Quaternary Geology

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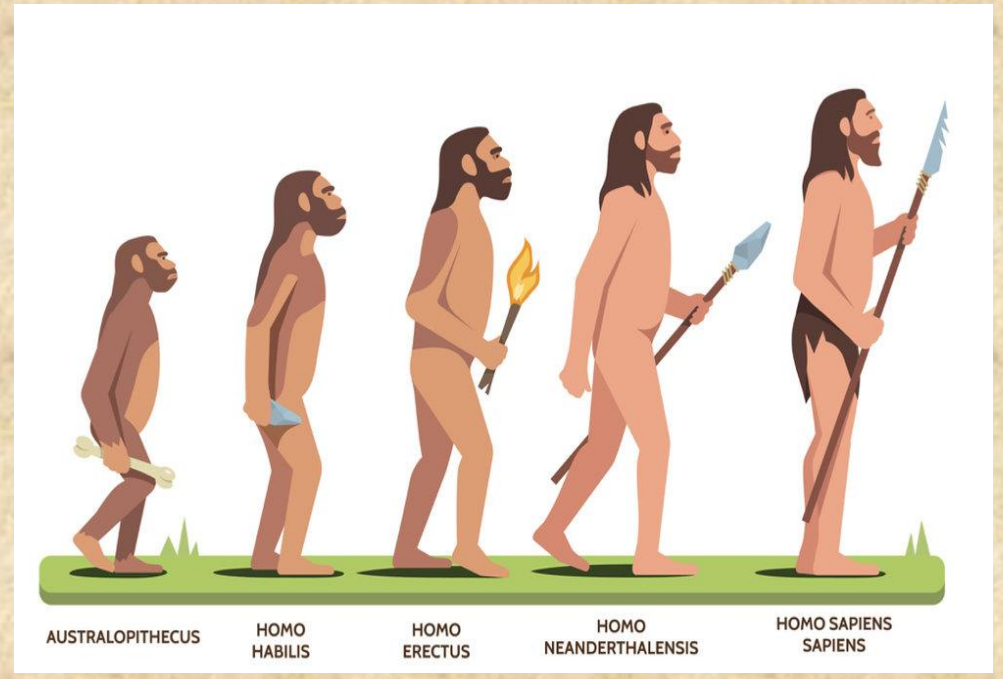

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Course outline

- **Part-I**
  - Quaternary: Concept and Development
- **Part-II**
  - Quaternary Stratigraphy – Madhupur Area
  - Quaternary Stratigraphy – Sylhet Region
  - Quaternary Stratigraphy – Mymensingh Area
  - Quaternary Stratigraphy – Panchagarh Area
  - Quaternary Stratigraphy – Barind Tract Area
- **Part-III**
  - Pedological Studies
  - Paleomagnetism and Rock Magnetism
  - Paleosoil and Micromorphology
  - Mineralogical and Sedimentological
  - Correlation of Quaternary Deposits

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Mineralogy and Sedimentology

