CHAPTER - II

GEOLOGICAL FRAMWORK OF THE TARAPHINI RIVER BASIN

The Taraphini River Basin, may be broadly divided into two longitudunal belts according to its geological formations. The western belt, composed of various rock types of Pre-Cambrian age, covers about 61 percent of the total area and the eastern belt is made up of the Tertiary and Quarternary formation, covering the remaining 39 percent of the total area.

The first recorded attempt of systematic mineral exploration in the western part of West Bengal dates back to 1881, when V. Ball carried out survey on geology. Later, J.A. Dunn and others (1939) mapped parts of Purulia and Midnapur District. A Hunday, mapped considerable area in Bankura and Midnapur Districts during 1954 - 58 and after 1960, P.S.Chakraborty (1969) and many research Officers of the Geological Survey of India have done voluminuous work on the Archean Geology and Mineral resources in the western districts of West Bengal. The Pre-Cambrians have attracted special attention from various workers because of their complexity in origin and mineral contents. The latest noted account of their characteristics have been brought out by D.S. Bhattacharya, K. D. Dasgupta, and A.N. Sarkar in 1978.

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A. Hunday, P.K. Chatterjee and S.K. Banerjee (1961) have described the Tertiary patches in Bankura and Midnapore District. The Quaternary geology of the lower Bengal Basin has been described by J.P. Morgan and W.G. McIntirein (1949). Drilling for ground water run by the G.S.I. (1966) has brought information regarding structure, deposit, thickness of alluvium in the fringe of the studied area.

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The geological framework of the river basin under study, chiefly based on the surveyed accounts by Dunn and others(1939) P.S. Chakraborty (1969) and Bhattacharya, D.S. et al (1978) is narrated below :-

The region under investigation belongs to the eastern portion of Singhbhum orogenic belt, which is considered a part of the'Great Satpura Orogenic Belt'. The main trend lines of structure runs from east to west.

The region has experienced repeated cycles of orogenic deformation. The first period of sedimentation and volcanic eruption took place 1700 million years ago. Other three main periods of orogenic deformation noted, were, about 1500 million years ago, 1170 million years ago, 850 million years ago respectively. These repeated movements have subjected the rocks to varying degrees of metamorphism, complex folds, faults, fractures etc. (Naha, D. 1960, Sarkar and Bhattacharya 1978).

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A long continued period of stability prevailed after the latest noted period of deformation at about 850 million years ago (Dunn, 1942 and Sarkar, 1978). It is only in the later part of the Tertiary era, when the region was again subjected to an upwarp and tilt in the south-eastern portion, i.e. flanking the costal area of the Bay of Bengal, (Dunn, 1942, Singh,1966, Hunday, 1957). The gravelly beds in the north central part of the area represents the deposit of that period. With the commencement of rise of the Himalaya, the sea began to recede, leaving behind deposits of river-borne and residual soils, classified by the geologists of the G. S. I. (Sengupta, S, 1971)as "old alluvium".

A Table(No. 1) has been compiled below, computed from the accounts of various workers in the field of Geological investigations, showing the distribution of successive striatigraphy and respective lithologic units in percent, to the total area of the Taraphini River Basin.

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TABLE NO.I

Distribution of the main Stratigraphical Units along their respective Lithologic Units.

Period	Stratigraphy	Lithologic Units	Area Covered km^2	Percent to Total Area
Quaternary.	Recent-Sub-Recent	Alluvium	126.24	24.00
	Pleistocene	Laterite, Lateritic gravels.	10.52	2.00
Tertiary	Pliocene Miocene	Ferruginous Sandstone Grit, Conglomerate, Clays. etc.	73.64	14.00
Pre-Cambrian	Post-Dalma	Quartz Vein, etc.	26.3	5.00
		Pegmatoid Granite, Meta-igneous etc.	26.3	5.00
	Dalmatrap	Meta-Volcanics	52.6	10.00
	Iron Ore Series	Meta-Sediments	210.40	40.00

Source: Geological Survey of India, (compiled from reports of various workers from 1939-1978).

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Each stratigraphy with its rock composition, structure, mode of formation etc. are elaborated below :-

Pre-Cambrian:

This unit is represented chiefly by the early recrystallised sediments of Archean-Dharwar age, metamorphosed igneous intrusives and extrusives.

