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Original Article

The Significance of Peat Deposits in Evaluating the Recent Environmental and Climatic Conditions in the Bangladesh Part of Bengal Basin

Mohammed Masum* and Mohammad Omer Faruk Khan
Geological Survey of Bangladesh, 153, Pioneer Road, Shegunbagicha, Dhaka-1000

***Corresponding Author**
Mohammed Masum
Assistant Director.
Geological Survey of Bangladesh
153, Pioneer Road, Shegunbagicha, Dhaka-1000
E-mail: masum613@yahoo.com

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Abstract

Peat is a biogenic deposit which forms under water logged conditions in continental swampy to marshy environments when organic matter is produced by plants and deposited at a faster rate than it is decomposed. Climate controls the rate of plant growth, type of plant growth and to a large extent, depositional rates, all of which ultimately determine whether or not peat will form. Thus, the peat deposits are not only important as fuel resources but also important from an environmental point of view, because peat deposits of an area may provide valuable information about past environments as well as climatic circumstances of the area. At many places in the eastern part of Bengal Basin (Bangladesh) peat occurs randomly at surface to near surface conditions. Generally, the base of the peat deposit is about 15 m below the surface and peat is not found below that depth. As there exists a relationship between the depth of sediment i.e. peat and time, it signifies a sudden change in the depositional environment within the basin in the recent past. This peat forming environment did not exist before that time. The current research discusses the depositional characters of the peat deposits and their significance in interpreting the recent environments and climatic conditions in the Bangladesh part of Bengal Basin. However, the detailed investigation of peat deposits is yet to be completed and should be done to know the past and predict the future climatic and environmental condition.

1. Introduction

Climate change is probably one of the most critical and challenging of all the issues that human intellect has ever encountered. This is the most important of all human challenges as it threatens the very existence of the human being on the planet Earth. Hence, initiatives from all facts of science and technology are of utmost importance to successfully handle this great challenge and knowledge of geology can be play very important role in this regard. In this paper, the significance of peat deposits (Plate. 1) occurring in the Bengal Basin would be evaluated for its utilization in the understanding of the past environment and climate and the change that is recorded in them using basic geologic concepts.

The potential of peat deposits as a climatic indicator [1] was further confirmed by Keith's (1981) seminal work-Peat stratigraphy and Climate Change.

Geologically Bangladesh is essentially a sedimentary basin namely the Bengal Basin, which is one of the largest sedimentary basins of the world filled up by the largest Bengal Delta. Thus, the land surface of most of the basin, hence Bangladesh is low lying and is at the level of the sea. The basin is undergoing active subsidence and sedimentation since the beginning of the Cenozoic Era about 65 million years ago. All these sediments recorded the rise and fall of the sea level since then. However, the occurrence of peat in this basin has only been recorded around the mid-Holocene which could be very significant from a climate change point of view.

Climate change is a multidisciplinary topic and attracted a diversity of professionals. However, geology can play a vital role in the understanding of the climate change issue by providing the history of the past climate and predicting the future climate. Because, all the rocks of the earth are deposited under certain climatic and environmental conditions and they hold some important clue as to the past climate, they can yield valuable information about the climatic condition. In this regard, peat deposit of the Bengal Basin can also give very important clue about the condition of deposition and how the climate has been in the recent past. Not only could that but by examining the nature of the peat deposits it also be possible to draw a conclusion about the near future of the climate change.

Plate 1: figure showing the real picture of peat deposits and collected sample from the subsurface (B. Baria on left and Hakaluki Haor at Moulvibazar on right).

2. Materials and Methods

This is mostly a theoretical approach involving analysis of existing data and information on peat deposits in Bangladesh. GIS technique has been used to preparing peat distribution map of Bangladesh. Open source GIS package QGIS Application (Version 2.0), Surfer-8, and graphic software have been used for that purpose. Location data (latitude and longitude) which have been taken by global positioning system device (Garmin GPS map 76cCSx). Location data have been utilized for preparing map. Some exploratory data which have been taken during the several peat exploration activities of Geological Survey of Bangladesh also been included. Peat explored by using hand auger method / shallow drilling method. An auger is a hand operated apparatus with a cutting bit at one end of a steel pipe. Lithological data have been collected for further analysis during the peat exploration works of GSB which mainly done by this Auger.

