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Geological framework of Bangladesh

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Abstract: Bangladesh is largely covered by alluvium laid down by these rivers, the Ganges, Bhahmaputra and Meghna.

Structurally, the Bangladesh portion of the Bengal Basin can be subdivided into 3 units namely, the Pre-Cambrian Platform, the Deeper Basin and the Folded Flank of the Chittagong trough.

INTRODUCTION

Bangladesh is covered for a greater part by alluvium deposited by three mighty rivers, the Ganges, the Brahmaputra and Meghna and their innumerable tributaries. The Bangladesh portion of the Bengal Basin can be divided into three main structural units (see Figure 1) namely:-

A. Pre-Cambrian Platform or the Buried Indian Shield.
B. The Deeper Basin (Bangla Foredeep)
C. The Folded Flank of the Chittagong Trough.

The Pre-Cambrian Platform is separated from the Deeper Basin by the Eocene Hinge Belt (see Figure 1).

PRE-CAMBRIAN PLATFORM

The Pre-Cambrian Platform in Bangladesh is represented by a sudsided slope, called locally the Dinajput slope, that connects the Deccan Shield of the Indian Platform in the west and the Shillong Massif in the north. The Shillong Massif is a large upthrown block of the basement, that has been detached from the main Platform. The Eocene Hinge Belt that separates the Pre-Cambrian platform from the Deeper Basin passes through Calcutta, just south of Bogra and to the north of Mymensingh. The areas to the west, north and northeast of the Hinge Belt make up this unit. The Pre-Cambrian Platform is characterized by a shallow depth of ridges and depressions and gradual thickening of the sediments towards the southeast.

The sediments which were deposited over the crystalline basement complex are about 18,600 feet in thickness. The general stratigraphy of these sediments identified to date is summarised in Table 1.

Based on the characteristics of the basement and sedimentary complex, the Pre-Cambrian Platform is further subdivided into three units namely:-

a) The Platform Slope of the Himalayan Foredeep.
b) The Garo-Rajmahal Gap or the Saddle.
c) The Stable Shelf zone or the Bogra Flank.

