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Lithofacies and Depositional Environment of Gondwana rocks of Singrimari area, West Garo Hills District, Meghalaya and Dhubri District, Assam

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Abstract

The Gondwana rocks of Singrimari area are dominantly arenaceous lithounits. The rocks are represented by diverse lithological variations and good preservations of sedimentary structures. Seven lithounits have been identified after field and megascopic observations. The lithofacies architecture of the succession is interpreted to reconstruct the depositional environment which ranges from point bar to channel bar of braided river system. The plant fossil remains are of Glossopteris flora. Both leaf and stemparts have been discovered from the carbonaceous shale layer. From the overall characters show the similarities with Lower Gondwana rocks.

The age is suggested to be Permo-carboniferous on the basis of plant remains and lithological characters.

Key words: Gondwana, Sedimentology, Permo-carboniferous, Singrimari, Meghalaya - Assam.

Introduction

The Singrimari area lies at the westernmost tip of the Assam - Meghalaya Plateau. A sedimentary blanket of roughly 20 sq. km. sprawls upon an eroded Precambrian basement (Fig.1) and reflects Gondwanide affinity (Fox, 1937; [2]). The sediments took place in a basin which is known as Gondwana basin lies within the suture zone between the cratonic block. Sediments are characterised by coarser sandstone having pebbles towards the base. These sandstones are compact, buff coloured with layers of carbonaceous shale and show fining upward sequence (Fig. 2a & 2b) following a hiatus, buff-pink coloured fine grained sandstones and siltstones are present in the field. These two sequences based on lithological characters

into two formations as Karharbari and Barakar under Damuda Group. The carbonaceous shale layers of the area are characterised by some leaf-stem impressions of Glossopteris flora[5-6]. These sequences were intruded by Doleritic dike of younger age. The whole lithostratigraphic units are shown along with age in Table 1.

Table - 1

Age	Lithotypes	
Recent	Alluvium	
- - - - - - - - - - - - - - - -	Unconformity - - - - - - - - - - - - - - - -	
Jurassic	Basic Intrusives - Dolerite	
- - - - - - - - - - - - - - - -	Unconformity - - - - - - - - - - - - - - - -	
	Fine grained sandstones bearing sedimentary pebbles at the base towards north, claystone, siltstone.	
Permo-Carboniferous	- - - - - - - - - - -- - Hiatus - - - - - - - - -	
	Pebbly sandstones with layers of carbonaceous shale having speack of coal- Jhama (?). Shales bear palaeofloral remnants and are mylonitised at certain patches	
- - - - - - - - - - - - - - - -	Unconformity - - - - - - - - - - - - - - - -	
Precambrian	Quartzofeldspathic gneiss, calc-silicate gneiss, amphibolite, migmatite, granite, vein rocks - quartzofeldspathic (pegmatite in certain cases) and quartz vein	pervasive brittle deformation, four sets of joint planes seen along with slippages in carbonaceous shale towards west

Generalised Lithofacies and Facies architecture :

A sedimentary rock is not only a product of specific provenance and transport history but, it is also a product of the environment of deposition[11]. There have been many ways developed for understanding the 'clast' history and, lithofacies analysis,[1,7,13] is one amongst them. The key to the interpretation of facies is to combine observations made on their spatial relations and internal characteristics - lithology

and sedimentary structures[10]. A genetical explanation for an ancient phenomenon is always made by an analogy with that of modern happenings[12].

Despite variations, the N-S trending sedimentary column is dominantly arenaceous and, based on their characteristics they have been divided into two types as shown in the Table 2. However, the smaller unmappable units cannot be neglected due to their genetical significance and as such, these smaller units like carbonaceous shale, siltstone and claystones which are exposed in the field have also been taken into consideration. Thus, following Allen's[1] and Miall's[7] schemes 7 (seven) lithofacies have been recognised in the area.

Table 2

Facies Code	Lithofacies variations Based upwards	Sedimentary Structures	Simplified Interpretations
Fl	Fine sand, silt, mud	Horizontal bedding, Fine lamination	Overbank or wanning flood deposits.
Fsc	Silt	Blocky and slabby	Backswamp deposit.
Fl	Fine sand with pebbles, silt, mud	Horizontal bedding, Fine lamination	Overbank or wanning flood deposits.
---------- - - - - - - - - - - - - hiatus ? ----------			
Sh (and Sp)	Sand (medium to very coarse, pebble towards the base)	Horizontal bedding, cross-bedding (at patches)	Planar bedflow (L & U flow regime)
C	Carbonaceous shale	Plants, mud films	Backswamp deposits
Sh and Sp	Sand (medium to very coarse, pebbly towards the base)	Horizontal bedding, cross-bedding (at patches)	Planar bedflow (L & U flow regime)
Gm	Massive or crudely bedded gravel	Horizontal bedding, imbrication	Longitudinal bars, lag deposits
---------- - - - - - - - - - - - - - - - - - - Unconformity - - - - - - - - - - - - - - - - - - ----------			