2.1 The Tectonic Settings of the Bengal Basin

The Bengal Basin has undergone a long evolutionary process of basin formation. The basal surface of the basin is funnel shaped (Fig. 1) which closes toward the northeast and widens towards the south. The western and northern parts of the basin are formed of continental masses. The eastern part of the basin is bordered by the Indo-Burman fold belt which is formed of the same sedimentary material as the basin. This funnel shaped depression is filled up by almost 20 km thick sediments most of which were deposited under sea. During the Plio-Pleistocene the basin got almost filled up and terrestrial deltaic to fluvial conditions prevailed. These rocks are not known for containing vegetal matter. Then, during the mid-Holocene environmental conditions permit the growth substantial vegetal matter in continental swampy to marshy environments. This plant growth later turned into extensive peat deposit all over the basin.

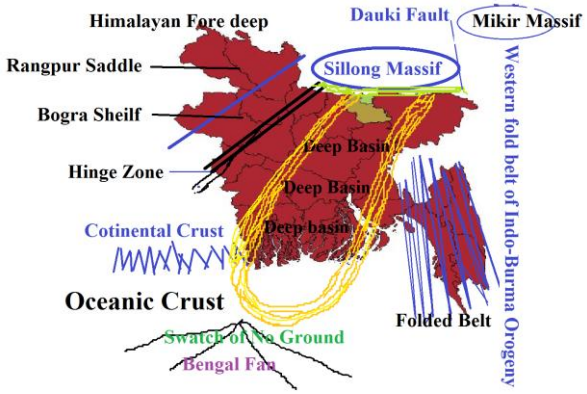

Figure 01: 3-Dimentional tectonic map of Bangladesh part of Bengal Basin.

2.2 Condition of Peat Deposition from the Geological point of view

Geology, tectonics and environment of any area are controlling parameter for peat deposition. Fluvial and deltaic plain with area of active subsidence are suitable for peat deposition. For the formation and preservation of significant peat deposits, a depositional setting is required in which there is high organic productivity, slow continuous subsidence and groundwater table is or at close to peat surface. Warm, wet tropical and subtropical climate are most favorable for the development of forest swamps. Such climatic areas are characterized by both high rates of plant accumulation and degradation.

In Bengal plain marshy land and swamps developed since mid-Holocene. The C14 dating of the Faridpur and B'Baria peat suggest that the calendar age in between 3000 to 6000 years [2]. During the last Himalayan upheaval in Pleistocene time, many folds and low lying areas were formed in the Bengal delta and these low lying areas were inundated during the high sea level condition in the mid Holocene time. Moreover, southwest monsoonal wind became stronger in Bangladesh since 12K, which caused heavy rainfall in Bangladesh and adjoining area. Although Pettijohn, 1984 suggested that peat forming condition area nearly everywhere associated with freshwater swamp but the valley of the area may have connections to the sea peat deposition took place [2].

The area includes the warm sub-tropical climatic region. This climatic condition is suitable for quick vegetation growth. Although the condition is complex one and depends on the interaction of species with different water requirements, rainfall and its annual distribution, evapotranspiration, runoff etc. Repeated growth, decay and decomposition of these vegetal matter result in the formation of peat. Floating plant also make an appreciable contribution in the formation of that peat. The peat layers of the area are found at surface or at shallow depth ranging from few centimeters to 3 meters below surface. Present of clay and silt of the upper part of the deposits indicating that the sediments are deposits usually in the winter season when the current of the water become weak. Moreover, the sediment may also be laid down in stagnant water after the recession of the flood. Peat deposited underlain by dark clay or peaty clay indicating these deposits have formed from the decay and decomposition of initial vegetal growth.

Age of peat at Khulna and Dhaka estimated between 1200 to 6000 years before present (Umitsu, 1993) so it is assumed that peat formation becomes end about thousands of year before present. At that period depositional environment change considerably. The alternated environment helps to provide overburden sediment under which the peat is preserved. Change of sedimentation pattern in stratigraphic sequence is smooth. This reflecting that after peat deposition there is no sudden diastrophic change of depositional environment.

Generally it should be commented that tropical peatland occur in this region where vegetation and local peatland development at these sites (fig. 2) and showing the influence of warm and dry climatic conditions during the middle Holocene (5000-7000 years).

2.3 Peat forming process

Some hypothetical diagram prepared which reveal the real pictures of peat forming process. The analysis of the sediments due to its depositional pattern shows that the Pleistocene sediments began to deposit over the Pliocene Dupi Tila Sediments (fig. 2) which is mostly sand bearing and deposited in continental fluvial environment. The depositional settings change during the last several thousand years of the Pleistocene with the widespread swampy environments in the basin allowing accumulation of substantial vegetal matter (fig. 3) leading to the peat deposits of the Holocene age. The peat deposition reached peak at some time and again the environment began to dwindle as evidenced by the closing up of the peat swamps (fig. 4).