The deposits are classified chiefly into three groups:- i) Meta-sediments, composed of the rocks of the Iron Ore Series, ii) Meta-volcanics, formed of Dalma Lava flow and iii) Meta-igneous, represented by Porphyry Granite. Pre-Cambrian is the most dominant unit in this region and covers the entire western, northern and patches in the southern portion of the river basin, under study.

The bulk of the rocks belonging to this system is constituted by Phyllite and Schists. The most abundant minerals are Mica, Garnet, Quartz and Felspar. (Photo No. 1).

A. Hunday (1959) has recognised regional metamorphic zones in the northern part of the river basin, including sericite - chlorite - muscovite - biotite and garnet - kynite zones. The grade of regional metamorphism was found to increase successively, from north to south. Srivastava and Ramswami (1962)

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have noted metamorphic zones further in the south represented by staurolite - kynite zone surrounding Belpahari - Silda area (Map No. 3).

Regional foliation dips of the schists and granites etc. are usually of steep angles i.e. about 75° and above. Northerly dips are usual although localised southerly dips are also noted. Localised intricate close fold of recumbent type have been marked surrounding the intrusives, fracture faults or shear planes. In the central part, around the granitic emplacement zone, cross folds resulting in the swing of the fold axes are noted (Chakraborty, 1960). In the southern part surrounding the zone of Dalma Lava deposits, the fold axis of archeans, which is mostly from north east to south west makes acute angle with Dalmas which run in an east-west direction (G.S.I. Memoir No. 97).

A large number of faults have been recognised in this region. Dunn (1939) has noticed that three faults are alingned in a north-south direction in the eastern edges of the Kuilapal Granite (Map No. 3). Along the northern border of Dalma Lava, a thrust plane marked by the lines of dislocation, calcification, and silicification is also recognised by Dunn. Miniature faults are also abundant (Chakrabory, 1968). Small fault zones, are expressed by brecciated quartzite, puckered schists etc. around Hatidoba, Thakurpahari and Mal Dungri.(Photo No. 2).

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One of the most remarkable shear zones has been distinguished by Hunday (1956) and Chakrabarty (1964) during the survey of Tungsten deposit in the central part along which granite blocks are emplaced "en echelon". (Map No. 3 & 4).

In the following paragraphs, the main lithological units of the Pre-Cambrians are discussed :-

Iron Ore Series:-

The series encloses a group of ferruginous materials where iron ores mainly occur as lenses of ferric oxides or banded hematite - quartzite or Jaspar. (Photo No. 1).

Garnets having fresh red and sheared transparent varieties, are found in isolated patches, occupying about 30 percent of total Pre-Cambrian. Near the border of Kuilapal Granite or Chhendapathar area, Garnets have been transformed into chloride, biotite and sericite affected by mineralised fluid.

A zone of muscovite - biotite enriched schist is found to cover an area of 38.50 km^2 in the northern and northeastern part of the region.

An elongated outcrop of staurolite - Kynite Schist is seen near Sildah. A similar outcrop flanking the eastern valley-side slope of a sub-tributary of the river Taraphini is also observed. It occurs as distinct blade-like feature and remains mainly as bluff on the hill-side slope. It covers approximately an area of 1.92 km^2. Haematite - quartzite and quartzites run either as elongated or linear manner traversing the country rock of mica-schist phyllite with abundant quartz veins. The average length of these banks are 1.81 m.

Dalma Metavolcanics:

A significant lava flow, mostly overlaps the pre-existing rocks of the Iron Ore series. But unconformable zones are infrequent, since the flows had occurred intermittently. Dalma epidiorites are found to be unconformably placed over the quartzite, due to faulting only in some places near Tulsibani and Gohalberia in the south western part of the area. Near Kuldiha and Balichua, Dalma Lava shows faulted boundary with the rocks of the Iron Ore Series.

The Dalma Lava rocks are here represented chiefly by epidiorite, epidiorite schists, talc - chlorite - tremolite schists. The latter rock types are the result of shearing

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and chemical alternation in the Dalma Lava. Dunn has regarded the Dalma traps as a sub-serial volcanic product but later works by the Geological Survey of India (Naha, Sarkar et al. 1977/78) have revealed that the Dalma Lavas are basaltic out-pourings which occurred during sedimentation in a sub-marine condition of the peninsula.

