Quaternary Geology

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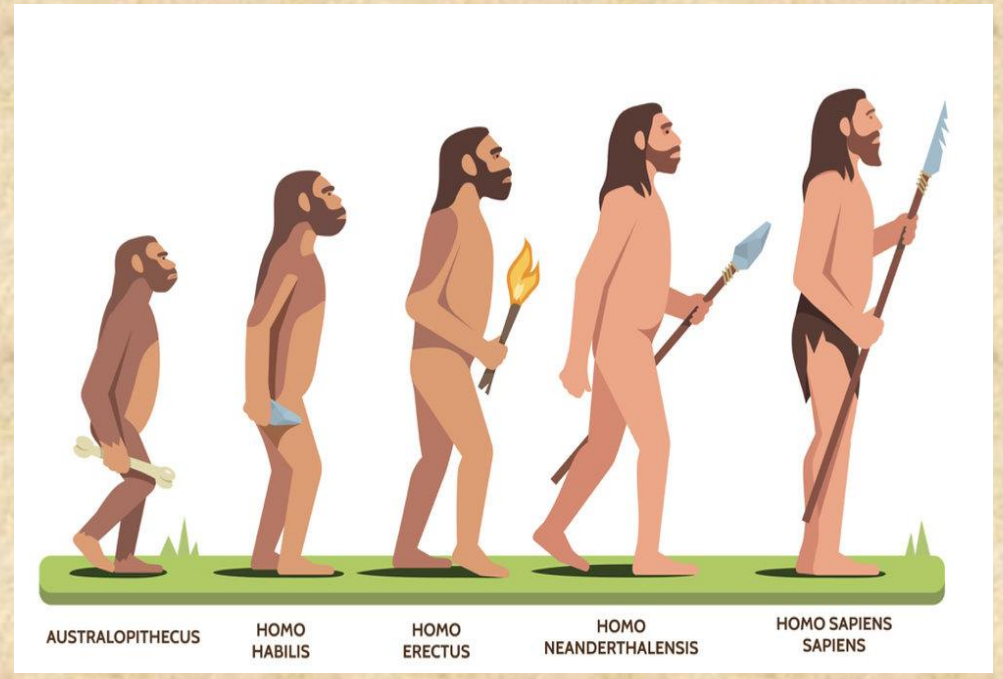

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Course outline

- **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
  - Correlation of Quaternary Deposits

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Paleomagnetism and Rock Magnetism