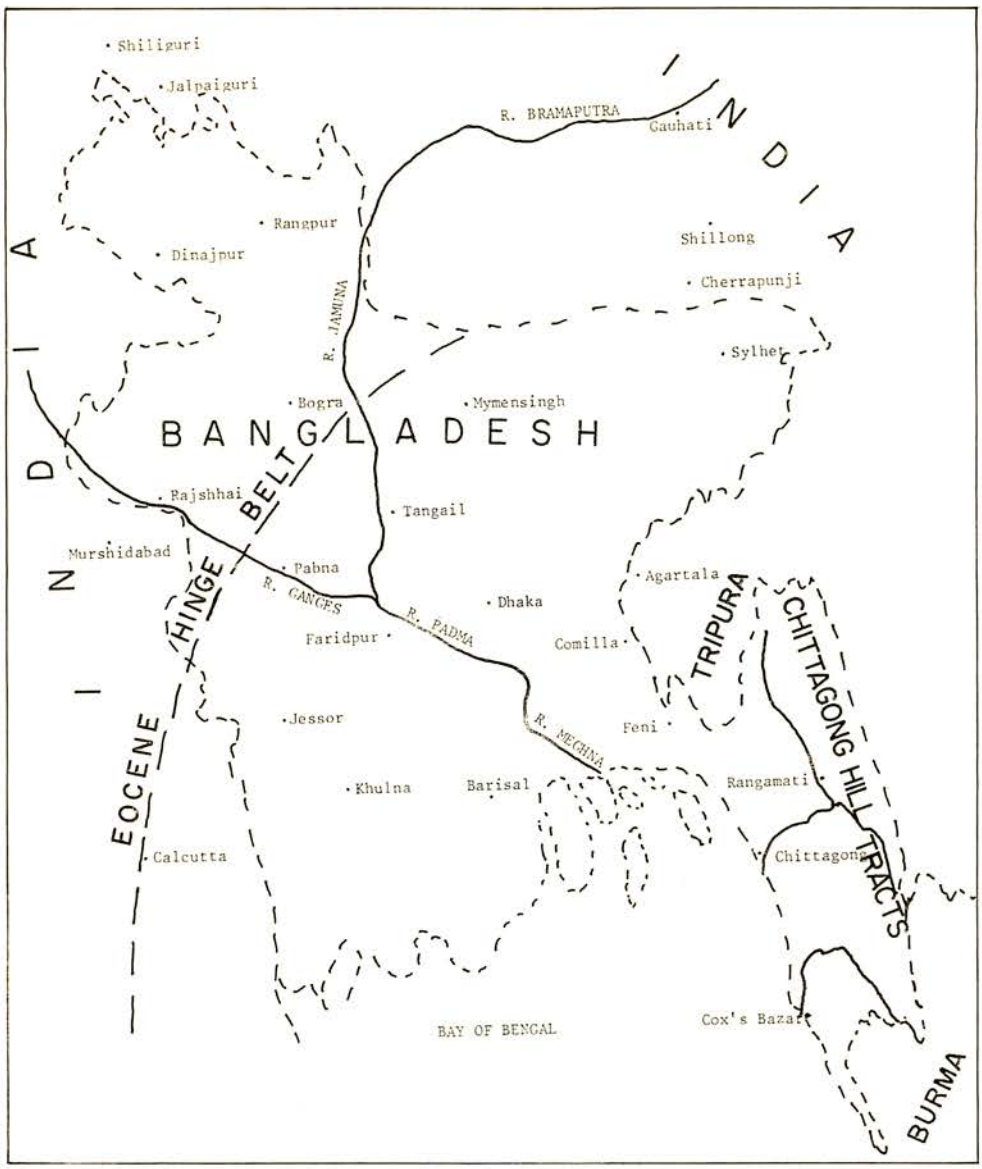

Fig. 1. The Main Structural Units of Bangladesh Portion of the Bengal Basin.

The sequence of rocks in the Rajshahi-Bogra Area is given in Table 2.

THE DEEPER BASIN

The Deeper Basin structural unit, includes the areas between the stable Pre-Cambrian Platform, to the west and north, and the folded belt of the Tripura and Chittagong to the southeast. In the Deeper Basin area, the basement is at a much greater depth with a thick

TABLE 1

GENERALIZED STRATIGRAPHY OF THE PRE-CAMBRIAN PLATFORM.

Age	Formation	Approximate Thickness (feet)
Quaternary	Sands and Clays	3,500
Miocene-Pliocene	Sandstone, Siltstone and Shales	12,000
Eocene	Sylhet Limestone	600
Cretaceous-Paleocene	Tura Sandstone	700
Jurassic	Rajmahal Trap	200
Permo-Carboniferous	Gondwana Sediments	1,600
Pre-Cambrian	Basement Complex	

Table 2

SEQUENCE OF STRATIGRAPHIC UNITS IN THE RAJSHAHI-BOGRA AREA (STABLE SHELF REGION)

Age	Group	Formation	Rock-type	Thickness (in feet)
Recent		Alluvium	Sand and clay	85-270
		Unconformity		
Pleistocene		Modhupur clay	Red and orange clay	
		Unconformity		
Miocence-Pliocence		Dupi Tilla	Sandstone	65-905
Oligocence-Miocene		Surma	Shale and sandstone	335-1355
		Unconformity		
Eocene	Jaintia	Kopili	Impure limestone, shales and sandstone	30-140
		Sylhet limestone	Foraminiferal limestone, sandstone and shale	45-120
		Tura sandstone	Impure limestone, sandstone and shale associated with coal seam	170-200
		Unconformity		
Cretaceous		Rajmahal Trap	Basalt	225-1790
		Unconformity		
Permian	Gondwana	Raniganj	Coarse to fine feldspathic and fine carbonaceous sandstone, carbonaceous shales coal (Five seams of total 170-1790 feet thickness)	
		Unconformity		
Pre-Cambrian	Archean		Complex of crystalline gneiss and schist.	