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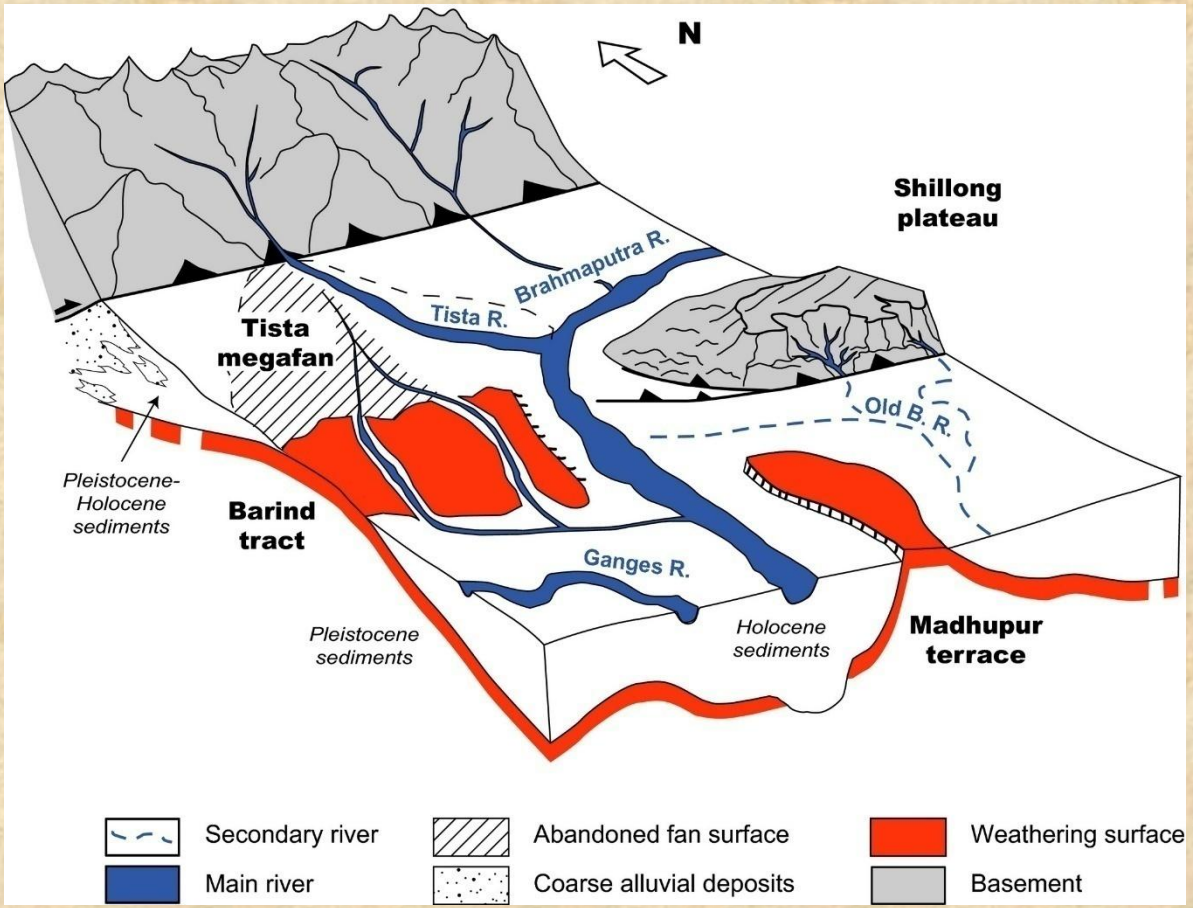

Talk outline

- Heavy mineral Studies
- Clay Mineral Studies
- Sedimentological Studies

Heavy Mineral studies

- Heavy mineral studies of Madhupur and Barind Formations were carried out by Hassan (1986) and Monsur (1990).

- The main objectives of the heavy minerals studies were:
  i) to correlate different stratigraphic units and subunits of the Madhupur and Barind Formations,
  ii) to characterize the Quaternary sediments in terms or heavy mineral associations and
  iii) to infer the provenance of the Pleistocene sediments.

Heavy Mineral studies

- Some common characteristics of heavy mineral assemblages in the different lithostratigraphic units of the different areas can be found (Monsur, 1990) :

a) the abundance of garnet separates the Basabo Formation from the underlying Madhupur Formation.

b) Homogeneous distribution of green and brown hornblende is the striking characteristics of both the Basabo and Chalanbil Formations.

c) the unavailability of biotitic mica and abundance of opaque minerals are the striking characteristics of the upper Members of both the Madhupur and Barind Formations.

d) the appearance of the green hornblende is the main characteristic of the lower Members of the Madhupur and Barind Formations.

Heavy Mineral studies

- A comparative abundance of the heavy minerals of the Pliocene (Dupi Tila Formation), Pleistocene (Mdhupur and Barind Formations) and Holocene Series are given in the Fig.18.

- From the Fig.18, it can be seen that the percentages of ubiquitous minerals of the Pliocene Series are much higher, whereas garnet dominates the holocene Series.