According to Dunn, the deposits of the Dalma Lava flow occurs only in the south western part of this region covering approximately an area of 22.58 km^2. Later in 1968 during the Wolfram Mineral Survey by G.S.I. another occurrences of Dalma Lava flow in the central part of this river basin, enclosing an area of 10 km^2 has been revealed (Map No. 3). Here, the flow is dominated by greenish schist of chloritic and tuffaceous character.

The mineralogical composition of Dalmas ranges from hornblende - plagioclase felspar, quartz - olivine - sphene - calcite to amphibole etc.

In the southwestern sector, Dalma Lava shows mineralisation along its northern borders with Iron Ore series, making thrust plane, (Map No. 3). The dips are moderate to

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to high in this sector, ranging from 40° to 70° while in the central part the dip values range from 26° to 71°.

Kuilapal Granite:-

The north western corner of the river basin is underlain by the fragment of a large elliptical mass of granite, named 'Kuilapal Granite'. It is mostly a massive gneissose body, grano - dioritic in composition, with the mineral assemblage of muscovite - garnet - biottite - quartz - plagioclase felspar - sphene - illmenite.

Its eastern end near Maisamura village is fractured by three close-set faults along which the granite is somewhat granophyric, with intensive graphic intergrowth. Several low temperature minerals like Opal, Chart, Jasper, Fill up the faulted zone.

Dunn regarded the origin of this granite as an intrusive igneous body but in the later period the closer examination by G.S.I. revealed that it is simply formed by 'anatectic melting' of the pre-existing schists, known as meta-igneous.

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The following statements, in favour of the above argument can be referred here :-

i. Serial arrangement of the metamorphic zones viz. Sillimanite-Kynite - Garnet metamorphic zones, surrounding the border of the granite block.

ii. Migmatic nature of rocks.

iii. Spatial association of high grade schist within granite etc.

The occurence of several dykes of hornblende schist lying almost in a cluster is noticed near the east of the Patagar village (Map No. 3). High values of 75^{0} - 85^{0} are noted only near the faulted region and surrounding the cluster of horn blende schist in this region. Towards the margin of the granite block with schists, pegmatite dykes cut this granite.

Chhendapather Granite:-

Unlike the Kuilapal Granite, this granite belt is composed of several isolated granite out crops but arranged in chains along the Jhiku Nala (Roy, S 1968) from Chhendapather village to Chapri (Map No. 4). These are mostly discordant with the

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country rock of garnetiferrous mica schist, phyllite. Also the localised occurrences as concordant sills along the foliation planes of the schists, are marked near Ghatwal village (Chakraborty, 1972).

The granite is composed of potash felspars, light-green muscovite. The biotite content increases towards its north and south east.. This granite is also pegmatoid, granophyric and in some parts the quantity of calcic plagioclase felspar is high.

The granite here, does not show any distinct grade of metamorphic zoning like that of Kuilapal and it is believed to have an intrusive origin (Chakraborty, 1966). Following the north west to south east trending shear zone, this granite has pushed up the host rock to make its way towards the surface and has resulted in well-jointed fractures, filled up with mineralised fluides and quarts veins.

The granite exposures have affected the country rock by the following fectures :-

1. Contact metamorphism and hydrothermal solutions i.e.Tourmaline, Graphite etc.

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2. Retrogressive change in the country rock i.e.sericite schist.

3. Quartz vein formation along the fractures or week planes in the adjoining schist.

The average size of these isolated patches of granite blocks are 50 cm^3 (G.S.I. Report 1966).

Quartz Veins :-

Quartz veins, as an end product, riddle the while deposits of Pre-Cambrian age as mentioned above. Near the central part, surrounding the Chhendapathar area, it is the result of granitic emplacement in the country rock. In other cases it has been formed largely by the segregation during metamorphism of the mica schist (G.S.I. Memoir No. 69).

The length of the Quartz veins vary from 1 cm to 50 cm. Here, the Quartz veins are mainly of two types :-

(i) Mineralised, bluish grey, sheeted jointed variety.