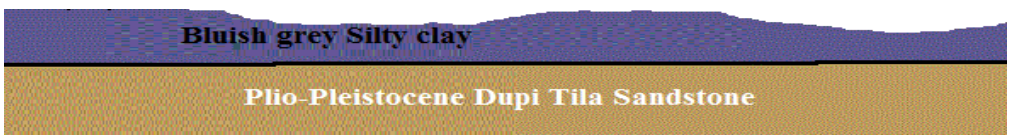

Figure 2: The hypothetical diagram showing the sediment deposits of the Plio-Pleistocene time which comprises of sandstone and overlain by the Holocene bluish grey silty clay. This bluish grey silty clay is the base of peat.

Figure 3: This hypothetical diagram showing the vegetation grown at different parts of bluish grey silty clay which are the origin of peat deposition.

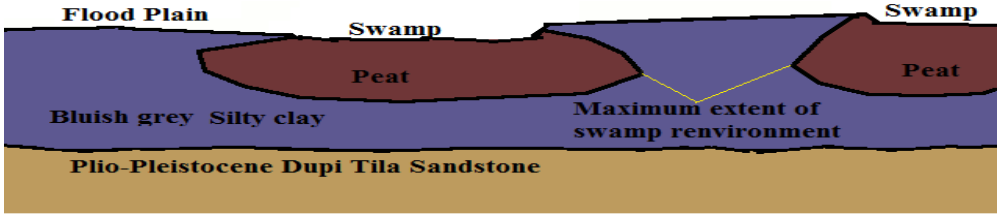

Figure 4: Figure showing the recent condition of peat deposition where peat formed the upper part of bluish grey silty clay within the swampy area. Flood plain deposits are overlies the peat

2.3 Nature and Distribution of the Peat Deposits

The peat of the Bengal Basin occurs at shallow depth and extends up to the land surface. The maximum depth of the bottom of the deposits is about 15 m beneath the surface which is rather very shallow in geologic context indicating a very recent time of deposition. The peat deposits occur mostly in the central stretches (Fig. 3) of the basin which are occupied by large wetlands termed as haors. The haors are being filled up by extensive water bodies during the monsoon and get dried up during the winter. The smaller water bodies then left are termed as beels. These beels and haors are the habitats of numerous varieties of fishes and also many aquatic and land based plants which form swamp forests.

There are quite a few hypotheses as to the nature of the vegetal matter found within the peat deposit. A few opine that during the growth of the vegetal matter the basin was under marine environment while others opine that the peat is continental marshy to swampy in origin. However, it should be a matter of through research to correctly understand the nature of the peat deposits to comprehend the true history of the basin during the growth of peat deposition to understand the environmental condition in the recent past.

Table: Mentionable peat dominant area of Bangladesh part of Bengal Basin (source-GSB).

No	Area	District
1)	Hakaluki Haor	Moulvibazar and Sylhet
2)	Baggia Chanda	Gopalganj
3)	4000 Hectre area of Bijoynagar	B, Baria
4)	Kola Mouza	Khulna
5)	Ajmirigonj	Habigonj

The above table also proved that peat dominant areas have been identified mainly in the central part of Bangladesh within the Bengal Basin which area comprise of depression or basin even in the present condition.

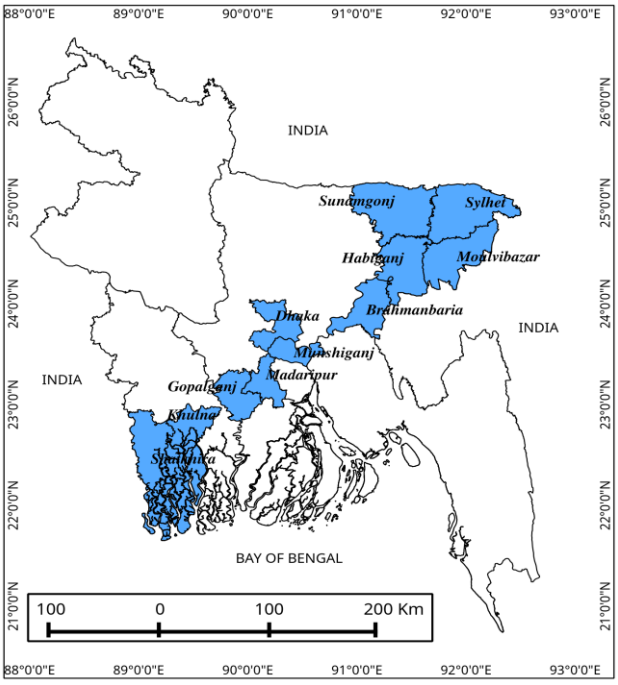

Figure 03: Peat distribution map of Bangladesh.