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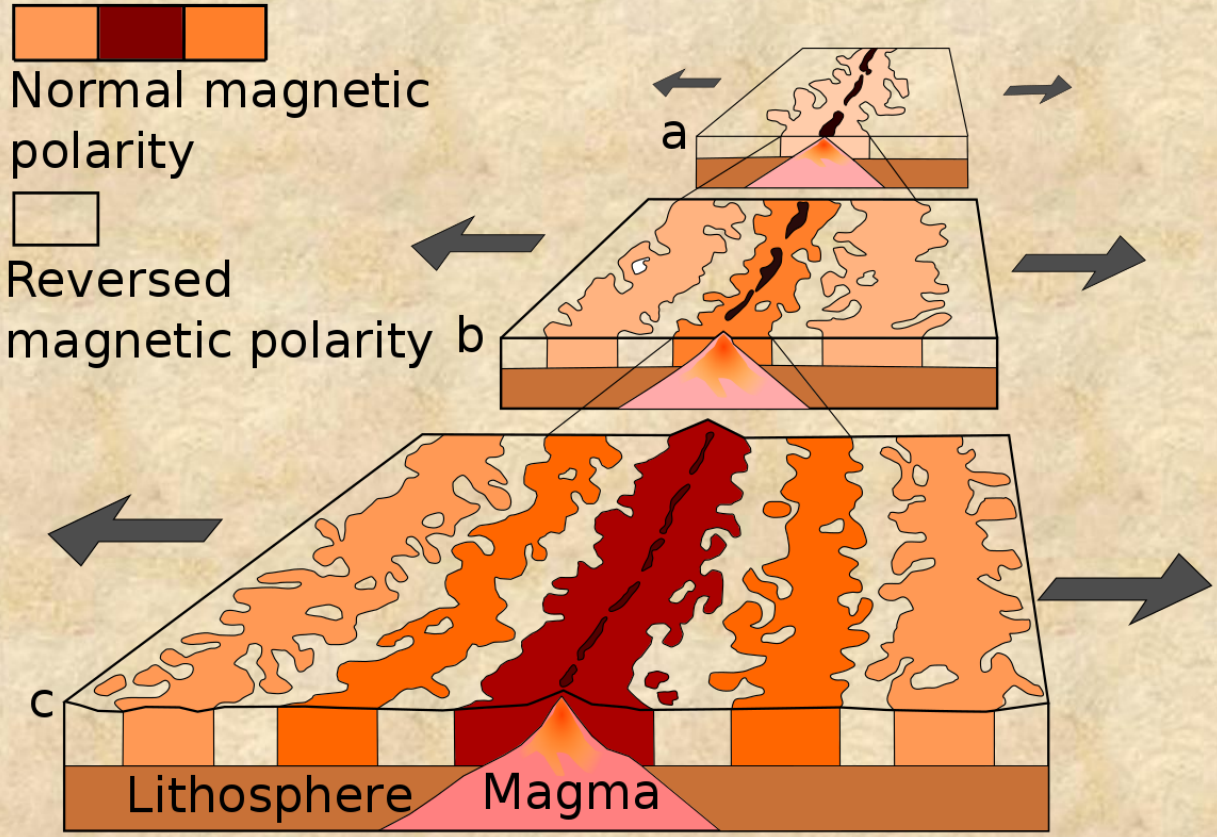
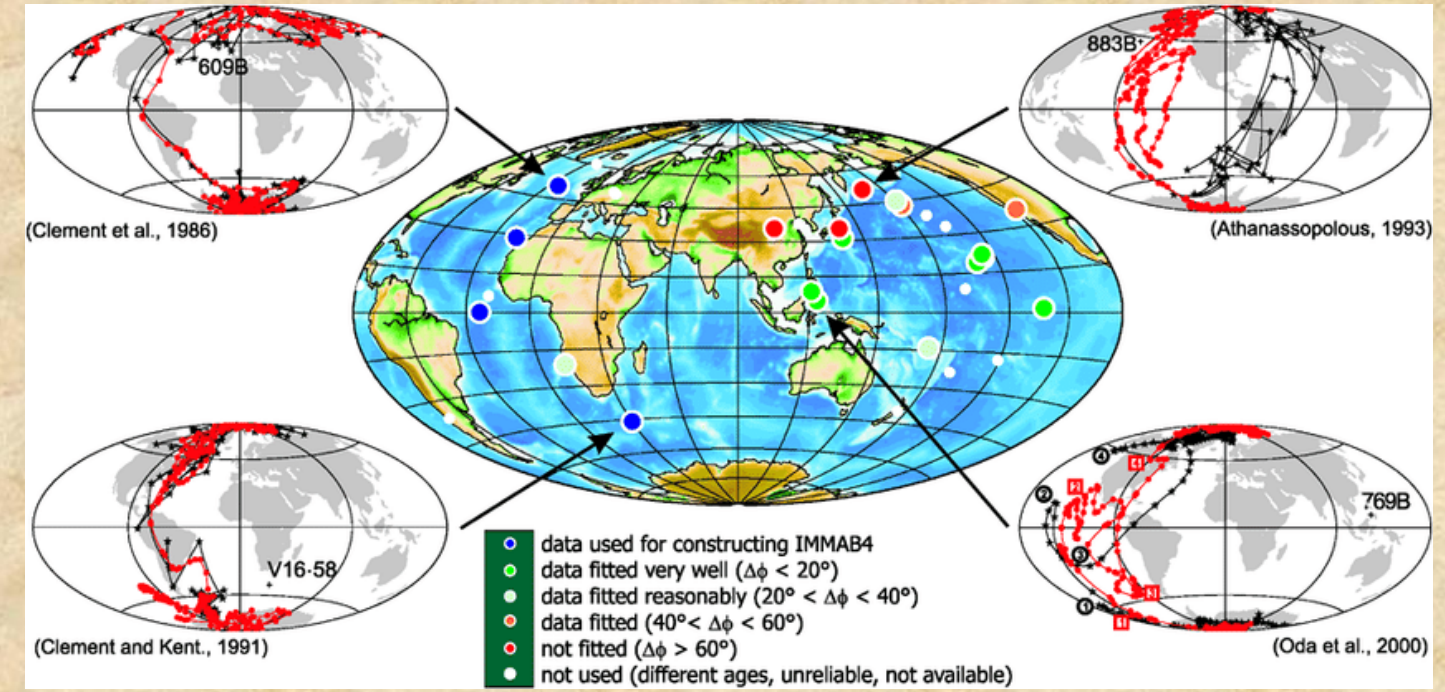


