of crops, including rice, wheat, and tea.

The Tertiary and Quaternary sequences of Assam also have a rich cultural heritage. The fossil content of these sequences provides valuable insights into the past life and environment of the region. The archaeological sites of Assam, such as the ruins of Pragjyotishpura, also provide valuable insights into the region's history and culture.

Fossil contents	Age
Calcareous shale and argillaceous limestone contain molluscs and rich assemblage of foraminifera. Coal contains microflora	Late Eocene
Highly fossiliferous throughout its entire thickness. Floral and faunal elements present. Foraminifera are dominant	Middle to late Middle Eocene
Apparently devoid of faunal remains. Carbonaceous shale and coal contain microflora	Early to early Middle Eocene