2.4 Peatlands and Carbon Sequestration

Peatland represent globally significant stores of soil C that have been accumulating for millennia and currently, peatland globally represent a major store of soil carbon, sink for carbon dioxide and source of atmospheric methane. In general, nitrous oxide (N_2O) emissions are low from natural peatland but there is evidence that those used for agriculture are releasing significant amounts of this potent greenhouse gas. Losses of peatland C from storage result from changes in the balance between net exchange of CO_2, emission of CH_4, and hydrological losses of carbon (e.g. dissolved organic and inorganic C and particulate organic C). The greenhouse gas (GHG) balance of a peatland depends on relative rates of net CO_2 uptake or efflux and CH_4 and N_2O efflux In terms of GHG management, the maintenance of large stores of C in undisturbed peatland should be a priority. Temporal studies of peatlands reveal that they may act as CO_2 sinks in some years and sources in others, depending on climate. Emissions of CH_4 and N_2O are similarly variable in space and time. When considering the role of peatlands in atmospheric GHG balances, it is important to consider that they have taken up and released GHGs continuously since their formation and thus their influence must be modeled over time. When this is considered, the effect of sequestering CO_2 in peat outweighs CH_4 emissions [3]. Thus the potential of Bangladesh peat for carbon sequestration should also be given keen interest as this peat deposits which may act as a very good store of carbon from the past.

3. Discussion

Peat deposits can reveal important information about the past (paleo) environment and climate change which belonging some environmental significances. The plant materials found within the peat which can be studied for the type of vegetation at the time of their formation. The pollen found in the peat that can be analyzed for reconstructing the paleo environment of this area [4]. The wood remains found in peat can be studied for the Carbon-14 dating which may give accurate date of the beginning of the peat deposition. Peat acts as sponges and can be stored water by absorbing and later release during dry period.

The peat deposition of Bengal Basin can be studied from the environmental and the climate change of point of views stated above. After completion of above peat analysis it signifies that the condition of the Bengal Basin hence Bangladesh was quite different about five thousand years ago but much similar to the present condition while before that time it was totally different. The scenario could also change with the current change in climate and environmental condition. The change recorded in the peat deposits could unravel valuable information to indicate this kind of changes. Peat could thus be regarded as valuable resource for its use as a fuel and also as an indicator of the environmental condition.

4. Conclusion

Since climate change is an issue of multidisciplinary interest and a holistic approach is very much important to fully comprehend the nature of this issue. In this context, the peat based research in Bengal Basin could be of great importance and a basin-wide exploration and research should be very helpful and informative to understand the totality of the complex condition of climate and environmental changes in this region.

References

[1] Aaby, B. Cyclic Climatic variations in climate over the peat 5500 years reflected in raised bogs. *Nature* 1976; 263: 281-284.

[2] Uddin M.N., 2010. "Pleistocene-Holocene Sedimentation in Relation to the Formation of Aquifers in the Central part of Bengal Basin, Bangladesh. PhD. Thesis, Dhaka University.

[3] Strack, M. 2008: Peatlands and Climate Change, International Peat Society (IPS), Vapaudenkatu 12, 40100 Jyväskylä, Finland.

[4] McGlone, M. S., Nelson, C. S., and Hume, T. M. Palynology, age and environmental significance of some peat beds in the upper Pleistocene Hinuera formation, South Auckland, New Zealand. Journal-Royal Society of New Zealand.12/1978; 8:385-393.

[5] Barber, K, E.1981: Peat Stratigraphy and Climatic Change- A paleoecological Test of the Theory of Cyclic Peat Bog Regeneration. Balkema, Rotterdam

[6] Matthew S. McGlone, Campbell S. Nelson & Terry M. Hume. Palynology, age and environmental significance of some peat beds in the upper Pleistocene Hinuera formation, South Auckland, New Zealand. *Journal of the Royal Society of New Zealand* 1978; 8(4): 385-393. DOI:10.1080/03036758.1978.10423320.