Talk outline

- Paleomagnetic Studies
- Magnetic susceptibility : Quaternary Deposits
- Radiocarbon Dating



Paleomagnetic studies

- It was discovered that the earth magnetic field changes its polarity during the geological time.

- An increase of palaeomagnetic studies, combined with K-Ar dating of young volcanic rocks, resulted in the first establishment of a geomagnetic polarity time scale in the early sixty's.

- Polarities of different rock strata are usually compared with the standard polarity time scale curve (Mankinen and Dalryple, 1979) and the relative dates are obtained.

- The natural remanent magnetization in most rocks contains stable and unstable components.

- Stable component (very strong) is the primary magnetization which indicates the ambient geomagnetic field during the time of its acquisition (or deposition).

Paleomagnetic studies

- Unstable components are the secondary magnetization which the magnetic grains acquire during the geological time after acquisition of primary magnetization or deposition.

- These secondary unstable components have low coercivity and can be removed easily from the magnetic grains to isolate the primary magnetization (stable component).

- Only the primary magnetization indicates the ambient geomagnetic field.

- The process of removal of unstable secondary components and to isolate the stable primary component is called magnetic cleaning.

- There are two methods of magnetic cleaning:
  i) Thermal magnetic cleaning and
  ii) Alternating field magnetic cleaning.

Paleomagnetic studies

- About 200 representative oriented undisturbed Samples were collected from different stratigraphy horizons of Quaternary deposits exposed in the Madhupor , *Barind, Lalmai* hills and Chalanbil areas.

- First of all, the natural remanent magnet magnetization of all the samples were measured with a cryogenic super conducting magnetometer.

- Based on the results of first measurements, several pilot specimens, representing each lithologic unit, were chosen for alternating field and thermal magnetization cleaning test to identify the stability of natural remancnce.

- From these tests thermal magnetic cleaning was preferred and 260 degree Celcius temperature was selected for magnetic cleaning of the rest of the samples.

Paleomagnetic studies

- The results of the palaeomagnetic investigations are shown in the Fig. 15 (in the book).

- Palaeomagnetic investigations indicate that the Rohanpur (Unit-R1), Chalanbil (investigation unit-Cl) and Basabo Formations have the normal polarity.

- The Basabo Formation have five subunits which were dated by C-14 dating method.

- From the radiocarbon dating, it was found that the maximum possible age of the lower part of the Basabo Formation is about 12780 yrs BP.

- The Basabo, Rohonpur, Boalmary and Chalanbil Formation were correlated and they belong to the Brunhes Magnetozone (Holocene Series).

Paleomagnetic studies

- The upper Kalsi Bed (M2-01) has normal polarity, probably, belongs to the Brunhes Magnetozone (Middle Pleistocene).

- The lower Kalsi Bed (M2-02) and the Gouripur Bed of the Barind Formation have the reversed polarity.

- These two Beds belong to the Matuyama Magnetozone (within the time limit of 0.90 to 0.73 my BP).

- The boundary between the upper and lower Kalsi Beds represents the Brunhes-Matuyama boundary (0.73 my BP).

- Gouripur Bed and the lower Kalsi Bed can be correlated with the lower Pleistocene Series.

- All the Members of the Barind and Madhupur Formations have normal polarity (Fig . 15), which probably belong to the Jaramillo event (0.90 - 0.97 my BP).

Paleomagnetic studies

- The sediments below the Quartz-chalcedony gravel bed showed reversed polarity which belongs to Matuyama Magnetozone.

