Palaeoenvironmental changes in the Ganga Plain deduced from proxy records in lake fill sequences

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Introduction

Late Quaternary is a time of repeated climate change effecting the monsoon rainfall and fluvial processes. These changes led to the development of highly diversified geomorphic features. The large-scale features are linked to major climate change and events in the Late Quaternary, while small scale features are related to minor fluctuations. Large-scale migration of monsoon rainfall has caused various geomorphological phenomena, sedimentation, and erosion, and records the complete depositional history of Late Pleistocene- Holocene as proxy tools to deduce the palaeoenenvironment.

The Ganga Plain has diversified network of drainage system, with large number of Lake and ponds. Most of these lakes are formed due to fluvial erosion, neotectonic and anthropogenic dissection, and records the complete depositional history of Late Pleistocene- Holocene as proxy tools to deduce the palaeoenenvironment.

Several lakes (Suraj Tal, Luhurade lake, Kora sheet) of the area have been studied for multiproxy data, general lithology, palynology, phytoliths, food content and carbon-oxygen isotope-data.

Results of Multi-Proxy data of different Lakes

Zone 1

- Heavier δ¹³C values, prevalence of Botryococcus, Cyanobacteria, poor arboral pollen, microcharcoal, low frequency of phytoliths, (sediments with minor present) indicate the lake is marly low land.
- Presence of some cultivated pollen, Rame, Chen/Am/Carrvophyllaceae, slight increase in abundance of diatoms, phytoliths indicate expansion of lake.
- First appearance of cultivated rice phytoliths, Cereals, with other cultivated pollen taxa, pollen of Madhuca indica, Apus, Acacia, Terminalia microcharcoal, paddy field diatom indicate good precipitation, expansion of lake and some sort of agricultural practices, also evidenced by the occurrence of rice husk (~ 8000 yrs BP) from archaeological sites.
- Consistent occurrence of cultivated phytoliths, paddy field diatom, occurrence of Tapa with other cultivated taxa indicate anthropogenic activity. Slight increase in chlorophyll phytoliths, lighter δ¹³C values suggest climate deteriorator.
- High rainfall and expansion of lake inferred from prevalence of deciduous trees pollen, abundance of aquatic taxa, increasing tendency of cultivated rice phytoliths, paddy field and diatoms.

Zone 2

- Influence of human activity is prominent as evidenced by increased sedimentation (due to sitiation), prevalence of Madhuca, Asteraceae, Chen/Am, Eufolica, Madhuca etc., abundance of cultivated rice phytoliths, consistent occurrence of microcharcoal throughout the profile suggestive of warm and humid climate.

Palaeoclimate Reconstruction

- Based on the study of lake fill sequences, major inference for last 20 kya are as follows:
  - 20 to 15 kya BP-Formation of new drainages and incision of river tributaries, low rainfall and low drainage density.
  - 13 to 8 kya BP-Increased rainfall due to monsoon system, formation and extension of dense network of tributaries. Reallocation of abandoned channels and meander cut-offs lakes or marshy areas.
  - 8 to 6 kya BP-Formation of large linear lakes as a result of channel abandonment and channel division, High precipitation.
  - 6 to 4 kya BP-Reduction in the area, accompanied by increased supply of terrigenous clastic sediments in the lakes.
  - 3 to 2 kya BP-Further sitiation and reduction in the dimensions of lakes, low rainfall and prevailing agricultural practices.
  - 2 to 0 kya BP-fragmentation of large lakes into small ponds, continued sitiation and reduction in the dimensions of lakes, strong anthropogenic influence on the rate of the sitiation of lakes.

Conclusions

Palaeoclimatic studies of lake deposit profiles for the last 15 kya BP suggest that the region was open grassland with some forested areas. It can be inferred that Indo-Ganggetic plains with a large variety of fluvial landscapes, availability of water in rivers and lakes, good vegetation and plenty of fleshy fruit have high demand for shrubs. It is highly probable that humans inhabiting Ganga Plain already adopted intense agricultural techniques during Late Glacial Maxima (280 000-130 kya BP). With improvement of increased rainfall, more intense agricultural activity probably started around 13 kya BP. Later (10-5 kya BP) interaction of wet-land agriculture, lake front agriculture and rice agriculture was observed. Some type of plant cultivation is evident in sediments collected from later lakes. Climate changes due to increased monsoon rainfall in Ganga Plain during latest Holoene were仓储 and change on the Holocene sediment funches and their later.