CAS in Geology, University Of Lucknow, Lucknow

Evolution and Tectonic subdivisions of Himalaya

Elective Sem-IV Lecture 2

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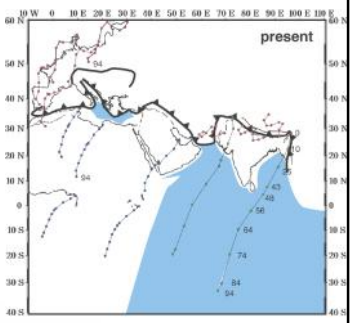
Introduction

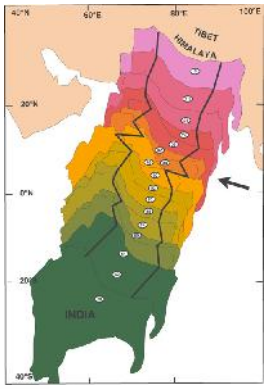
- It is an arcuade mountain chain, having an east west extent of about 2400 Km.
- The Himalayan range is one of the youngest mountain ranges on the planet and consists mostly of uplifted sedimentary and metamorphic rock.
- It is formed by the Continent-Continent collision of the Indian and Eurasian plates.
- Due to continued seismic movements this part of the Indian subcontinent is seismically active.

Tectonic evolution of Himalaya

- India was initially a part of the Gondwanaland, and was placed in the Southern Hemisphere.
- At about 94 Ma, it was detatched from Gondwanaland and it started moving northwards (NNE).

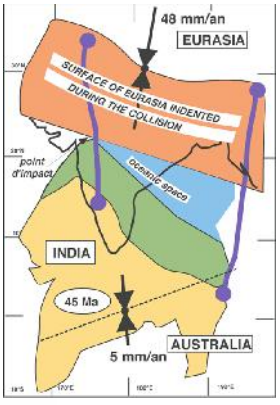


- The Northward movement was somewhat zigzag, and it continued from another 45 Ma, until the Indian plate collided with the Eurasian plate in the North.
- At about 50 Ma soft collision took place and the two plates continued moving leading to a hard collision taking place at about 25 Ma leading to formation of the Himalaya.



(Patriat and Achache,1984)

The speed of Indo-Australian plate was about 5mm/an, while that of the Eurasian plate was about 48mm/an whaen the soft collison took place at about 45-50 Ma.

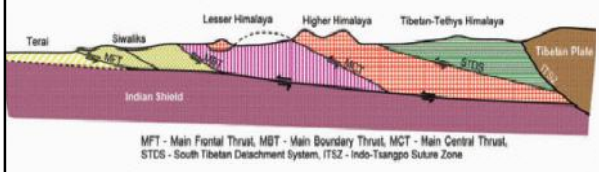


Le Pichon et al. 1993

Tectonic Subdivisions of Himalaya

- There are 5 tectonic subdivisions of the Himalaya

a. Outer Himalaya
b. Lesser Himalaya
c. Central Crystallines
d. Higher Himalaya
e. Tethys Himalaya



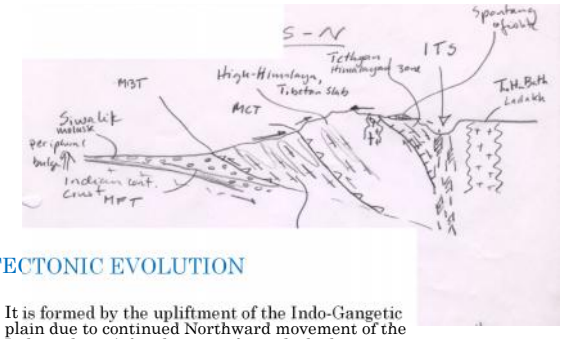
MFT - Main Frontal Thrust, MBT - Main Boundary Thrust, MCT - Main Central Thrust, STDS - South Tibetan Detachment System, ITSZ - Indo-Tsangpo Suture Zone

- The Himalayan Frontal Fault (HFT) is present between the Ganga plain and the Outer Himalaya.
- Main Boundary Fault (MBT) separates the Outer Himalaya from the Lesser Himalaya.
- Between Lesser Himalaya and Central Crystallines MCT is present.
- Martoli fault marks the boundary between Central Crystallines and Higher Himalaya.
- The Indus-TsangPo Suture Zone (ITSZ) is present between the Higher Himalayas and Tethys Himalaya.