Table 3

GENERALIZED STRATIGRAPHY OF THE NORTHEASTERN PART OF BANGLADESH
(DEEPER BASIN OR EASTERN REGION)

Approximate Age	Local Nomenclature	Generalized Lithology
	Alluvium	
	Unconformity	
Plio-Plesistocene Dihing Series (400 feet)		Pebble beds, coloured sands.
	Unconformity	
Upper Miocence, Dupi	Upper Dupi Tilla stage	Coloured sandstone, clays.
Tilla Series (Maximum 800 feet)	Lower Dupi Tilla stage	Ferruginous sandstone, pebbles.
	Unconformity	
Middle Miocene, Tipam Series (2200-5000 feet)	Girujan clay stage Tipam sandstone stage	
Lower-Middle Miocene, Surma Series (9000-10,000 feet)	Bokabil stage Bhuban stage	Sandstone, shales etc. Shales, sandstone, sandy shales.
	Unconformity	
Middle-Upper Oligocene, Barail Series (8000-9000 feet)	Renji stage	Massive sandstone
	Jenam stage	Shales, sandy shales, carbonaceous sandstone.
	Lisong stage	Sandstone, partings of shale.
Paleocene Upper Eocene, Jainta Series (3000 feet)	Kopili Alternations stage	Alternations of impure limestone, grey and carbonaceous shales, sandstone & impure coal.
	Sylhet limestone stage	Foraminiferal impure limestone, sandstone with carbonaceous shales and thin coal seams.
	Tura stage	Impure limestone, sandstone and carbonaceous shales.
	Unconformity	
Cretaceous, Cretaceous series (700-1000 feet)		Gritty, calcareous sandstone and sandy limestone
	Unconformity	