(ii) Non-mineralised, massive, irregular, white, saccra-hoidal barren quartz veins.

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Non-mineralised veins are abundant throughout the region and the mineralised varieties are found surrounding the granitic patches of Chhendapathar.

Most of these run parallel with the schistosity of the mica schist. The dips of mineralised veins are about 45° to 65° northeasterly.

The dip of non-mineralised veins ranges from 15° to 65° northerly. Southerly dips of about 70° are also noted near Jallangdih village, at a distance of 7 km north of Belpahari on the left bank of the river Taraphini (Map No. 3).

Thus, the era of Pre-Cambrian, in the studied area, is completed with the formation of Quartz veins, and after a long interval, the deposits of Tertiary commenced.

Tertiary :-

Occurrences of gravelly deposits of Miocene age, masking the deposits of the Pre-Cambrian, cover about 13 percent of the total surface area of this region in the Central Part. (Map No. 3).

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The Tertiary deposits are mainly made up of conglomerates, sandstones, gravels, pebbles and ferruginous conglomerate (particularly). most of the deposits are fluvial, as evidenced by their roundness (G.S.I. Memoir No. 69). Also the coarse grained gravels deriving from the local archean rocks are encountered near Amritpal village. Hunday (1954) also recorded the resemblence of the formation of the present area to the formation of the over-lying Miocene limestone deposit of Orissa and suggested that this belt is a continuation of the Tertiary deposits in Orissa, extending from eastern coast of Orissa through the western border of West Bengal, as north as Bolpur in Birbhum District.

The Tertiary beds are almost horizontal (although in some places) and dip values range from 13^{0} to 25^{0}. Occasionally Quarts veins and other deposits of Archean age are exposed from beneath. (Photo No.3).

Laterite :-

It is a weathering product of the various rock formations which had formed at the end of Tertiary era in a monsoon climate with alternate wet and dry seasons.

The Laterites mainly occur here as caps, with marked preference for metabasic and ferruginuous meta-sediments. One of the notable occurrence is reported over the epidioritic "Patpirnia Pahar" hill, where its thickness is over 30 m.

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It is rare on high grade schists because their hardness resists easy decomposition. The Laterites vary in mineral constituents. Colour and texture also vary from place to place. The colour is lemon-yellow to red with occasional deep brown tint. The Laterite of the 'Patpinria Pahar' has a dark metallic glaze.

Laterites are found to consist of rounded haematite grains enclosed within a matrix of geethite. They are highly porous and cavernous. Box structures are found in Laterite capped hillock near Balichua village in the Dalma-lava region.

In this region, about 80 percent of the total Laterite are found over the hill top. Only near Nelara village, nine km. north of Enthela village and three km northeast from Sildah (Map No. 3), the laterites are spread out as a slight swells over the underlying parent rock of the mica-schist phyllite. Hill-top laterites suggest their presence as a result of minor differential uplift, after their formation at the surface.

Laterites of the present day are believed to be forming on the exposures of various rocks suitable for laterisation, under optimum conditions, but their extent are thinner than the above mentioned hill-top Laterites of Pleistocene and Tertiary age (Young, 1976).

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Alluvium :-

The Alluvium covers about 24 percent of the total surface. The deposition of this alluvium commenced after the final uplift of the Himalaya. Since it marks the starting region of the lower Bengal basin alluvium, the thickness of alluvium is not significant in this terrain. For the most part the thickness is a mere veener of average 2 m over the Pre-Cambrian. From an average thickness of 5 m near the Taraphini-Bhairabbanki confluence (Harda village) it thickens gradually to about 10 m towards the Taraphini - Kangsabati confluence.

Lithologically it contains abundant disseminations of impure calcareous matter in the form of irregular "Concretions", composed of small size particles of quartz, felspar, kynite, & illmonite, garnet, tourmaline etc. Geologists prefer to define this alluvium as 'residual soil derived from adjacent rocky up-lands'.

The alluvium deposits flanking the river bank terraces and river channels of Taraphini and its tributaries show lesser calcareous matter but with preponderance of small size gravels of 2 mm to 6 mm of quartz, garnet, felspar, flakes of mica etc.

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