All the Himalayan Thrusts are North dipping except ITSZ which is South dipping.

Outer Himalaya

- It is the Southern most tectonic division of the Himalaya.
- In the South of Outer Himalaya Indo-Gangetic plain is present.
- The average height of Siwaliks is about 1000m.
- Vertebrate fossils have been reported from this part of Himalaya.
- It comprises of lithified fluvial sediments. Siltstones ans sandstones form the major lithology and intercalated bands of shale are common.
- The age of Siwaliks is Middle Miocene to Lower Pleistocene.



TECTONIC EVOLUTION

- It is formed by the upliftment of the Indo-Gangetic plain due to continued Northward movement of the Indian plate. A foredeep was formed which was filled with freshwater sediments and was later uplifted to form siwaliks.

Lesser Himalaya

- It is located in the North of The Outer Himalayas and is separated from the Outer Himalaya and the Central Crystalline in the South and North by the MBT and MCT respectively.
- Its average height is about 4000 m.
- It consists exclusively of marine sediments.
- A number of crystalline units are present as inliers in the Lesser Himalayas, like the Almora crystallines, Baijnath crystallines, etc.
- AGE: Precambrian-Cambrian with 3 transgressive events 1. Permian 2. Cretaceous 3. Eocene

- The Lesser Himalaya is divided into 2 regions, in the South it is called as 'Outer Sedimentary Belt' and in the North it is called 'Inner Sedimentary Belt'.
- The Outer sedimentary belt is believed to be younger than the inner sedimentary belt.
- The Inner sedimentaries are dominated by the Calcareous lithologies while the Outer sedimentary belt consists of 5 lithounits- Jaunsar group, Blaini group, Infra-Krol, Krol and Tal group which consist mainly of terrigenous clastics.

CRYSTALLINE UNITS

- The Lesser Himalayan Crystalline units are also having thrusted contact with the sedimentary belt. These are metamorphic units primarily having granites, gneisses and Quartzites.
- EVOLUTION

Several models have been given for tectonic evolution of the crystalline units

a. As a recumbent fold limb of the Central Crystallines.
b. As thrust sheet derived from the Central Crystallines
c. As para-autochthonus block squeezed out from the basement.

Higher Himalaya

- It is also known as the Central Crystallines.
- This is a completely crystalline unit of Himalaya.
- It is bounded by the MCT in the South and by Martoli Fault in the North.
- It is highly folded unit and are considered to be the oldest rock unit of Himalaya ranging between 1800- 1000 Ma.
- There is very strong similarity in the rock type of Higher Himalaya and the inliers in the Lesser Himalayan belt, both comsisting of gneisses, Quartzites, Schists, etc.

Tethys Himalaya

- These rocks range in age from Cambrian to Cretaceous.
- Exclusively marine rocks, abundant in micro fossils.
- The sediments here are believed to be the remanant of Tethys sea that existed between Indian and Eurasian continental lithospheres.
- The tectonic contact with Higher Himalaya is the Martoli Fault in the South and in the North it is bounded by the Indo-TsangPo suture Zone.

ITSZ

- The Indus TsangPo suture zone shows the presence of Ophiolites which is the obducted Oceanic crust.
- Along this suture zone occurs exotic rocks known as 'exotic blocks of mallazohar' which is a mixture of Dunite, Felspathic Quartzarenite, silicious oozes with radiolarian fossils suggesting subduction.
- In the north of ITSZ Tibetian plateau is present.

Conclusions

- The Himalayan mountain chain is one of the youngest in the world.
- The lithology and rock type is highly variable throughout and this variation suggests that a variety of processes were involved in the evolution, such as subduction, thrusting, various phases of sedimentation, etc.
- The Himalayas contain the third-largest deposit of ice and snow in the world, after Antarctica and the Arctic. The Himalayan range encompasses about 15,000 glaciers, which store about 12,000 km3 (3,000 cubic miles) of fresh water.