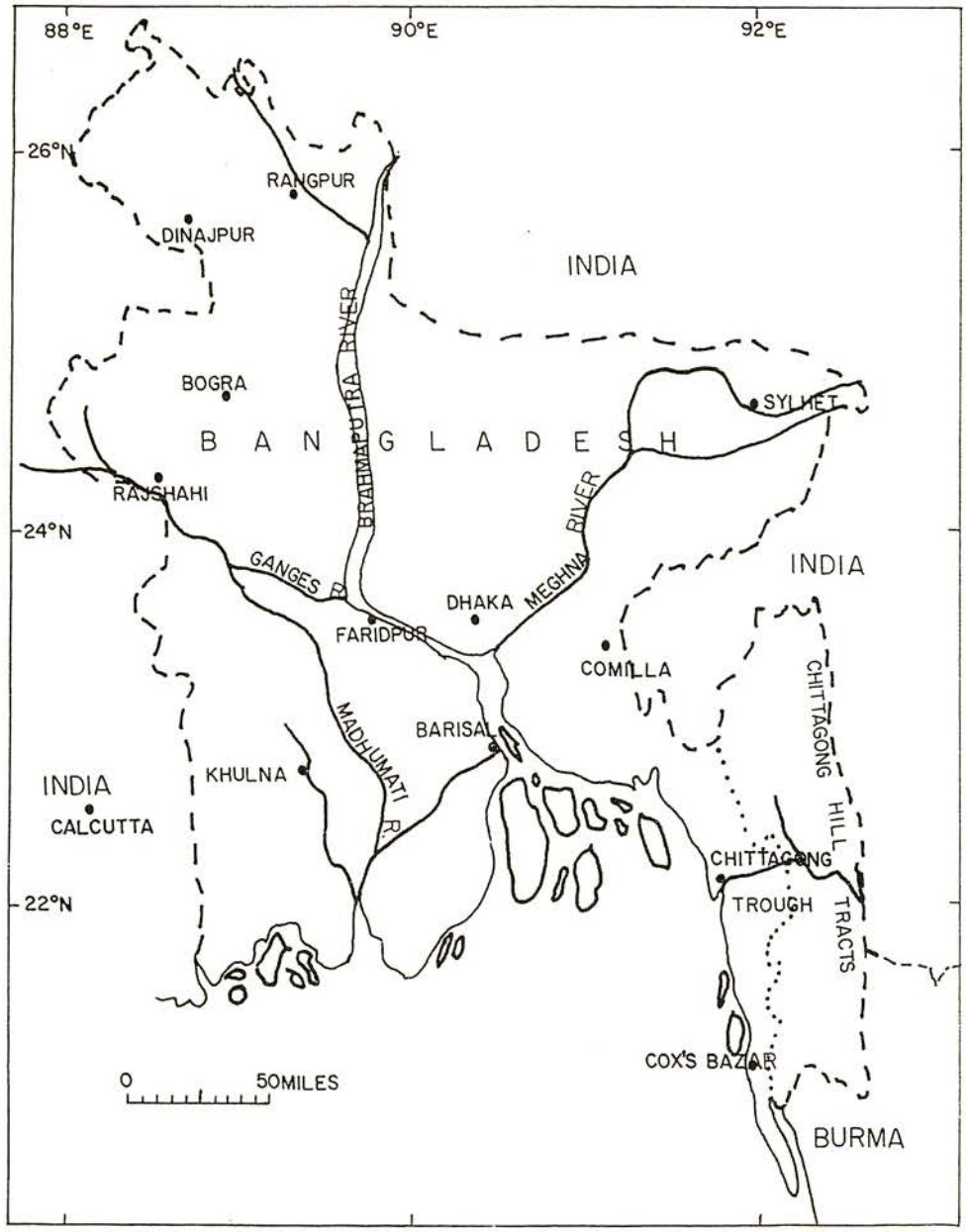

Fig. 2. Map of Bangladesh showing Chittagong Trough and Chittagong Hill Tracts with major rivers and cities.

sandy-argillaceous mollassic Tertiary sedimentary cover and simple structures. The generalized stratigraphy of a typical section of the Deeper Basin found in the northeastern part of Bangladesh is given in Table 3.

Geological, geophysical and drill well data obtained by Petrobangla, the Government Petroleum Exploration Company, has enabled the Deeper Basin to be sub-divided into three big depressions viz. Sylhet, Faridpur and Chittagong and two considerable uplifts, namely the Barisal and Tripura. The Sylhet and Faridpur troughs are elliptical depressions almost adjacent to the Eocence hinge belt and are identified geophysically by gravity minima. Both these troughs are filled up by enormous amount of Tertiary sediments. The uplifted zones of Barisal and Tripura divide the Bengal Foredeep into two parts - the northwestern and southeastern. The southeastern portion is occupied by the vast depression called the Chittagong Trough.

The whole area of southeastern portion of Bangladesh is called the Chittagong Trough whereas the eastern portion of Chittagong Trough is called the Chittagong Hill tracts (see Figure 2). The sequence of rocks found in this hill tract is given in Table 4.

FOLDED FLANK OF THE CHITTAGONG TROUGH

The Folded Flank of the Chittagong Trough can be sub-divided into three subzones namely:-

a) Western most gentle subzone of box-like structures.
b) Middle subzone of asymmetrical and faulted structures.
c) Eastern subzone of highly compressed and disturbed structures.

Western Subzone. This lies along the eastern coast of the Bay of Bengal and includes Dakhim Nila, Inani, Jaldi, Sitakund, Semutang and Patiya anticlines and their corresponding synclines. They are characterized by the occurrence of rocks in the crest with gentle dips from 3° - 5° to 10° - 12° with the crestal part being rather wide, 1 to 2 miles. The dip on either flank of the structures ranges from 45° to 55°. The cores of the anticlines expose sediments from upper Bhuban to Tipam while the synclinal troughs are composed of Dupi Tilla sediments having very gentle dips.

Middle Subzone. The folding in the subzone is characterized by more intensive manifestation of tectonic forces and development of more complex structures. The southern portion of the subzone is occupied by structures with large amplitudes such as Matamuhri, Bandarban, Gilasari while the northern part includes structures of smaller sizes, namely, the Sitapahar, Belassari, Changhotaung, Kassalong and Shishak. Matamuhri, Bandarban and Gilasari anticlines are sharply asymmetrical with ridge-like structures having relatively gentle western flanks. Middle Bhuban sediments are exposed. Faults generally occur along the junction of the steep flanks with the gentle crests. In the northern portion of the subzone, anticlines are shorter, having box-like form and their eastern limbs are thrust. On the crests, mainly upper Bhuban rocks are exposed.