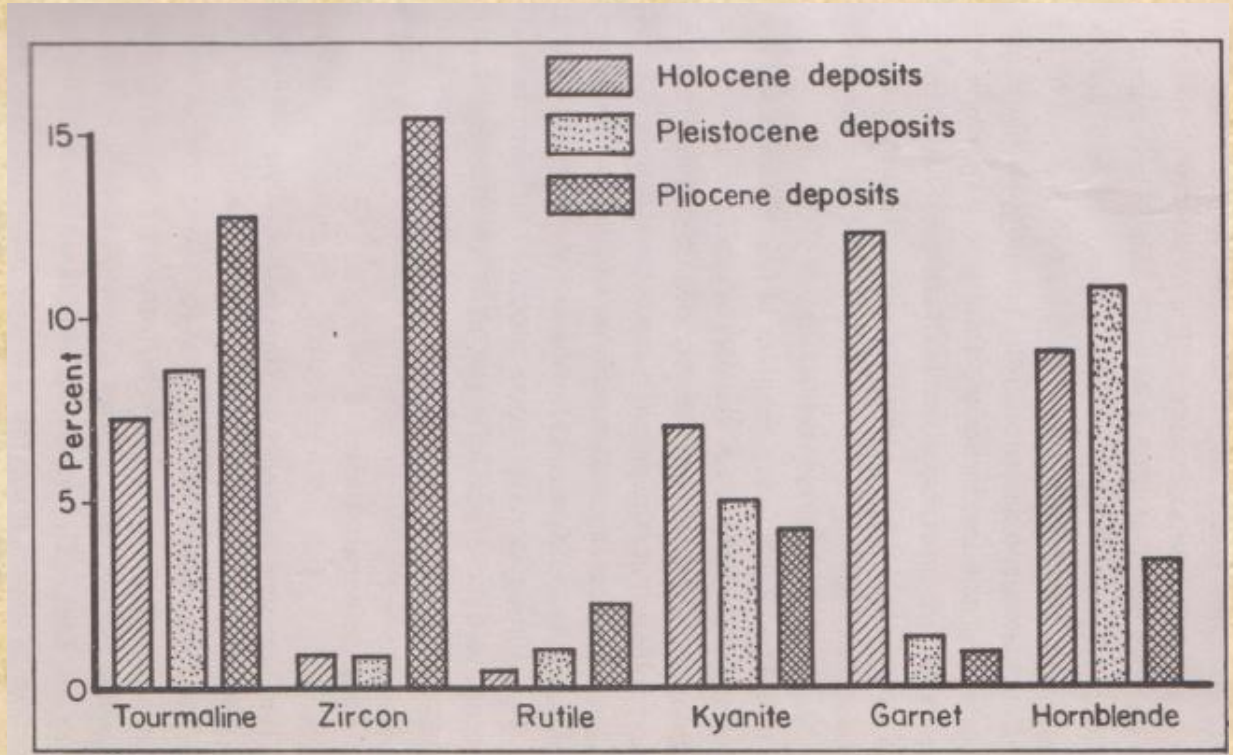

Fig. 18 Comparison of heavy minerals of different formations

Heavy Mineral studies

- The heavy mineral associations of the Madhupur and Barind Formations reveal that the sediments were derived from gneissic and schistose rock sources.

- The metamorphic mineral group includes staurolite, sillimanite and kyanite. These minerals are naturally derived from schists, granulites and granite gneisses.

- The Daling Series of the Himalayas is exposed facing India-Bangladesh and agrees with the petrology of Madhupur and Barind Formations.

- Hence the Daling Series probably, the source rock of metamorphic minerals (Hassan, 1986).

- As Daling Series is a schistose group, it may also supply the mica group of minerals.

- Hence, Daling Series probably will be the source rock of the Madhupur and Barind Formations.

Heavy Mineral studies

- It was found that the distributions of heavy minerals of the Barind and Madhupur areas are very much similar with the mineralogical association of the Archaean System.

- From the geomorphological configuration, it can be seen that the Bengal basin has been receiving sediments, washed out from the Assam Himalayas upto the Kumaon Himalayas for a long geological time.

- The shifting of river system produced an admixture of sediments derived from different parts of the Himalayas (Monsur, 1990).