I. The sequence begins with massive or crudely bedded gravel facies, (Gm) representing transportation due to high current velocities and deposition as channel lags. Generally, these sort of deposits accumulate by vertical accretion on longitudinal bars and are either horizontally stratified or, imbricate - case which is seen in the present area. The coarser clasts had their provenance in a Precambrian terrain whereafter they went through a large scale physical weathering prior to their deposition. However, based on roundness observations, nothing can be said on the length of transportation. From the on-field 'clast' features of parallelism and imbrication, it seems to be a manifestation of a turbidite like situation or a case of flash flood under a braided alluvial setup[6]. Fining upward of grain size indicate deposition by a single current system with progressively diminishing

energy.

II. Overlying the aforestated facies are medium to coarse grained sandy - often pebbly facies, (Sh and, Sp) type showing mainly sporadic horizontal and cross bedding which is indicative of a continued influence of a active hydrodynamism. While these activities took place under the upper flow regime (F>1) conditions in the main, sporadic cross beddings indicative of a lower flow regime may be attributed to bedform irregularities or, fluctuations in the flow strength.

III. Following up the aforestated facies type is a minor litho entity of carbonaceous shale facies, (C) showing plant and mud films. Although smaller in scale, this unit depicts a contrasting hydrodynamic influence on the area. With field evidences showing the carbonaceous shale layer in sharp contact with the underlying coarse facies. This facies may be formed as minor over bank facies[12]. Generally it is theoretically hard to believe the influence of such contrasting hydrodynamic influence if a temporal hiatus is not considered. But, it is seen that this unit which generally depicts a passive hydrodynamism or, stagnancy follows an active regime.

IV. Following up the aforestated facies type, there is again revival of conditions leading to the deposition of facies types like Sh and Sp in the main. These are indicative of a truncated cyclicity quite possible under a braided setup. One may also interpret them as a result of channel wandering and intermittent tectonism, (Casshyap, 1970).

V. Fine sand (with sporadic sedimentary pebbles), silt and mud, (Fl) comprise the finer lithofacies entity in this area which looks like representing inter-channel overbank facies of a flood plain where local muddy environment of reducing nature was prevalent where deposition of fine clay took place. This unit being in contrast with that of the coarser facies shows meandering characteristics. All these features could have been due to a change in the fluvial nature and, are products of seasonal increament. Definitely a slackening of energy took place base upwards. Moreover, could the sporadic sedimentary pebbles seen at the base of these sandstones be due to a localised hiatus.

VI. Interwoven with the aforestated fine grained facies lies a minor unit of silt, (Fsc) showing blocky and slabby bedding. Characteristics of this unit indicate a period of inactivity compared to the earlier stages. Perhaps accumulation took place in a backswamp setup. This unit which apparently looks unfossiliferous might have had oxidising influence on it.

VII. Repetition of the Fl facies type without sedimentary pebbles represent the youngest deposits of this column.

In short, the sedimentary column of Singrimari, based on field evidences, look to be a reflection of fluvial regime in which hydrodynamic activism was in decreasing trend base upwards although cyclicity of activism is seen towards the earlier stages of deposition. The fluvial regime seem to transgress from braided to meandering base upwards and there might have been a localised hiatus between the Basal type is sandstones and the Upper type sandstones.

provenance and depositional environment:

The concept of cyclic sedimentation which is a recurring sequence of sedimentary

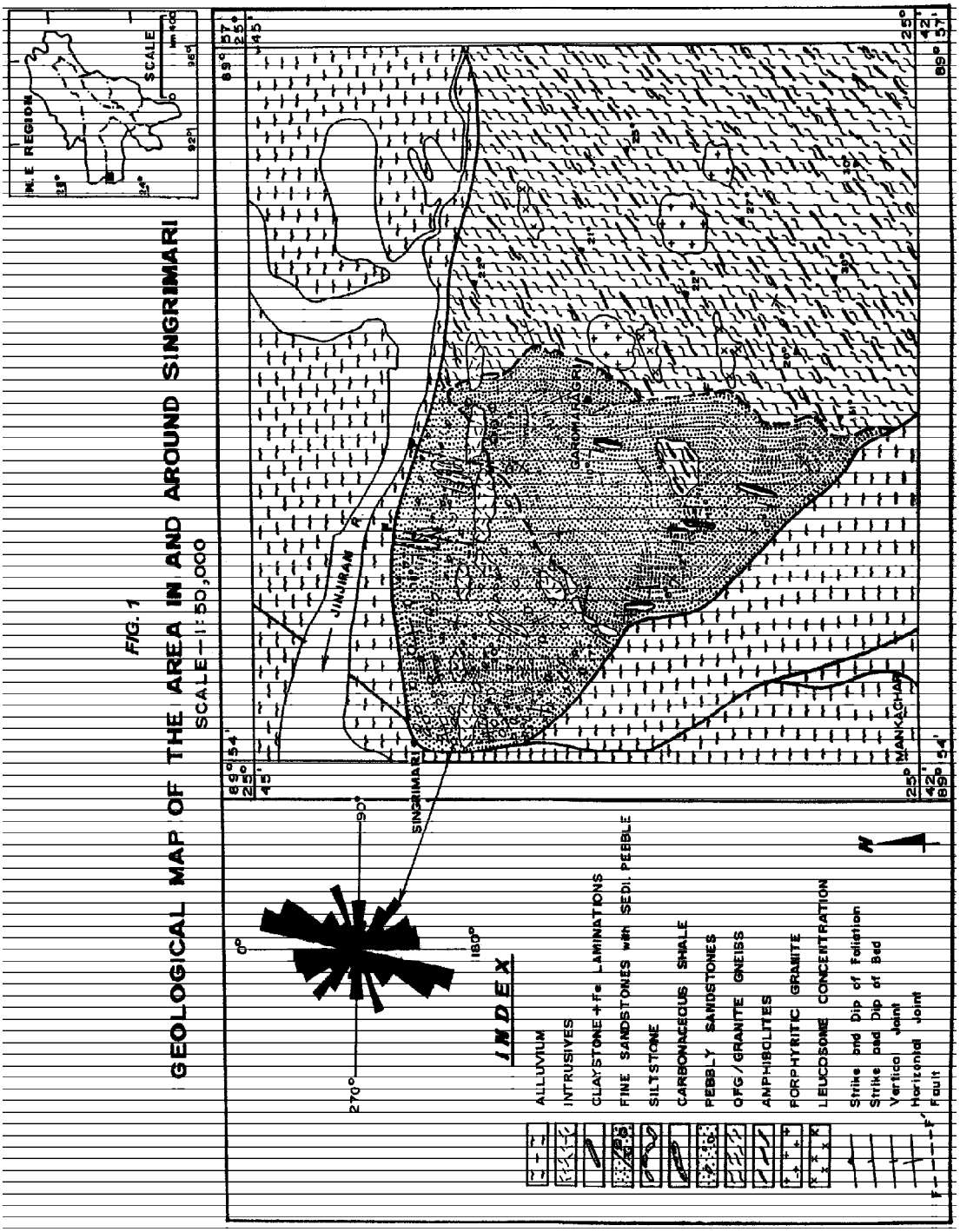
FIG. 1
GEOLOGICAL MAP OF THE AREA IN AND AROUND SINGRIMARI
SCALE — 1: 50,000
N.E REGION
SCALE
JINJIRAM
SINGRIMARI
GAROWADGRI
MANKACHAR
INDEX
ALLUVIUM
INTRUSIVES
CLAYSTONE + fe LAMINATIONS
FINE SANDSTONES with SEDI. PEBBLE
SILTSTONE
CARBONACEOUS SHALE
PEBBLY SANDSTONES
QFG / GRANITE GNEISS
AMPHIBOLITES
PORPHYRITIC GRANITE
LEUCOSOME CONCENTRATION
Strike and Dip of Foliation
Strike and Dip of Bed
Vertical Joint
Horizontal Joint
Fault
N
0°
90°
180°
270°

Fig. 2a. Photograph showing a basal sandstone, (pebbly or, B-type sandstone) with fining upward feature. *Locality : West of BSF Camp*

Fig. 2b. Photograph showing traces of a current-bedding within the basal sandstone, (pebbly or, B-type sandstone). *Locality : South-east of BSF Camp*