- The Quartz-chalcedony gravel Bed seems to be the age of 0.97 my BP.

- From the palaeomagnetic investigation, it was found that the beds which gave reversed polarity were isolated and occurred as fluvial terraces.

- Therefore, it can be assumed that the red beds in the Bengal basin are, probably, a combination of several fluvial terraces which are yet to be recognized.

Paleomagnetic studies

- To establish an ideal polarity time scale, it is necessary to have sediments which were deposited during the geological time without any time gap.

- The deposits of the Bengal basin have several unconformities. Therefore, it is not easy to correlate the obtained polarities with the standard geomagnetic polarity time scale.

- For confirmation it needs absolute dating. But unfortunately, no datable materials were available.

- In this case, the author has tried to correlate in most possible ways.

- Most of the lower Pleistocene deposits have deep reddish brown colour, such as, Rocourt soil of Belgium, Chinese loess deposits, Pikermi soil of Greece.

- Deep reddish brown colour of the Madhupur and Barind Formations is quite striking.

- The appearance of reddish brown colour of these deposits is due to the oxidation and hydration of iron, i.e. the formation of iron minerals, such as, hematite, goethite, limonite, maghemite etc.

- Moreover, there are many hiatus (unconformity) in the stratigraphic sequences. So, it was very difficult to correlate the obtained results with the standard palaeomagnetic time scale.

- Most part of the section was covered with alluvium or vegetation. Hence, it was not possible to get a reliable stratigraphic section in the Jaintiapur area.

Magnetic susceptibility of the Quaternary deposits

- The determination of initial magnetic susceptibility of rocks is quite important for the estimation of magnetic components of sediments.

- Magnetic susceptibility plays a vital role for aeromagnetic interpretations, soil horizon recognition and also acts as an important indicator for any chemical change affecting the magnetic grains.

- The magnetic susceptibility can be defined as the induced magnetization of the magnetic minerals divided by the applied field.

- The initial susceptibility of ferromagnetic minerals depends on the size, shape, initial stresses and composition.

Magnetic susceptibility of the Quaternary deposits

- The Pleistocene sediments of the Madhupur and Barind areas are highly oxidized.

- The present author has estimated the magnetic susceptibility of the Quaternary sediments during his Doctoral research (1990, Monsur, 1995).

- Some of the magnetic susceptibility of the Madhupur, Barind, Basabo, Rohonpur and Chalanbil Formations are given in the Table 4.

- Susceptibilities of the Madhupur Formation are placed against the stratigraphic position and are shown in the Fig.16. From the Fig.16, it can be seen that the susceptibility decreases downward from the upper Member of the Madhupur Formation. Exactly, the similar trend can be observed in the case of the Barind Formation.

- The upper parts of the Madhupur and Barind Formations are highly weathered (except the Kalsi Beds).

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- Moreover, the pedogenic process was quite active in the upper part of these Formations.

- The pedogenic process enhanced the concentration of Fe ion which ultimately oxidized to form new magnetic minerals.

- Thus, the upper parts of the Barind and Madhupur Formations exhibit higher susceptibilities.

- Lower parts of these Formations show low susceptibilities because of less oxidation and weakly developed soil.

Radiocarbon

- Several peat samples were collected from the Basabo Formation exposed at Gulshan Lake, Dakshingaon and Kalibari pond in the Dhaka city.

- The position of the peat samples and their obtained ages are given in the Fig.17.

- The obtained radiocarbon dates for the subunits Ml-2 to Ml-5 respectively 4040±70, 5730±60,8940±105 and 12780 - ±140 year BP (Monsur and Paepe, 1994).

- The radiocarbon dates helped to correlate the subunits of the Basabo, Rohonpur, Chalanbil and Boalmari Formations, exposed in Madhupur, Barind, Chalanbil and Panchagarh areas of the Bengal basin (Table 5)

- **Placing** the recent deposits on top, the two subunits of the **Chalanbil** Formation are correlated with the Sub-atlantic and **Sub boreal** Substages of Holocene Series.
- Based on the c**orrelation** scheme, it can be conceived that before 5000 yrs BP. the (chalanbil area was under the process of erosion .