Clay Mineral studies

- It is necessary to identify the composition of the Madhupur Clay and Sand Formation in terms of clay mineralogy since the term "Madhupur Clay" has been used for a long time.

- A detail clay mineralogical studies were performed by Hassan (1986) during his Doctoral research in supervision with Professor Thorez of Liege University in Belgium.

- From the clay mineralogical studies, it was found that the Madhupur Formation has two components (Hassan, 1986).

- The first main component includes the halloysite and illite.

- The second is a minor component. The minor component includes mainly the mixed layers: (10 - 14sm)I, (10 - 14v), (10 - 14c), C2, C - (14c - 14v), (14c - 14v), (10 - 14sm)14, (10 - 14sm) - 14sm, Sm and AI17.

Clay Mineral studies

- A second series belongs to the sediments of the Chandina Formation belonging to the Holocene Series.

- Here, also the sediments include two main components. The first component includes the Kaolinite and illite.

- The second component includes: (10 - 14sm)I, (10 - 14v), (10 - 14c), C, C - (14c - 14v), (14c -14v), V, (10 - 14sm)14, (10 - 14sm) - 14sm, Sm and Al17.

- The mixed layers are almost the same as was found in the Madhupur Formation.

- The Madhupur Formation is very much swelling. Addition of a little amount of water increases a great volume of the clay.

- It means that the clay expands in the presence of water.

Clay Mineral studies

- Illite looks fine mica-like minerals. It exhibits a deficit of K+ and with excess of water in comparison with normal mica, but without swelling properties.

- Smectite is a group name of expanding clay minerals. The presence of smectite and illite-smectite mixed layer are responsible for swelling.

- The presence of water quickly expands the interlayer spaces and as a result the clay expands.

- This explains the cause of swelling of the Madhupur and Barind Formation.

- It is to be mentioned that the weathering of ferromagnesian and silicate minerals resulted in the development of clay integrown which ultimately formed the clay minerals.

Sedimentological studies

- Detail sedimentological researches of these Madhupur and Barind Formations were carried out by Hassan (1986) and Monsur (1990, 1995).

- The main purposes of these sedimentological researches were to infer the ancient depositional environment with the application of sedimentological parameters.

- A number of attempts have been made to introduce a rigorous and objective approach to the comparison and interpretation of grain size frequency distribution by means of statistics.

- But unfortunately no method seems to interpret the ancient environment precisely.

- This is because of the fact that depositional basin has its own physical, chemical and biological characteristics which may or may not always be similar to the characteristics of adjacent basin.

Sedimentological studies

- In addition, the tested samples in the applied discriminatory techniques, were taken from river bars, beach, shallow marine or dune sand.

- The stratigraphic world is not solely composed of beach, river bars or dune sands.

- Hence, the results obtained from the sedimentological studies in search of depositional environment is not reliable.

- Here in this text, some textural characteristics are discussed.

- The general term "Madhupur Clay" has been used for a long time since Morgan and McIntire published a report from the Louisiana University in 1956 on these reddish brown deposits.

- The upper part of the Formation is highly weathered. That's why, the term Madhupur Clay has probably wrongly implied.

Radiocarbon

- Fig.20 shows the grain size distribution of the Madhupur Formation in a stratigraphic section.

- From the Figures it is clear that the major parts of these Formation occupy the sand fractions.

- Only the upper part is dominated by clay materials.

- Lithostratigraphic boundaries are usually fixed up by the observation with the nacked eyes.

- The changes of lithology and physical characteristics of sediments are put forward to subdivide the lithostratigraphic units.

- In the case of Madhupur and Barind Formations, the subdivions were based on thepresence of palaeosols (Monsur and Paepe, 1992, 1994).

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- The gradational boundary of these Formations makes a problem to fix up accurately the lithostratigraphic boundary.

- Sedimentological parameters were used to fix up the lithostratigraphic boundaries more precisely.

- Fig.21 shows such a sedimentostratigraphical approach to fix up the boundaries in subdividing the lithostratigraphic units of the Madhupur and Barind Formations.