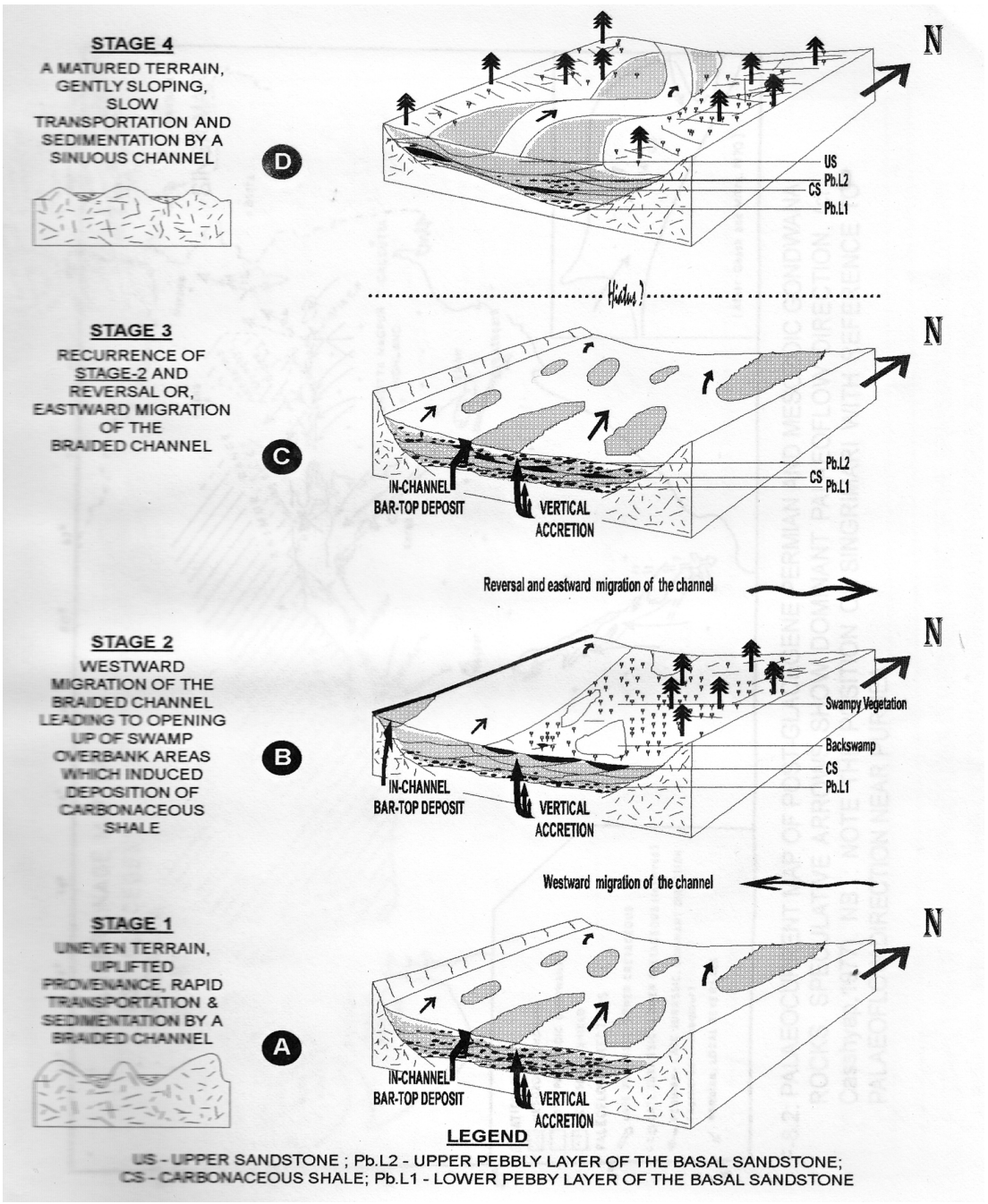

Fig. 3. Generalised schematic representation of a model showing palaeoprofile, channel nature and patterns of sedimentation of the singrimari sedmentary column

facies, has been widely used in interpreting depositional environment of a sedimentary sequence.

The lithofacies relationship and the associated sedimentary structures of point bar and channel bar deposition of meandering and braided river system. Both the distributions show a strong tendency of clogging in the river environment in a broad spectrum where besides the typical fluvial process during the different stages of sedimentation[3]. Similar type of lithofacies are also reported from Gondwana succession from other places of India[14]. Moreover, the provenance was not very far away from the site of deposition, as most of the grains are sub-angular and pebbliferous lithofacies at the bottom.

A hypothetically constructed model (Fig. 3) on Singrimari sedimentation shows a southern basement uplifted zone of a Continental-Block Provenance acting as a source of detritus (Baruah and Das, 2001b). Moreover, the tectonic is of ACM (Active Continental Margin) type.

Based on the detail lithofacies analysis, the Gondwana succession of the area is interpreted as point and channel floor deposition of braided river system[7,8,9].

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