Eastern Subzone. This subzone comprises sharp faulted anticlines like Mowdak, Barkal, Dumba etc. Limbs of these structures have dips of 70° - 90° and are faulted. The cores of the

Table 4

SEQUENCE OF ROCKS EXPOSED IN THE CHITTAGONG HILL TRACTS

Age	Group	Formation	Name of the Rock	Description
Upper Miocene to Pliocene		Dupi Tilla (2500 to 3000 feet)		Coarse ferruginous soft sandstone with numerous layers of quartz and chert pebbles; clays sometimes sandy and mottled, occur at intervals. Pebbly sandstone conglomerate beds and fossil wood common.
		Unconformity		
Middle Miocence		Tipam (about 4000 feet)	Girujan clay	Dark grey and bluish grey clay with mottlings; lower part consists of ferruginous sandstones.
			Tipam sandstone	Coarse and gritty ferrugious sandstone with interlayers of clays; sandstones are massive, cross bedded and yellowish brown coloured; conglomerates in pockets; fossil wood and lignite (about 1600 feet thick in Sitapahar).
Miocene		Bokabil (4000-6000 feet)	Upper unit	Bluish grey shales with conchoidal fracture lenses of hard calcareous shale.
			Middle unit	Alterations of 75-350 feet bands of massive and bedded sandstone and thin layers of shales and siltstones; lenticular and spheroidal concrections common at the top; fossiliferous conglomerates occassional.
			Lower unit	Thin bedded, bluish grey shales with intercalations of shaly siltstone.
	Surma	Bhuban (7500-13,000 feet)	Upper unit	Bands of massive and bedded sandstone with interlayers of siltstone at the top, laminated sandy shales interbedded with sandstone at the middle and alternation of sandstone and siltstone at the base.
			Middle unit	Predominantly a shaly and silty unit with numerous partings of arenaceous material; upper part sandy.
			Lower unit	Highly micaceous bedded to massive compact sandstones and fossil shales.

anticlines are formed by the middle Bhupan rocks while the synclines are filled up by the Tipam and Bokabil rocks.

TECTONIC AND DEPOSITIONAL HISTORY.

The Pre-Cambrian basement complex is not exposed anywhere in Bangladesh but is reached in drillholes in several places in North Bengal. Exposures of the Pre-Cambrian are however located in the areas surrounding Bangladesh. In the north is the Shillong Plateau while in the west are the Birbhum and the Chotagpur massives. The Indian shield bordering the western fringe of the Bengal Basin comprises of Archaean metasediments with granite, dolerite and lamprophyric intrusions. A large part of the Shillong Plateau, an agglomeration of several blocks namely the Garo block, the Khasi-Jainta block, the Kopili block and the Mikir block is occupied by gneiss overlain by quartzites, slates and schists with numerous intrusions of granite, peridotite and dolerite.

The basement rocks in the buried Indian Shield consist of crystalline gneiss, granitoid pegmatites and metamorphic biotite-hornblende schists. These rocks underlie the northern parts of Rajshahi and Bogia districts and the whole of Dinajpur district at depths ranging from 600 feet to about 1,000 feet. In all the other districts these basement rocks are buried under thousands of feet of much younger sediments, mostly of the Tertiary period.

Subsurface invertigations in the platform region in Bangladesh or West Bengal did not reveal the presence of any Cambrian to Middle Carboniferous rocks. This indicates that these rocks were not deposited in Bangladesh and that the whole of Bangladesh formed a land surface till the end of the Carboniferous. The territory of Bangladesh except for a small portion in North Bengal was therefore never under the sea during the whole of the Palaeozoic era.

Only 5,000 years ago the sea washed the Rajmahal hills and the country around Sylhet was a lagoon of that sea. The diversion of the Brahmaputra to the east of Madhupur some centuries ago and its later deflection again to the west in the middle of the nineteenth century are well recorded events. This diverted portion which broke away from its course to join the Ganges 40 miles westwards was named the Jamuna. Moreover, the Tista followed southward through Dinajpur and joined the Ganges. Now it has a south-easterly course and discharges into the Brahmaputra. The eastern sea-face of the delta is changing at a rapid rate by the formation of new ground and new islands while the western portion of the deltaic coastline has remained practically unchanged since 1770.

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